Supporting the transformation of the Slovak economy by increasing its innovation performance

AS-IS report

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MINISTRY
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Executive Summary

This report constitutes an analysis of the Slovak Research Technology Development and Innovation (RTDI) system. It provides an evidence base and analysis for the purpose of informing Slovakia's updated Regional Innovation Strategy for Smart Specialisation 2021+. The reports looks into the organisation and functioning of the Slovak RTDI system, the drivers and barriers for innovation in Slovakia, and the current and planned policy measures.

The Slovak RTDI system

Slovakia's economy is closely linked to globalisation and the country will be strongly impacted by the technological revolution currently unfolding in the manufacturing sector. Slovakia has pockets of highly innovative activities in ICT and engineering, biomedicine, bioeconomy, for example, but it suffers from underfunding, fragmentation of actors and activities, and the absence of sufficient private sector investment.

RTDI policy is centralised and led by the Ministries of Education and of Economy. Although there are effective forums for coordination of RTDI at ministry level, the general view is that policy coordination overall is problematic. This is due to the large number of different agencies, for example, both integrated and external, and it has resulted in delays, frequent legislative changes and increased administrative costs for start-ups and SMEs that are crucial to ensuring successful knowledge transfer. Cooperation on the implementation of the Operational Programmes for RTDI under the 2014-2020 ESIF programme period has not been successful.

There is a great willingness to change the current situation, and in particular to ensure that the upcoming 2021+ programme period is implemented successfully. During the interviews, many stakeholders were reflective and provided concrete recommendations for how to better build consensus, and efficient and decisive action around RTDI policy.

RTDI funding

Slovakia is the most dependent countries in the EU-27 on European Structural and Investment Funds (ESIF) and the Framework Programme for RTD (Horizon 2020). The EEA and Norway Grants also provide opportunities for collaborative bottom-up innovation projects, also involving SMEs. Competitive international funding (Horizon 2020) is centred on the Bratislava and Košice regions, but international competitive funding is lacking in most other regions. As such, there is a heavy reliance on non-competitive ESIF investments.

The delays in implementing ESIF investments have had severe knock-on effects stemming from the lack of distribution of funding for the current programme period. Human resource capacity, brain drain and the involvement of many different agencies, ministries and advisory bodies are the key causes of these delays. Another potential knock-on effect is that the calls for proposals are attracting fewer applications, possibly partly due to lack of trust in the processes and 'reputational damage', but partly also due to potential beneficiaries seeking access to funding through other means.

The stakeholder interview findings suggest that several barriers were behind the significant ESIF funds delay. These could be categorised as organisational, administrative and behavioural barriers. One clear incidence of this was the cancelling of announced calls, since they did not conform to the ex-ante conditionalities. There was therefore also a need to change and revise the procedures of the calls.

With regards to national funding, the largest source of finance is awarded through block funding to universities and to a lesser extent to the Slovak Academy of Sciences and other state research institutes. However, currently block funding is not linked to excellence-related criteria and spread across a large number of institutions, making it somewhat ineffective.

RTDI infrastructure

Since 2007, Slovakia has taken significant steps to upgrade its RTDI infrastructure with the help of ESIF investments. Although significant investments are still being made through the current ESIF period, there is also a need to ensure that existing infrastructures are used and maintained effectively. This requires good collaboration between public research performers (who tend to host the RI) and private sector actors including entrepreneurs (who need access to the R&I and to institutional knowledge in order to innovate). It will also require investments in human resources and the upkeep of RI technology.

Collaboration between RTDI actors

A fragmented system and lack of collaboration among stakeholders is a well-documented challenge in Slovakia. Fundamentally, a lack of a collaborative culture and a tendency to work in silos are still issues, but there are signs that cooperation is improving. Improved cooperation can be identified both through bottom-up initiatives (e.g. younger researchers and younger entrepreneurs are more open to inclusivity) and through top-down policy steering (e.g. insisting on collaborative applications in response to calls for proposals, establishing collaborative instruments such as competence centres). Anecdotal evidence suggests that once 'forced to' collaborate, public and private research performers tend to see the benefits of partnerships. Slovak clusters could contribute more to the RTDI system than is currently the case. Clusters are – with a few expectations – driven by industry. Some clusters are very successful and could be used as models for upcoming ones. ESIF support for clusters has been delayed.

Drivers and barriers for innovation

Many of the barriers identified can be traced to the fragmented set-up and overall governance of RTDI. Although the structure of responsibility and governance in Slovakia is similar to other EU systems, it is more convoluted, less intuitive and has more administrative layers. From this can be traced particular habits and behaviours that are not conducive to trust and collaboration. A lack of public and private investment (GERD and BERD) into RTDI also constitutes a barrier.

Among the potential drivers for innovation are new areas of RTDI (e.g. biomedicine, bioeconomy) existing strong holds (e.g. ICT) and new actors – young researchers with new ideas and existing international networks, as well as SMEs and other businesses, especially export-oriented enterprises. Large investments resulting in upgraded R&I are also a driver (provided that access to R&I can be improved). Three key areas – digitalisation, automation and robotics – are particularly pertinent to the wider Slovak economy. Given their importance and links to the wider labour market structure, these areas need special policy attention and investment. New challenges closely linked to sustainable development will require support for research and innovation in agriculture, food industry and areas capitalising on the potential of biomass.

Current and planned policy measures

RTDI policy is a relatively new policy area for Slovakia and constitutes a significant change in direction from the previous strategy of attracting foreign direct investments and 'relying on' imported knowledge from multinational companies. Generally, the Slovak strategies are in line with OECD country trends and with EU strategies in particular. However, there appears to be a disconnect between the setting of a policy direction and in operationalising agreed strategies, exemplified by the significant delays in ESIF implementation. But other reforms and changes foreseen also illustrate this problem. In practice, however, thy have led to little or limited change on the ground. Another challenge to overcome is the fact that Slovak strategies tend to rely on ESIF investments with no national budgets earmarked for implementation mechanisms.

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Abbreviations

BERD	Business Expenditure of Research and Development
CEDEFOP	European Centre for the Development of Vocational Training
EDP	Entrepreneurial Discovery Process
EFSI	European Fund for Strategic Investments
ESFRI	European Strategy Forum on Research Infrastructures
ESIF	European Structural and Investment Funds
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GERD	Government Expenditure of Research and Development
HERD	Higher Education Expenditure of Research and Development
IPR	Intellectual Property Rights
KEGA	Kultúrna a edukačná grantová agentúra (Cultural and Educational Grant Agency)
MFF	Multiannual Financial Framework
MNC	Multinational Corporation
MoARD	Ministry of Agriculture
MoC	Ministry of Culture
MoEn	Ministry of Environment
MoESRS	Ministry of Education, Science, Research and Sports
MoF	Ministry of Finance
MoH	Ministry of Health
MoI	Ministry of Interior
MoLSAF	Ministry of Labour
OECD	Organisation for Economic Co-operation and Development
OfII	Office of the Deputy Prime Minister of the Slovak Republic for Investments and Informatisation
OP	Operational Programme
R&D	Research and Development
R&I	Research and Innovation
RI	Research Infrastructure
RIS3	Research and Innovation Strategies for Smart Specialisation
RTDI	Research Technology Development Innovation
SAS	Slovak Academy of Sciences
SASPRO	Slovak Academy of Sciences Programme for international mobility of experienced scientists
SBA	Slovak Business Agency
SGCSTI	Slovak Government Council for Science, Technology and Innovation
SIEA	Slovak Innovation and Energy Agency
SITDA	Slovak Investment and Trade Development Agency
SLORD	Slovak Liaison Office for Research and Development
SME	Small Medium Enterprise
TRL	Technology Readiness Levels (TRLs)

TT	Technology Transfer
VEGA	Vedecká grantová agentúra (Scientific Grant Agency)
Visegrád	The Czech Republic, Hungary, Poland, and Slovakia

1 Introduction

Chapter 1 describes the objectives of the AS-IS Report before providing a high-level introduction to the socio-economic context of Slovakia, so as to set the scene for the analysis provided in subsequent chapters. The socio-economic analysis also includes an update on the COVID-19 crisis.

1.1 Objectives and approach

This AS-IS report constitutes an analysis of the Slovak Research Technology Development and Innovation system. It has been produced as part of the study "Supporting the transformation of the Slovak economy by increasing its innovation performance". It is Deliverable 1 of this assignment.

The aim of this report is to provide an evidence base and analysis for the purpose of informing the updated RIS3 SK 2021+ (Deliverable 6 of this assignment). This report should also help the Slovak Republic to "*document its compliance with some of the enabling conditions for policy objective 1 under Regulation COM (2018) 375 final*".[1]

The analysis of the AS-IS report covers:

1. **An analysis of the Slovak research, development and innovation ecosystem (hereafter referred to as Research Technology Development and Innovation system, or RTDI system)** focused on: the system of governance and distribution of competences among the state administration authorities; the relevant legal framework; funding from public and private sources; possibilities for development of instruments for financial guarantee schemes; under-financing and lack of interest from domestic industry; system fragmentation; functioning of grant agencies; evaluation of creative activity; availability and use of research infrastructure; possibilities for stimulation of academy-industry cooperation; publication activity and citations; and the protection of intellectual property rights.

   In agreement with the Steering Group, specific emphasis has been placed on the analysis of the system of governance and distribution of competences among the state administration authorities.

2. **An analysis of bottlenecks for innovation diffusion, including digitalisation, automation, and robotics** focused on: the technology transfer system and innovation performance; factors determining Slovakia´s low innovation performance; barriers to dissemination of innovation in public and private sector; barriers for the emerging of industrial research; and the reasons for insufficient Intellectual Property Rights (IPR) support for SMEs.

3. **An analysis of industrial transition measures** that have been implemented in the Slovak economy over the past five years, including an assessment of currently available (or gaps in) skills sets related to research, innovation and transition of the Slovak economy.

The evidence supporting the analysis of this report has been gathered through a thorough evidence review and face-to-face and telephone interviews with stakeholders. A full bibliography and list of stakeholders consulted as part of the interview programme are appended to this report.

[1] Request for Service: Supporting the transformation of the Slovak economy by increasing its innovation performance, 2019

A validation webinar to discuss this report (and forthcoming recommendations) was carried out on 23 April. A second validation webinar was carried out on 23 June 2020. Summaries of the discussions and participation lists can be found annexed to this report.

The research compiled for this report was carried out in spring 2020. As the long-term consequences of the COVID-19 crisis became more apparent during the course of the assignment, it was agreed with the Steering Committee that the study team would make efforts to include analyses on the longer term impacts of the crisis on the Slovak RTDI system. These are presented in section 1.2.1 below.

1.2 Socio-economic context

This report's main objective is to provide an analysis of the Slovak RTDI system. The RTDI system – including its drivers and barriers to producing outputs and outcomes – is the subject of Chapters 2-4. To support the RTDI analysis, the purpose of this chapter (1.2) is to set the scene by providing a brief description of the socio-economic context within which Slovak RTDI activities are carried out.

Since the wider context is a factor in determining RTDI capacity, it also plays an important role in improving the RTDI system. As such, the below introduction serves to introduce the reader to some of the key characteristics of the Slovak economy.

Slovakia has a small and quite open economy. The economy has experienced consistent growth over the past decade. Annual growth in Gross Domestic Product (GDP) was 1.6% in the EU-28, but 3.2% in Slovakia in period 2010-2018.[2] Since the outbreak of COVID-19, economic predictions have drastically changed and at the time of writing only preliminary predictions can be made (see further below).

In terms of other relevant economic indicators, Slovakia receives medium-good rankings in pillars of financial market development (32nd out of 137 countries), macroeconomic stability (35th), technological readiness (42nd) and good market efficiency (55th). The weakest indicators included higher education and training (62nd), innovation (67th), labour market efficiency (87th) and institutions (93rd).[3] Chapter 3 of this report will discuss some of the key barriers to an effective performance which helps to explain these weak indicators.

Before the COVID-19 outbreak, real GDP growth was also expected to remain strong at 4.1% in 2019 before decreasing to 3.5% in 2020.[4] These figures looked very favourable when compared with other economies. Slovakia's per capita income growth was stronger than in many Organisation for Economic Co-operation and Development (OECD) countries, but the impact of the COVID-19 virus has been forecast to continue into the near future.[5]

Indeed, the Slovak economy does not follow average OECD or EU trends. Due to the open nature of its economy, the COVID-19 crisis may have put Slovakia in an especially vulnerable position. Future performance will in part depend on actions taken now (2020) and the extent to which Slovakia will manage to decrease its dependence on the performance of neighbouring economies, to lessen its dependence on the manufacturing sector and diversify to other (more sustainable) sectors.

[2] Forthcoming Baláž, V., Frank, K., Ojala, T. (2020) Innovation Country Report 2019: High growth enterprises, innovation and productivity challenges, Slovak Republic

[3] Baláž, V.; Frank, K.; Ojala, T.; RIO Country Report 2017: Slovak Republic., EUR 29181 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-81482-2, doi:10.2760/427548, JRC111379. P8

[4] SWD (2019) 1024 final

[5] OECD (2019) OECD Economic Surveys Slovak Republic

Despite strong economic growth in certain areas, some of the key data reveals a broad set of economic challenges. When looking at baseline economic indicators, it is important to note that net national income has grown steadily to EUR 24,563 per capita in 2018. This places it ahead of Poland and Greece, but behind Portugal.[6] This growth in per capita income, however, hides strong regional disparities. Infrastructure gaps and weak links between urban and rural areas mean that, in 2017 for example, GDP per person (in purchasing power standards) ranged between 179% of the EU average in the capital region to 54% in the less developed regions in the east of the country. These regional disparities are less significant when comparing net disposable income, which ranged from 87% in Eastern Slovakia to 153% in the Bratislava region in 2017.[7]

The factors underpinning Slovakia's past positive trajectory pre-COVID have contributed to "solid growth" in household spending, "large average pay increases", and improving private sector investments (led by foreign direct investments).[8] The forthcoming Research and Innovation Observatory (RIO) report on Slovak innovation suggests that high growth rates were thanks to transfers of technologies and innovations to the Slovak economy via Foreign Direct Investments (FDI) from multinational corporations, mainly operating in the automotive sector, but also including Amazon.[9]

The most recent European Commission analysis (undertaken before the pandemic in Europe) found that domestic demand and growth in net exports supports a favourable economic outlook.[10] However, this outlook depends on continued external investments into the export-heavy manufacturing sector.[11] It will also depend on the long-term consequences of the COVID-19 outbreak.

In Slovakia, manufacturing accounts for 85% of total production.[12] The country is more dependent on manufacturing than the average country (measuring value added of manufacturing as a percentage of GDP).

According to World Bank data, in 2018 (the last year available) the added value of manufacturing as a percentage of GDP was 19.68%, while the global average of 152 countries was 12.5%.[13]

[6] OECD, Selected indicators for Slovak Republic, https://data.oecd.org/slovak-republic.htm

[7] SWD (2020) 524 final

[8] SWD (2019) 1024 final

[9] Forthcoming Baláž, V., Frank, K., Ojala, T. (2020) Innovation Country Report 2019: High growth enterprises, innovation and productivity challenges, Slovak Republic

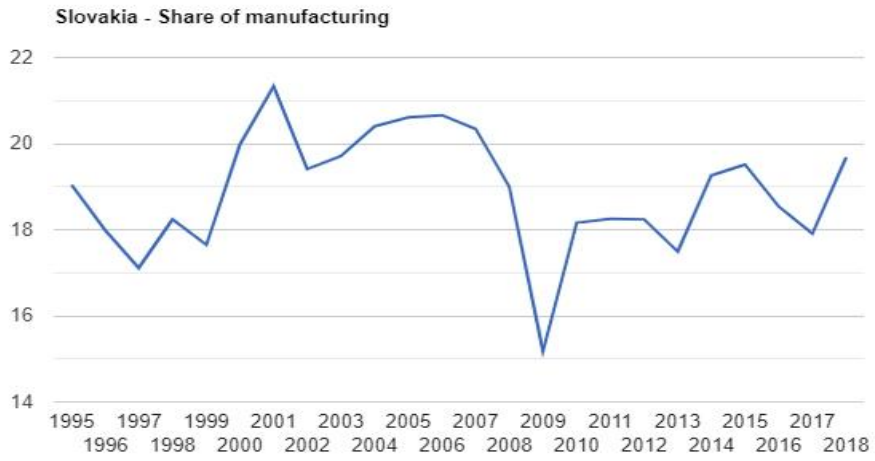
[10] SWD (2019) 1024 final

[11] SWD (2019) 1024 final

[12] Trading Economics, Slovakia Manufacturing Production, https://tradingeconomics.com/slovakia/manufacturing-production

[13] https://www.theglobaleconomy.com/Slovakia/Share_of_manufacturing/

Figure 1: Slovak manufacturing trends (value added)



Source: TheGlobalEconomy.com, The World Bank

Currently, the largest segments of Slovak manufacturing are:

1. Motor vehicles (33% of total production)
2. Computer products (7%)
3. Machinery and equipment; basic metals; rubber products; fabricated metal products (all 5%)
4. Coke and refined petroleum products; and electrical equipment (all 4%).[14]

Manufacturing is largely concentrated in the west of the country and the benefits in terms of investment and employment do not stretch to other regions.

Any economic outlook developed in the year 2020 needs to take into account the dramatic impact of the COVID-19 crisis.

1.2.1 Consequences of the COVID-19 crisis

Slovakia's former and current governments (an election on 29 February 2020 resulted in a new government) implemented swift containment and social distancing measures at the start of the outbreak in Europe (March 2020). These public health measures in combination with disruptions in global/trans-European supply chains plus border controls quickly sent the Slovak economy into its biggest slump in modern history.[15]

Economic forecasts by Discover CEE (published at the end of April 2020) expect GDP to drop at least by 6% in 2020, which is a somewhat steeper drop than during the 2008-2009 crisis when Slovakia's GDP contracted by 5.5%.[16]

[14] Trading Economics, Slovakia Manufacturing Production, https://tradingeconomics.com/slovakia/manufacturing-production

[15] Covid-19 in Slovakia: Active plus effective (new) government – lack of anticyclical tools, first published on 27 April 2020. Analysis by Juraj Valachy, Tibor Lőrincz, Tatrabank, Slovakia and Gunter Deuber, RBI Vienna. See http://www.discover-cee.com/covid-19-in-slovakia-active-plus-effective-new-government-lack-of-anticyclical-tools/

[16] Ibid.

Current estimates indicate that the economy contracted by 20-30% cumulatively during March and April. Even if the remaining restrictions on shops and services in Slovakia were to be eased (soon), it is expected that GDP will recover only marginally, since the greatest problem is the lack of foreign demand. In Slovakia foreign trade amounts for around 190% of GDP, compared to 150-160% in the Czech Republic and Hungary, 110% in Austria and 90% in Germany. [17]

Crucial for Slovakia will be how the larger economies of Western Europe attempt to gradually revive their economies. It is a positive sign that Germany, Austria and Central Europe are beginning to re-open their economies,[18] but significant short-term damage to the Slovak economy has already been done.

In the longer term there is still great uncertainty. The longer the coronavirus crisis goes on, the lower the importance of short-term and one-time measures to mitigate damages, and the more important the general quality of the Slovak administration and government becomes.[19]

Although the Slovak government was swift and decisive, it has no long-term strategy to implement. SMER, the party in power for 12 of the past 14 years, is not thought to have prepared a pandemic plan. All decisions are instead being made by the new government, increasing the risk for mistakes and miscalculations.[20]

1.2.1.1 Immediate economic challenges

With regards to the important automotive sector, the following companies were shut down as part of a COVID-19 response:

- Volkswagen Slovakia (it has three factories located near Bratislava, Stupava, Martin, providing jobs to 14,800 people)
- PSA, French automobile manufacturing factory near Trnava;
- Jaguar Land Rover plant near Nitra;
- Kia Motors Slovakia factory near Teplička nad Váhom[21]

Thanks to these four automotive plants, Slovakia is the largest car producer per capita in the world.[22] The Slovak automotive industry makes up 13.9% of GDP and provides 275,000 jobs directly or indirectly. It generates 49.5% of industrial output and 46% of the country's exports.[23]

However, heavy FDI by the car industry also means an overreliance on the automotive sector. This situation could be described as a structural challenge to the Slovak economy. Another such challenge is the fact that Slovak growth is closely interlinked with the global economy and a weak domestic sector. Weak domestic demand also means that innovative sectors are forced to rely on exports in order to grow. In this sense, the Slovak economy is highly dependent on other countries' demand.

Thirdly, Slovakia currently has a skills mismatch and lacks *inter alia* ICT and engineering professionals. Indeed, our interviews provided anecdotal evidence of high-technology firms systematically recruiting competence from abroad (e.g. Ukraine) in order to meet their skills needs.[24] In 2019, the

[17] Ibid.

[18] Ibid.

[19] Ibid.

[20] Ibid.

[21] Centre of Energy Partnership COVID-19 vs economy of Slovakia, first published 26 March 2020. See https://cepconsult.com/publications/covid-19-vs-economy-of-slovakia/

[22] Garda Report Slovakia from 26 March 2020. See: https://www.garda.com/crisis24/country-reports/slovakia

[23] Garda Report Slovakia from 26 March 2020. See: https://www.garda.com/crisis24/country-reports/slovakia

[24] See for example "Roundup: Slovakia to deal with shortage of labour by employing foreigners" via http://www.xinhuanet.com/english/2018-08/31/c_137431810.htm

OECD reported that Slovak labour shortages are concentrated in the manufacturing sector and are related to currently strong growth.[25] Labour supply and demand is another structural weakness, also impacted by COVID-19 restrictions, which needs to be addressed in the longer term through improved education, improved links between labour market business needs and the education system as well as requiring solutions in response to migration restrictions due to the pandemic.

It is worth noting that there has been a sharp decline in educational performance (reading, science, mathematics) since 2006, which has led to a lack of technical and professional skills, as well as low level digital skills.[26] The causes of this decline are numerous, and include comparatively low levels of investment in education (in 2017 this was 3.8% of GDP compared to the EU average of 4.6%), an ageing teacher population, as well as outdated teaching methods, which do not sufficiently promote social inclusion (specifically with regards to socially disadvantaged students or those from minority backgrounds).[27] In terms of digitalisation, in 2019, Slovakia ranked 21st in the European Commission's Digital Economy and Society Index (DESI) with a higher score (46.3) compared to previous years (44.5 in 2018 and 41.0 in 2017). The availability of broadband and 4G services is not as widespread as the EU average, with fixed broadband covering 88% of households (compared to the EU average of 97%).[28]

In addition to skills shortages, other structural economic challenges include low levels of productivity, low levels of uptake of new technologies, lack of infrastructure, weaknesses in the public administration and stark territorial differences.[29, 30]

These structural challenges are already substantial and, in combination with the pandemic, will become even more so. Indeed, COVID-related analysis concludes that the current government's longevity will depend on its response to the coronavirus outbreak and finding a common ground on contentious social issues over which the coalition parties differ. The government will also struggle to deliver on its pre-election promises, at least while the COVID-19 outbreak continues.

A delay or an inability to deliver on election promises as a result of the crisis will have negative knock-on effects on a number of policy areas where the government has promised change:

- Balancing economic growth across regions
- Boosting R&D and innovation
- Fighting corruption[31]

1.2.1.2 Immediate and expected impacts on RTDI

The research conducted for this report was carried out during spring 2020. As the extent of the pandemic in Europe become more apparent, the study team agreed to further investigate the immediate and potential future impacts of the COVID-19 crises on RTDI specifically.

To this end, we drafted and sent out a COVID-19 survey to a list of around 100 RTDI stakeholders from the public sector, private sector and relevant government ministries and agencies. The survey ran between April and May 2020. Overall, 87% of the respondents said that the crisis has made their

[25] OECD, *OECD Economic Surveys Slovak Republic,* 2019.

[26] OECD, *Slovak Republic Economic Snapshot*, http://www.oecd.org/economy/slovak-republic-economic-snapshot/ p7.

[27] Education and Training Monitor 2019: Slovakia, EUROPEAN COMMISSION, 2019, https://ec.europa.eu/education/sites/education/files/document-library-docs/et-monitor-report-2019-slovakia_en.pdf

[28] European Commission, *Digital Economy and Society Index (DESI),* 2019.

[29] OECD, *OECD Economic Surveys Slovak Republic,* 2019.

[30] SWD(2019) 1024 final

[31] Garda Report Slovakia from 26 March 2020. See: https://www.garda.com/crisis24/country-reports/slovakia

daily work more difficult (in the context of R&I activities). The remaining respondents said the crisis had no effect, but these were all from government ministries or agencies.

The largest concerns for each sector can be seen in Table 1. For both research performers and the government, the direction of funds away from key research areas and towards COVID-19 related areas was a large concern. For the private sector concerns were more related to financing and revenue generation.

Table 1: Concerns of the survey respondents

Sector		
Research Performer (public)	**Private Sector**	**Government**
- cutting of financing for research and reallocation to other issues - lack of staff - sufficient local food production - impact of lockdown on the quality of education and research - uncertainty in financing, including already signed contracts - reduction of research activities focused on other diseases - dismissal of employees	- decrease in orders - decrease in financing from the banks - lack of staff due to closed schools - stopped or delayed investment into capital goods as a result of uncertainty	- pressure to move RTD funds elsewhere – e.g. into direct payments to support institutions affected by the crisis etc. - food self-sufficiency (at a national level) - under-execution of public finances despite relaxed rules - length of the crisis duration and the extent of its impact on the stakeholders involved in education, research and science

With regards to the short-term and long-term impact on the RTDI ecosystem (Figure 2), the respondents felt that, in the short term, levels of research funding were most at risk, and the quality of the research overall was least at risk. When looking longer term, there was a slight change, as concerns over the quality of the research moved up two places, and risks to collaborative research were lowered in the long term. Respondents also felt that the pandemic posed a risk to the development of a long-term research strategy, although it would serve to highlight the economy's dependence on the automotive sector and a need to create political will for diversification.

Figure 2: Perceived impact of COVID-19 pandemic on Slovak RTDI system

Short-Term	Overall Rank
Research funding	1
Knowledge transfer/ commercialisation	2
Collaborative research and innovation	3
Internationalisation	4
Staff recruitment/ retention	5
Current and planned policy measures	6
Quality of research overall	7

Long-Term Impact	Overall Rank
Research funding	1
Knowledge transfer/ commercialisation	2
Current and planned policy measures	3
Internationalisation	4
Quality of research overall	5
Staff recruitment/ retention	6
Collaborative research and innovation	7

Source: Study survey

Generally speaking, most respondents agreed that the government's actions to combat the negative effects of coronavirus in Slovakia were appropriate and positive. However, some felt as though the economic effects were not sufficiently directed towards R&I staff and activities, and disproportionately focused on the self-employed. There was also a worry that too much of the ESIF funding was being taken away from the RIS3 domains.

Indeed, the Slovak Republic and the EU have – in cooperation with the EU-27 as a whole – agreed a number of mitigating actions to ESIF in order to directly address the crisis. Some of these actions impact directly on RTDI.

As this report will later explain, the ESIF constitutes the major source of funding for RTDI in Slovakia. As such, the Operational Programmes (OPs) in place to fund research and innovation are major tools for trying to mitigate and protect RTDI and respond to concerns raised by the RTDI community.

On 28 April 2020, the Slovak ministries involved in ESIF coordination and the European Commission agreed upon a proposal[32] to use ESI Funds to (more effectively) contribute towards the mitigation of the negative consequences of the COVID-19 pandemic. The aim of this initiative is to mobilise cohesion policy to respond more flexibly to the needs of the sectors put under significant pressure by the pandemic. These include sectors such as health, SMEs and the labour market.

At the EU level, the Commission has agreed two legislative packages. Together, they cover the following:

1. The provision of immediate liquidity across the EU-27 totalling EUR 8 billion for advance payments, with the Slovak Republic´s share amounting to EUR 525 million;
2. Greater flexibility in the application of EU spending rules;

[32] Návrh opatrení financovaných z operačných programov európskych štrukturálnych a investičných fondov na boj s pandémiou COVID-19 a odstraňovanie a zmiernenie jej dôsledkov. This was adopted as a Resolution by the government of the Slovak Republic.

3. Extension of the scope of the EU Solidarity Fund; and
4. The provision of a wide range of flexibility for Member States in the use of hitherto unused ESI Funds to combat the COVID-19 pandemic.

Specifically, to support businesses, there is an agreed temporary framework for state aid measures, which allows Slovakia, along with the other Member States, to provide direct grants (or tax benefits) of up to EUR 800,000 per company. Other parts of the agreement include aid in the form of state guarantees for bank loans, subsidised interest rates and guarantees, along with loans provided through credit institutions or other financial institutions and short-term export credit insurance.

To complement the EU-wide measures, the Slovak government has also agreed a number of actions to be implemented in tandem with the EU-wide relief instruments. In the area of financial management, the deputy prime minister and the minister of finance have granted an exemption from the Financial Management System of the Structural Funds, the Cohesion Fund and the European and Maritime Fund for the 2014-2020 programming period. These funds will allow for:

1. More flexibility by beneficiaries in submitting the request for payment;
2. A change in the rules for calculating the maximum amount of the advance payment;
3. Greater flexibility in defining beneficiaries eligible for the advance payment system;
4. Greater flexibility in combining funding schemes for all beneficiaries;
5. An extension of the deadline to request an advance payment; and
6. Flexibility in the deadlines for submitting information and financial transactions.

Further support made available outside of the financial management includes such actions as extending the deadlines for calls for proposals, making use of expert evaluation resources beyond those of the managing authority, and the waiving sanctions on beneficiaries if they fail to meet previously agreed deadlines.

With regards to adjustments made to individual Operational Programmes (OPs), the OP Integrated Infrastructure was listed as one of the OPs identified to be used as an instrument to respond to the crisis. There are currently significant resources available to spend from this OP – up to EUR 2 billion in non-contracted funds and up to EUR 4.3 billion in unspent funds.

The agreement between the Slovak government and the Commission sees possibilities for further supporting SMEs through a number of Partnership Agreements (PAs) which are managed through the Ministry of Economy:

- PA 11 Strengthening the competitiveness and growth of SMEs
- PA 12 Development of competitive SMEs in the Bratislava region
- PO 9 Support of research, development and innovation
- PO 10 Support of research, development and innovation in the Bratislava region

At the time of writing, this report can outline the actions taken, but we are not in a position to describe the effects of the mitigation activities nor assess their effectiveness. Further time is needed in this regard. However, it is possible to say that there are positive precedents with regards to EU funds responding to past economic crisis. Indeed, the ex post evaluation of European Regional Development Fund (ERDF) and the Cohesion Fund found that the adaptation of programmes in the

economic crisis was one of the success stories in the 2007-2013 period and should be further built upon.[33]

There are clearly both parallels that can be drawn and lessons that can be learned with the COVID-19 crisis. However, it is also important to note that this is a different crisis and that different or nuanced mitigation actions may be needed to tackle the specific circumstances currently being experienced. It will be necessary to closely monitor the response from the RTDI community and how they react to the ESIF modifications.

Finally, in addition to these new challenges as a result of COVID-19, it should be noted that past Slovak governments have struggled to improve the RTDI system even though weaknesses have been raised. Although Slovakia has made good progress with acting on many of the country-specific recommendations that are issued on an annual basis through the European Commission Semester procedure, recommendations that refer to education and RTDI seem to lag behind – in particular the targets to increase R&D intensity for businesses, which remains among the lowest in the EU.[34]

With regards to RTDI generally, this does not appear to be a high-ranking policy priority in Slovakia, i.e. there is no agreed political vision on RTDI towards which policymakers and other stakeholders can focus their efforts.

[33] Regulation COM (2018) 375 final.

[34] UK Science & Innovation Network Country Snapshot: Slovak Republic Slovak Republic's Science and Innovation Landscape

2 The Slovak RTDI system

Chapter 2 provides a descriptive analysis of the Slovak RTDI system. Its analysis spans the years 2015-2020. Although the overall analysis and the conclusions remain valid, the preceding section on the current COVID-19 crisis needs to be taken into account when reading the analysis provided below since the current situation is having substantial negative impacts on the Slovak RTDI system as a whole, and on the Slovak economy generally.

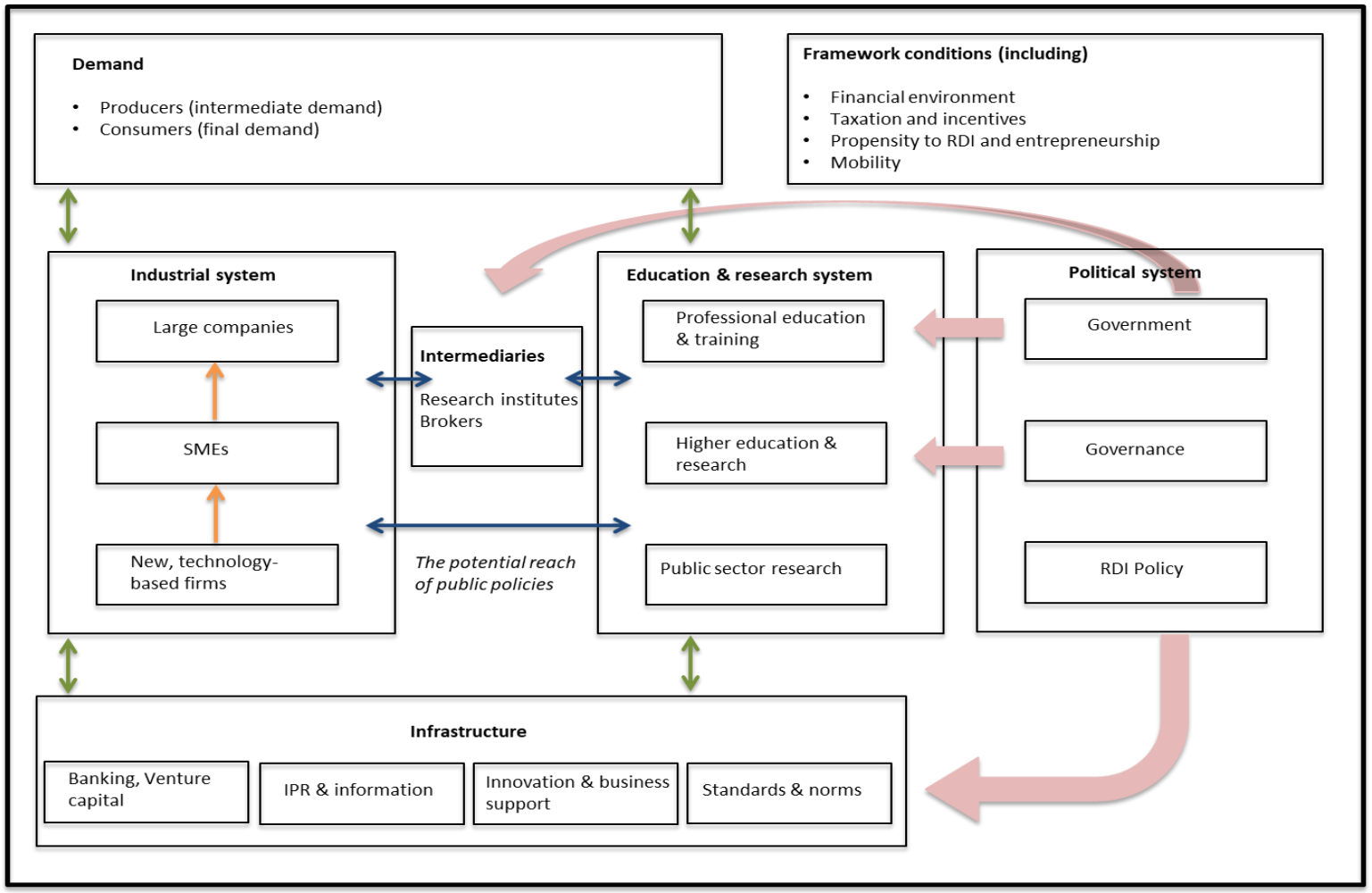
This chapter aims to bring to the forefront a large number of interrelated issues[35] all linked to RTDI performance and outcomes in Slovakia, which are then further built on in the analysis of drivers and barriers outlined in Chapter 3.

An important part of Chapter 2 entails explaining and assessing the public and private institutional arrangements that characterise Slovakia and in particular the way in which the Research and Innovation (R&I) system is structured.

Our theoretical framework, therefore, makes use of the R&I systems approach, which – in addition to setting out the institutional arrangements – also maps and analyses interactions between the different parts of the RTDI system. The diagram below shows the interlinkages between the industrial system, the education and research system and the political system, while also emphasising the important role of framework conditions. This model was first developed in 2001. Although its systemic approach remains highly relevant, it may also be helpful to introduce more recent factors such as public good to cover the need for policymakers to bring in green solutions by improving demand.

[35] The RfS stipulates that this chapter should discuss "the system of governance and distribution of competences among state administration authorities; the relevant legal framework; funding from public and private sources; possibilities for development of instruments for financial guarantee schemes; under-financing and lack of interest of domestic industry; system fragmentation; functioning of grant agencies; evaluation of creative activity; availability and use of research infrastructure; possibilities for stimulation of academy-industry cooperation; publication activity and citations; protection of intellectual property rights." Request for Service: Supporting the transformation of the Slovak economy by increasing its innovation performance, 2019

Figure 3: RTDI system



Source: Study team adaptation based on Kuhlmann and Arnold (2001)

Arnold and Kuhlmann (2000) define an RTDI system as being composed of a number of key elements such as demand for innovation, framework conditions such as the regulatory framework or tax system, industrial systems composed of large companies, SMEs and start-ups, education and research systems, intermediaries such as business and support organisations, political systems and infrastructures including an IPR regime, the availability of venture capital and the development of technical standards.

While all the different elements in an innovation system have the potential to reinforce one another, they may also risk blocking one another and having the opposite effect.[36] This assumption that the different parts of the system may reinforce or block each other is a key aspect of the analysis of this AS-IS report.

Slovakia has a long tradition of RTDI. Some of its activities are considered world-leading, for example, the Slovak School of Quantum Structures in Mathematics, or research into supraconductivity at the Institute of Experimental Physics. However, national RTDI suffers from chronic underfunding that stems back decades.

Over the past 20 years, efforts have been made to develop policy documents and development strategies aimed at boosting RTDI, although many of the challenges facing Slovakia still persist.

Authoritative literature that analyses the RTDI system in Slovakia (EC/Joint Research Centre (JRC), OECD, peer reviewed academic papers) tends to describe the Slovak RTDI system as fragmented, strongly implying there is a lack of cooperation and coordination between the various elements that make up the Slovak system. For example, the 2019 EC Semester Report provides the following analysis:

"*Research, development and innovation policy suffers from ineffective coordination between ministries and implementing agencies, and major reforms have been regularly postponed. Domestic technological development is low, as shown by weak patenting activity, and although the number of public-private scientific co-publications shows some encouraging results, science-business linkages are low, hindering broader knowledge diffusion.* "[37]

This observation of a crucial weakness is further discussed by the study authors in Chapters 2.2 and in Chapter 3.

Questions then arise about the underlying factors with regards to the fragmentation: what are the barriers to moving towards a more integrated, coherent system that is more effective and efficient? What drivers are there to promote a more effective system and more effective collaborations between RTDI system elements?

This report will therefore focus on describing and analysing the Slovak RTDI system's performance in terms of overcoming existing barriers that can improve its current innovation potential. The analysis will also highlight current drivers, describing their importance and – with the next deliverable – provide suggestions for how they can be further strengthened.

Drivers and barriers will cover aspects such as:

- The governance structure and processes and national (and regional) commitment to R&I;
- The strengths and operational practices of the higher education and research institutes, including the nature of funding mechanisms;

[36] Quoted in Izsák et al, *Lessons from a Decade of Innovation Policy: What can be learnt from the INNO Policy TrendChart and The Innovation Union Scoreboard,* 2013, Final Report.
[37] SWD (2019) 1024 final

- The processes of engagement of the industrial sector in R&I, both within and between organisations and between the industry and academic sectors and the use of the support available;
- The nature and processes of R&I infrastructure and support; and
- Cultural and social processes – nature of entrepreneurial discovery evident in a country, attitudes towards entrepreneurship.

The remaining parts of Chapter 2 will provide a descriptive analysis of the main strategy for RTDI in Slovakia, key public and private RTDI actors in Slovakia and introduce the legal framework under which RTDI actors and institutions operate. Chapter 2 will then provide an overview of resources (funding and infrastructure), and how resources are shared (collaboration). Internationalisation of Slovak RTDI and an assessment of its overall performance is provided at the end of Chapter 2.

2.1 RIS3 strategy

Slovakia´s Research and Innovation Smart Specialisation Strategy(RIS3) 2014-2020 is the main strategic document governing RTDI in Slovakia.

RIS3 is a process concentrated on creating conditions for utilising the Slovak Republic's growth potential by setting priorities and supportive areas in order to gain comparative advantage.[38] The design and implementation of RIS3 is the ex-ante conditionality for the European Structural and Investment Funds. Slovakia was one of the first EU Member States to pass a Smart Specialisation Strategy(RIS3 SK14+) on 13 November 2013.[39] As the country is a small economy,[40] the RIS3 for the period 2014-2020 was carried out at national level.

2.1.1 RIS3 strategies objectives and development

The RIS3 document presents a vision for the Slovak economy:

> "To drive a structural change of the Slovak economy towards growth based on increasing innovation capability and R&D excellence to promote self-sustaining growth in income, employment and standard of living."[41]

Four main objectives, including several partial objectives and 20 measures as policy mix, were defined to achieve the vision:

1. Deepening integration and embeddedness of major key industries to increase local value added through the cooperation of the local supply chains and turning local supply chains into embedded clusters.[42]
2. Increased contribution of research to the economic growth via global excellence and local relevance.

[38] Deputy Prime Ministers Office for Investments and Informatisation, *R&D&I in Slovakia: Digital Slovakia and the Creative Industries*, https://www.itapa.sk/data/att/4986.pdf

[39] "Through knowledge towards prosperity", Research and Innovation Strategy for Smart Specialisation of the Slovak Republic, 13. November 2013.

[40] Slovakia has 5.4 million inhabitants and is therefore of comparable size with higher-level regions in larger EU countries.

[41] "Through knowledge towards prosperity", Research and Innovation Strategy for Smart Specialisation of the Slovak Republic, 13. November 2013, p. 60.

[42] The following partial objectives are, for example, assigned to objective 1: a) create conditions for growth of added value generated at home in total exports by 5% until 2020 in comparison to the current status, b) increase the number of large companies that become Tier 2 suppliers; and c) improve the linkages of local SMEs with large MNC suppliers.

3. Creating a dynamic, open, and inclusive innovative society as one of the preconditions for the increase in the standard of living.
4. Improving the quality of human resources for an innovative Slovakia.

For readability purposes, the full list of measures is not included, but it should be noted that the measures are important, since they list everything from university excellence, SME policy to education. Measures include:

- Developing innovative capacities through business cooperation and research institutes,
- Upgrading technology for structural change in industry,
- Linking universities, Academy of Science, research institutes and industry partners,
- Improving the quality of secondary and higher education.

The foundation of the strategy is built on an extensive analytical framework including analysis of export specialisation, the innovation environment, and the business sector's innovation capacity, the R&D potential, the science system and research areas, as well as the availability of human resources. Based on this analysis, a comprehensive SWOT analysis was conducted and three different types of areas of specialisation were identified: ,

1. Economic areas based on the sectors that are traditionally strong in Slovakia[43]
2. Prospective areas of specialisation based on high-potential, fast-growing sectors[44]
3. Areas of specialisation regarding the availability of scientific and research capacities which already increased their R&D capacities but require further expansion[45]

The RIS3 strategy document also sets out several far-reaching governance reforms and a forthcoming action plan.

2.1.2 RIS3 strategy implementation plan

Although the RIS3 strategy was well elaborated and state of the art, difficulties arose on agreeing an action plan. Therefore, administrative delays were incurred to its implementation.[46]

In June 2017, the Implementation Plan of the Research and Innovation Strategy for Smart Specialization of the Slovak Republic was approved by the Government Council for RTI with the aim of fulfilling the missing criteria related to ex-ante conditionality.[47] The implementation plan sets out the prioritisation of the smart specialisation areas and defines five smart specialisation domains based on economic, prospective and scientific areas of specialisation.[48] The five domains and its most relevant key sectors (in two-digit NACE codes) are shown in the table below. The most relevant key sectors of each domain (see below) are complemented by a number of functionally linked sectors.

[43] Areas of economic specialisation are a) Automotive and mechanical engineering industries, b) Consumer electronics and electrical equipment, c) ICT and Services and d) Production and processing of iron and steel.

[44] Prospective areas of specialisation are a) Automation, robotics and digital technology, b) Processing and increasing the value of light metals and their alloys, c) Production and processing of plastics, d) Creative industry and e) Increasing the value of domestic raw material base.

[45] Areas of specialisation from the point of view of available scientific and research capacities are a) Research of materials and nanotechnology, b) Biomedicine and biotechnology, c) Environment and agriculture and d) Sustainable energy.

[46] Vladimír Baláž, Karol Frank and Tauno Ojala, *RIO Country Report 2017: Slovak Republic*, 2017, 20.

[47] Operational Programme Research and Innovation, *Implementation plan: Research and Innovation Strategy for Smart Specialisation of the Slovak Republic, 2015.*

[48] Operational Programme Research and Innovation, *Implementation plan: Research and Innovation Strategy for Smart Specialisation of the Slovak Republic, 2015.*

Table 2: Overview of Smart Specialisation Domains

Domain	NACE CODE	Key sectors
Vehicles for the 21st Century	C29	Manufacture of motor vehicles, trailers and semi-trailers
	C30	Manufacture of other transport equipment
Industry for the 21st Century	C20	Manufacture of chemicals and chemical products
	C22	Manufacture of rubber and plastic products
	C24	Manufacture of basic metals
	C25	Manufacture of fabricated metal products, except machinery and equipment
	C27	Manufacture of electrical equipment
	C28	Manufacture of machinery and equipment n.e.c.
	D35	Electricity, gas, steam, and air conditioning supply, water collection, treatment and supply
Digital Slovakia and Creative Industry	C26	Manufacture of computer, electronic and optical products
	J62	Computer programming, consultancy and related activities
	J63	Information service activities
	M74	Professional, scientific and technical activities
	M75	Veterinary activities
Population Health and Medical Technology	Q86	Human health
Healthy Food and Environment	A1	Crop and animal production, hunting and related service activities
	A2	Forestry and logging

Source: Implementation plan: Research and Innovation Strategy for Smart Specialisation of the Slovak Republic, p. 14.

For each of the identified domains, an Entrepreneurial Discovery Process (EDP) has been initiated with the aim of identifying "key activities and products for the economic and research specialisation of the Slovak Republic, taking into account the technological and research capacities of enterprises, the existing research infrastructure in the public sector, the research potential of the leading Slovak scientific teams and the economic specialisation of the Slovak Republic in foreign trade".[49] Implementing an EDP with wide stakeholder involvement is one of the fundamental methods of the RIS3 for selecting and prioritising strategic areas and activities for intervention and transformation.

Domain platforms have been established (uniting crucial actors from the triple helix), and data gathered in surveys with the aim of narrowing down the domains into new product lines. The product lines are connected to various development trends, which are different for every domain, as well as to specific industrial sectors. An example for the product lines is given in the table below. In the EDP Synthesis Reports the procedure for determining the eligibility of a project (R&D or product) is outlined, too. The eligibility criteria are mainly linked to the relevant NACE codes of the domains.[50]

[49] Deputy Prime Minister's Office for Investments and Informatisation, *Product Lines For Digital Slovakia And Creative Industry*, 2018 https://www.opvai.sk/media/99313/digit_creativ_domena_final_22032018_pp.pdf

[50] Ministry of Economy, *Product Lines For Domain Vehicles For 21st Century*, 2017, https://www.opvai.sk/media/99315/produktove-linie-pre-domenu-dopravne-prostriedky-pre-21-storocie_web.pdf; *Product Lines For Domain Industry For 21 Centuries* https://www.opvai.sk/media/99316/produktove-linie-pre-domenu-priemysel-pre-21-storocie_web.pdf; *Product Lines For The Population Health And Health Technology Domain* https://www.opvai.sk/media/99313/digit_creativ_domena_final_22032018_pp.pdf; https://www.opvai.sk/media/99314/súhrnná-správa-k-doméne-č-4-zdravie-obyvateľstva-a-zdravotnícke-technológie_final_22_01_2018.pdf; *Product Lines For The Healthy Food Environment* https://www.opvai.sk/media/98931/zdrave-potraviny_a_zivotne-prostredie.pdf.

Table 3: Example of one trend and the related product lines in the domain industry for the 21st Century

Main trend	Secondary trend	Product line
I. New construction materials, construction time and technology for industry and energy needs	Progressive materials, construction time, products and technologies	Metallic, non-metallic, chemical, petrochemical and polymer materials and composites for the manufacture of components, machinery, apparatus and equipment (materials with improved properties such as reducing product weight, noise and vibration, increasing safety, performance, etc.).
		Progressive technologies of production and processing of materials and products made of them, powder technologies, vacuum metallurgical technologies, precision casting, 3D printing of composites, external industrial production, advanced technologies of surface coating production, automated and robotic manufacturing technologies.
		Advanced technologies of machining, forming, joining, welding and cutting of materials.
		Construction time and products (e.g. products of an industrial nature and products resulting from the combination of multisectoral solutions such as engineering and electrical engineering, possibly also with vortexes, etc.).
		Materials and parts handling equipment and systems in production (e.g. safety improvement systems, warehouse automation systems and logos, etc.).
		Elements for industrial energy storage and recovery (e.g. power electronic converters, power distribution technologies, tools for intelligent power management, energy production and distribution, etc.).
		Specific materials for use in a fast reactor IV. Generation

Source: https://www.opvai.sk/media/99316/produktove-linie-pre-domenu-priemysel-pre-21-storocie_web.pdf (translated with DeepL).

2.1.3 Evaluation of the RIS3 strategy: on-side interviews

The overall observation derived from the interviews carried out by the authors of this study was that the strategy, the domain selection and EDP was well drawn up in terms of methods chosen and overall quality. Most of the interviewees agreed that the selection of the domains was appropriate and well done.

Nevertheless, several concerns and flaws were mentioned. The most important points of concern were that the domain selection and the EDP was only done once. Neither an updating/continuous process nor a monitoring system was implemented and, as a result, new developments, such as Artificial Intelligence or battery research, were not listed. Furthermore, the domain selection was based on economic size and exports, which excluded some innovative but smaller industries/companies from the strategy. Operational difficulties were mentioned as the domains "Vehicle for the 21st Century" and "Industry for the 21st Century" were overlapping and have similar product lines. In general, the EDP resulted in "too many product lines and (is) too generally written" and has not been supported enough. Most interviewees are convinced that the implementation of the RIS3 was hampered due to multiple reasons. These are described in further detail later in this

chapter. However, one important aspect is that the eligibility criteria of projects linked to NACE codes appeared to be too strict.

2.1.4 Evaluation of the RIS3 strategy: methodological review

From a methodological point of view the domain selection and the EDP generated valuable results. Nevertheless, a closer look reveals that the priority areas were not sufficiently targeted within the selected S3 domains.

First, the sheer multitude of identified development trends and associated product lines looks like an Eldorado of innovation. Such a vast assortment lies in contradiction to a fundamental principle of S3: concentrate on *specific* priorities based on available *capacities*. This is crucial for generating a density of actors and projects that are related and dedicated to a common priority – an imperative for benefitting from the resulting synergies, complementarity and agglomeration, which are essential determinants of innovation, creativity and R&D productivity.

Second, the focus on industry sectors to narrow down the S3 domains is opposed to a second fundamental principle of S3: the focus of S3 should not be on existing structures (sectors, industries) but on the *transformation* of these structures and *new combinations* of capacities. The fact that an actor is classified in a particular NACE code does not necessarily mean that an actor can contribute to a desired direction of change. Vice versa, actors from outside of the pre-supposed industry classifications can become crucial innovation drivers for an aspired transformation process.

> The final analysis of the RIS3 of SK14+ and the resulting recommendations for the new RIS3 are still in progress and will be carried out in a later assignment.

2.2 Key actors and governance

This section will describe key public and private actors involved in RTDI governance in Slovakia.

To put the governance of RTDI into a wider context, there has been a general trend over the past decade or so for OECD countries to highlight the importance of RTDI policy – in Europe RTDI policy is, at least in part, coordinated by the offices of prime ministers, or similar central cabinet set ups. In Slovakia, this coordination work has been carried out by the deputy prime minister's office for investment and informatisation since 2016[51]. R&I policy is increasingly being embedded horizontally into other policy areas, such as the environment and climate change, social and health policy, regional policy, and education, training and skills policy. The implementation of Smart Specialisation strategies (RIS3) is another contributing factor towards the more direct participation of, and greater engagement by, the regional actors in the development of RTDI policies.[52]

A RTDI governmental system, which involves a fairly large number of ministries, generally has its advantages and disadvantages. On the one hand, it ensures the inclusion of thematic priorities in RTDI, but it also makes coordination of RTDI policy more complex, and more time is needed throughout the policy cycle to consult and agree through cooperation.

However, individual country histories and institutional preferences also play a distinct role in how RTDI systems are organised. In countries that are currently less competitive in RTDI, it can be challenging to find the political will and consensus to prioritise funding and investments. This creates a precarious situation where RTDI investments are short term, prone to more drastic shifts when

[51] During the finalisation of this report, the deputy prime minister's office was being transformed into the Ministry of Regional Development and Investments. This policy change is referred to in the TO-BE report.

[52] Baláž, V., Frank, K., Ojala, T. , *Innovation Country Report 2019: High growth enterprises, innovation and productivity challenges*, 2020, Slovak Republic.

there is a change in political administrations and take a low profile during the election campaigns.[53] There are many factors that play a role in addressing problems around low RTDI competitiveness. In the case of Slovakia, historically, an overreliance on FDI, a fragmented system of RTDI producers, and a general lack of cooperation in the innovation system could be highlighted as some key contributing factors that need to be addressed to improve overall performance. All of these barriers are further described in Section 3.

2.2.1 Government actors and their roles

Slovakia's public administration is characterised by a small and centralised state. RTDI policy is a central government competence, i.e. the national government is responsible for science and technology policy, industrial policy and higher education policy. However, there are eight regional governments that have some competences in secondary education and vocational training, and in regional innovation, but in practice these are rather weak since regional governments have limited planning and financial privileges.

Although the regional governments are peripheral actors in this sense, there are (forthcoming) regional RIS3 strategies in the Bratislava, and Košice regions, among others.[54] The Nitra region recently published its regional RIS strategy focusing on agriculture food and biofuel. [55]

This study's stakeholder interviews were largely positive about the development of regional strategies, since they indicate (improved) collaboration and indeed concrete bottom-up action at the local and regional level. However, it is not clear how well coordinated regional initiatives are with the central administration's RTDI policies.

The current set up of the RTDI system in Slovakia has been in place for that past five years and is characterised by "relatively modest state support" and a "high number of government agencies".

Source: Based on forthcoming Baláž, V., Frank, K., Ojala, T. (2020) Innovation Country Report 2019: High growth enterprises, innovation and productivity challenges, Slovak Republic.

The centrally placed coordination body is the **Slovak Government Council for Science, Technology and Innovation** (SGCSTI). This is described by Baláž, Frank, and Ojala as the key advisory body for coordination of the Slovak Science and Technology (S&T) policies. Its role is to coordinate the cooperation of public and private sector organisations to ensure the objectives of the science, technology and innovation policies and comprehensively assess the materials of central state administration bodies in the field of science, technology and innovation.[56]

The Council brings together the key public RTDI actors including the relevant ministers. The Deputy Prime Minister for Investment and Informatisation is the Head of the Council. The Ministers for Education, Science, Research and Sport, Economy, Finance, Health, Agriculture and Rural Development, Environment, Transport and Construction and Labour, Social Affairs and Family also sit on the Council. The Chairman of the Slovak Academy of Sciences, Slovak Universities (via the Rector Conference), research institutions and industry and employer associations are also represented on the council.

[53] Baláž, V., Frank, K., Ojala, T. , *Innovation Country Report 2019: High growth enterprises, innovation and productivity challenges*, 2020, Slovak Republic.

[54] For example, *Regional Research And Innovation Strategy Of The Žilina Region* 2014+, http://www.zilinskazupa.sk/sk/samosprava/urad-zsk/odbor-regionalneho-rozvoja/regionalny-rozvoj-uzemne-planovanie/inovacie/regionalna-vyskumna-inovacna-strategia-zilinskeho-kraja-2014.html

[55] See https://www.unsk.sk/zobraz/sekciu/dokumenty-regionalneho-rozvoja

[56] European Commission Joint Research Council, *Research and Innovation Observatory – Country Profile Slovakia*, https://rio.jrc.ec.europa.eu/country-analysis/organisations/slovak-government-council-science-technology-and-innovation

Qualitative evidence obtained through the stakeholder interviews indicates that the Council is an effective forum for cooperation with frank and open discussions between stakeholders. It also functions as an informal meeting place for initiating networks which are then further developed outside of the Council meetings.

Instead, our interviewees report that the Council's advisory and therefore limited role in promoting change represents a drawback. It was considered by stakeholders, who attend the Council meetings, that much of the consensus achieved through discussions is not extended to, and carried out by, the stakeholders that make up the Council.

Having an advisory Council for Science Policy is common for R&I systems, for example in the Netherlands[57], the United Kingdom[58] and Japan[59]. However, in order to maximise the advantages and minimise the drawbacks of the Council advisory format in Slovakia, the Council should mirror similar formats elsewhere and aim to become more open, involved and transparent. As noted by Grünwald, the Slovak Council lacks the same degree of independence from the ministries as others and should be more of an arms-length body, with a larger number of science and technology experts.[60] At present, the Council is heavily ministry-dominated, perhaps indicative of the lack of an overall 'ministry champion' for R&D in the government. In the UK, the Science and Technology Council contains just two ministries, the Department for Business, Energy and Industrial Strategy, and the Treasury, which both sit in as observers. The core membership in the UK is composed of industry or academic positions, including the chairs.[61] By contrast, the Slovak model has nine different ministries as core members of the council.

There are two key ministries involved in RTDI policy, although other departments also play important roles (as shall be described). Coordination between ministries appears to be a particular challenge. The dominant view from the stakeholder interviews is that the cooperation and consensus-building between the ministries is problematic overall. The Ministry of Economy and its agencies were provided as an example by some stakeholders (independent of the ministry) of more effective management, although it was equally recognised by the same stakeholders that this ministry also had fundamental shortcomings. Engagement with the EU in Brussels is managed through the Slovak Liaison Office for Research and Development (SLORD), which is coordinated by the Ministry of Education, Science, Research and Sport. It focuses on monitoring and analysis of EU policies and tools for the support of research, development and innovation, particularly through the EU Framework Programmes for Research and Innovation.[62]

After changes made in December 2019, basic and applied research is no longer the responsibility of the Ministry of Education, Science, Research and Sports (MESRS). However, MESRS maintains a number of crucial activities and responsibilities in the field of R&D:

- Coordination and cooperation with central state administration bodies, SAS, representative bodies of universities, representative employers' associations and other representatives of the scientific and research community;
- Implementation of state science and technology policy;

[57] For example, Dutch Advisory Council for Science, Technology, and Innovation: https://english.awti.nl/

[58] For example, UK Council for Science and Technology: https://www.gov.uk/government/organisations/council-for-science-and-technology

[59] For example, Japanese Council for Science, Technology and Innovation: https://www8.cao.go.jp/cstp/english/index.html

[60] Norbert Grünwald, Education, *Innovation and Economic Society Development*, Business and Economics, 2015, p54

[61] UK Government, *Council for Scientific Technology: Membership*, https://www.gov.uk/government/organisations/council-for-science-and-technology/about/membership

[62] Slovak Liaison Office for Research and Development, *'About us'*, https://www.slord.sk/about-us/?lang=en#tabs_desc_110_1

- Preparation of strategic and programme documents for research and development at the level of central state administration bodies of the Slovak Republic;
- Implementation of state policy in the area of mobility of qualified R&D employees and students;
- Management of the membership and representation of Slovakia in international organisations, for example the European Strategy Forum on Research Infrastructures (ESFRI); and
- Promotion of science and technology.

The Ministry of Transport and Construction is now the Managing Authority for European Structural and Investment Fund (ESIF) programmes in the field of research, with MESRS and the Ministry of Economy as intermediary bodies for the Operational Programme Integrated Infrastructure.

Since the ESIF programme constitutes significant funding for RTDI in Slovakia, cooperation to effectively and efficiently make use of ESIF investment constitutes a hugely important element of the ministries' responsibility. Slovakia's high dependency on EU funding streams is partly due to the weakness of private investment. In 2015, 39% of Slovak R&D investment came from foreign funding sources. Of these, 89% of funds were EU funds. It should be noted that structural funding is highly cyclical and Slovakian foreign funding rates hover between 10% and 20% for other years.

However, the sharp decline in overall public R&D funding after this cycle, from 1.16% of GDP in 2015 to 0.79% in 2016, indicates that there remains an over-reliance of the Slovak research system on the European Structural and Investment Funds as a large component of foreign funding.

By comparison, the other Visegrad countries do not have such prominent cyclical dips in their spending, indicating both smoother cycle management and less reliance on structural funds as a percentage of total foreign funding. The post-ESIF cycle drop for the Czech Republic was 13% of total gross domestic expenditure on R&D (GERD), for Hungary it was 12% and 4% for Poland, while for Slovakia it was a 32% drop between cycles. While it is true that the large drop is a consequence of extensive use of remaining funds in the last year of the previous programming period, comparable countries also have similar higher ERDF spending in this last year and do not have such a marked decline. This indicates that Slovakia has one of the highest dependencies in the EU-27 [63] and raises serious questions about the sustainability and adequacy of the national R&D funding programmes.

ESIF funds dedicated to RIS3 are overseen by the Permanent Committee for RIS3 Implementation. In addition to the Ministries of Economy, Education and Transportation and Construction, the following government departments are also represented in the Permanent Committee for RIS3 Implementation:

- Ministry of Agriculture (MoARD)
- Ministry of Culture (MoC)
- Ministry of Labour (MoLSAF)
- Ministry of Environment (MoEn)
- Ministry of Health (MoH)
- Ministry of Interior (MoI)
- Ministry of Finance (MoF)
- Office of the Deputy Prime Minister of the Slovak Republic for Investments and Informatisation (OfII)

[63] SWD (2019) 1024 final and *European Semester Report Slovakia* 2019 p37 and Eurostat

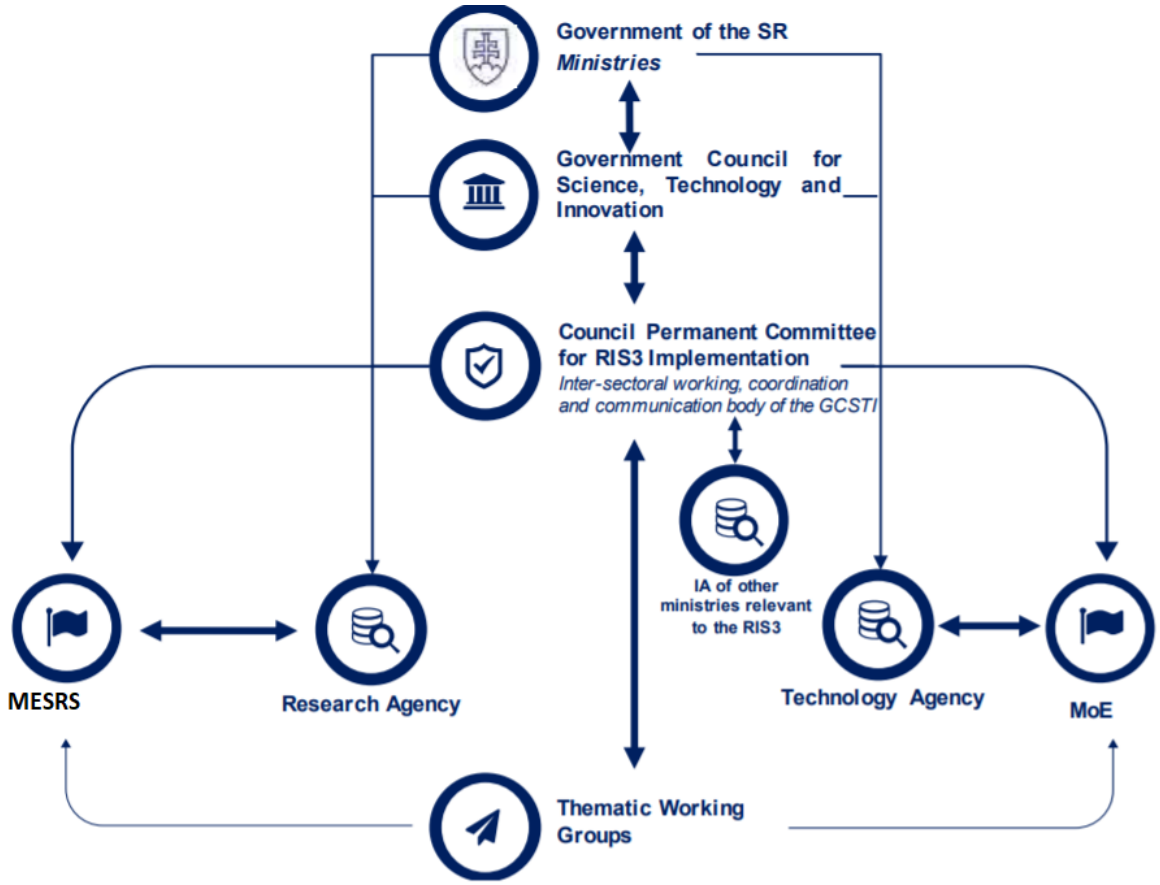
As part of the research, the study team has spoken to the Ministries of Agriculture, Education, Economy, Environment and Health about cooperation on RTDI, especially ESIF cooperation. Interviews with the other ministries were also sought.

An overall observation derived from the interviews was that the RIS3 Permanent Committee meetings – similar to the Council meetings described above – provided a good and open forum for discussion and decision-making. However, practical problems appear to arise in the implementation of agreed decisions. Stakeholders interviewed describe delays in evaluations and award funding and delays in issuing calls, but they were unable to pinpoint the exact reasons for those delays. Ministries with more limited – or emerging – RTDI portfolios also expressed frustration and felt their interests were insufficiently taken into account within RTDI priority areas (Smart Specialisation domains).

The below figure puts the role of the Permanent Committee into the context of the wider RTDI governing system. The roles and responsibilities between the SGCSTI and the Permanent Committee are outlined in detail in the Action Plan for the Implementation of the Research and Innovation Strategy for Smart Specialisation of the Slovak Republic 2014–2016.

In summary, the role of the Council is high level and strategic, while the RIS3 Committee is tasked with the implementation and monitoring. The Committee also liaises with the various agencies that are part of the strategy implementation.

Figure 4: Overview of the RIS3 Management System[64]



Source: IMPLEMENTATION PLAN: Research and Innovation Strategy for Smart Specialisation of the Slovak Republic

Generally, cooperation on the implementation of the Operational Programmes for RTDI under the 2014-2020 was not successful (see further section 2.3.1.1). However, ministries are now recognising that the current situation needs to improve. Many stakeholders were reflective and provided concrete recommendations for how to better build consensus, and decisive, efficient action around RTDI policy. There was a consensus that drastic and quick improvement was needed with regards to the management, and crucially, expenditure of the funds. Evaluation procedures need urgent review and change. More transparency and more efficient handling of the calls for proposals procedures were also demanded.

2.2.2 Implementing agencies

A large number of agencies are in charge of the implementation of ESIF and national RTDI funding. Government agencies in Slovakia operate closely under the supervision of their parent ministries, i.e. they have limited autonomy and their focus is on the evaluation of proposals and implementation of funding, rather than direction.[65]

[64] This report notes that the above figure (Figure 4) has been amended in practice based on the Implementing Decision C(2019) 9078 of 11 December, 2019. Following this decision, OP R&I for 2014-2020 was merged with OP II, which lead to change of the implementation structure. The Ministry of Transport and Construction is now the Managing Authority. MESR and MoE are now two Intermediary Bodies. OP R&I therefore ceased to exist and its priorities, goals and funded areas are incorporated in OP II.

[65] See for example the statues of the Slovak Research and Development Agency: https://www.apvv.sk/buxus/docs/agentura/ine-dokumenty/statute-srda.pdf

There are several funding agencies operating under MESRS. The Cultural and Educational Grant Agency (KEGA) supports public university research in the areas of education, teaching and creative and performing arts. The Scientific Grant Agency (VEGA) is operated jointly between the Ministry and the Slovak Academy of Sciences (SAS). VEGA supports basic research at SAS and at the universities, including institutional funding (block funding). In that sense, it does not operate open schemes but rather those founded as common grant schemes of the education sector and form part of state budget for HEI and SAS, distributed on a project basis.

The amount of money available from this budget is different for each RTDI actor, with SAS having received EUR 4.5m and HEIs EUR 10.8m in 2018 (EUR 12.3m is allocated for HEIs in 2020).[66] The Slovak Research and Development Agency (SRDA) is responsible for applied research, basic research and international research cooperation. The Research Agency has been delegated by MESRS as the Intermediary Body for the Operational Programme Integrated Infrastructure. It should also be noted that MESRS itself contains a Section for Science and Technology (SST), which operates as a *quasi* agency for research and development, providing grants for the private sector with participation of public research institutes. However, little further detail regarding SST was uncovered during the course of the research, which in itself indicates that more could be done to raise awareness of the role of this agency as well as the funding available.

The Ministry of Economy also runs three agencies that administer innovation funding. These are the Slovak Business Agency (SBA), the Slovak Investment and Trade Development Agency (SITDA) and the Slovak Innovation and Energy Agency (SIEA). SIEA co-administers the ESIF Open Programmes (OPs) OP Integrated infrastructure and OP Quality of Environment. In general, all of these agencies are well regarded by stakeholders, although their resources are limited.

The stakeholder interview programme has revealed some insights into the workings of the agencies. Stakeholders were very critical about the long delays in publishing calls for tenders, the long delays in evaluating proposals, and the long delays and administrative requirements associated with funding. However, stakeholders were not able to point to the exact point of failure, but rather suggested it was the result of lack of cooperation and transparency between the ministries and agencies involved. Our analysis confirms this to be the case: the root cause is both a lack of human resources and too many approval and discussion layers for publishing calls, which dilutes the decision-making process.

Stakeholders interviewed agreed that the burdensome administrative requirements were predominantly of their own making and not the result of EU-imposed requirements. Indeed, government stakeholders suggested that many of the Slovak requirements for seeking ESIF support had been carried over from the last programme period. While efforts had been made by the managing authorities to lessen the administrative burden on applicants, virtually all stakeholders interviewed still perceived the administrative burden to be very heavy, in particular for SMEs and innovation newcomers. This change had created noticeable negative impact on public and private RTDI performers seeking funding in response to the calls for proposals.

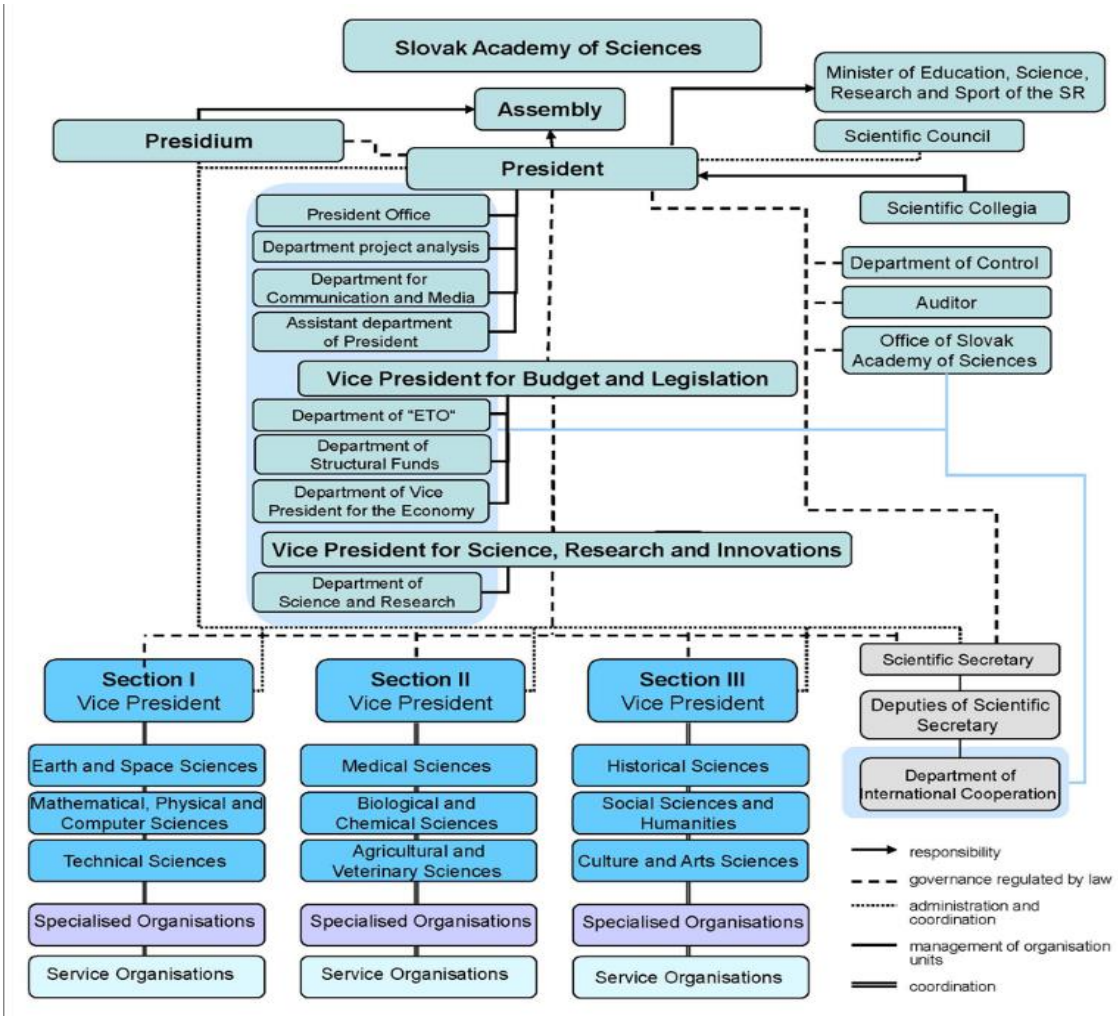
In addition, the second key barrier to making effective use of ESIF funding concerns obstacles related to the evaluation procedures of grant proposals. These were a particular sticking point consisting of challenges both with regards to securing high-quality and independent evaluators to assess the proposals submitted, as well as challenges with regards to the transparency and timing of the evaluations.

[66] SLOVENSKEJ REPUBLIKY, ZBIERKA ZÁKONOV, Vyhlásené: 27.12. 2019 Časová verzia predpisu účinná od: 5. 8.2020, accessed via https://www.mfsr.sk/sk/financie/verejne-financie/rozpocet-verejnej-spravy/

2.2.3 Research and education actors

Higher education institutions (HEIs) and the Slovak Academy of Sciences (SAS) are the key research performers in Slovakia. There are currently 20 public universities, 10 private universities and three state universities and colleges in Slovakia.[67] The SAS is composed of 45 research institutes and carries out both basic and applied research, while HEIs carry out far more basic research than applied. The SAS has around 3,000 employees, including around 1,900 researchers and scholars.[68] Its structure can be seen in Figure 5 (below).

Figure 5: Structure of the Slovak Academy of Sciences



Source: SAS, https://www.sav.sk/?lang=en&doc=sas-org

In addition to SAS and the HEIs, a number of ministries have their own research institutes attached. For example, the Ministry of Environment is the founder of the Slovak Hydrometeorological Institute, Research Institute of Water Management, and State Geological Institute of Dionýz Štúr.

Similarly, the Ministry of Agriculture and Rural Development founded six subsidised research organisations to perform basic and applied research, development and related innovations for the agricultural practice, with a view to being compatible with the Europe 2020 Strategy and the EU

[67] https://www.timeshighereducation.com/student/where-to-study/study-in-slovakia

[68] The Interacademy Partnership, *Membership Profiles, Slovak Academy of Sciences*: https://www.interacademies.org/index.php/organization/slovak-academy-sciences

Framework Programme for Research and Innovation.[69] As of 2020 some of these research organisations were merged, and now the most important are the National Agricultural and Food Centre, National Forest Centre, the Central Agricultural Inspection and Testing Institute and the State Veterinary and Food Institute. These organisations carry out mostly applied research, with a small amount of basic research also being undertaken.

A key reform was passed in 2002 that transformed most of the state HEIs into public institutions, with different economic conditions, multisource funding and property ownership, thus permitting them to benefit from intellectual property ownership. The SAS did not benefit from the same reforms, although a law was passed in 2017 to allow individual research institutes of the SAS to commercialise research.[70] There remains a lack of clarity around how this applies in practice. Disputes between the SAS and the Ministry of Education persisted in the years that followed, and the matter has still not been settled.[71]

In 2020 the state budget allocated to support public HEIs amounted to EUR 603m, of which EUR 184.6m supports R&D, EUR 168m is for the operation and development of research infrastructure and EUR 347.8m for teaching and the operations of HEIs. The budget for the VEGA agency to support HEIs basic research projects amounts to EUR 12.3m while EUR 4.4m has been allocated to the KEGA agency on HEIs R&D projects[72].

The SAS institutional budget was set at EUR 85.4m[73] in 2020. Individual HEIs and SAS organisations complement their institutional budgets by project grants from the VEGA and KEGA agencies (HEIs only). The 2018 figures revealed that SAS received EUR 4.5m and HEIs received EUR 10.8m from VEGA[74]. HEIs were also allocated EUR 3.4m[75] (EUR 3.9m[76] in 2019) from KEGA.

In terms of HEIs, the highest ranked institutions for overall research performance in 2019-2020 were[77]:

- Comenius University in Bratislava (global rank for research – 614)
- Pavol Jozef Šafárik University in Košice (global rank for research – 1,281)
- Slovak University of Technology in Bratislava (global rank for research – 1,333)
- Technical University of Košice (global rank for research – 1,894)

The methodology to produce this ranking looked at research volume, income and reputation, number of citations and international outlook.[78] A brief comparison between the institutions in terms of size, structure and outputs can be seen in the Table below, as well as data for SAS as a baseline.

[69] *Through knowledge towards prosperity: Research and Innovation Strategy for Smart Specialisation of the Slovak Republic*, 2013, p31.

[70] *Through knowledge towards prosperity: Research and Innovation Strategy for Smart Specialisation of the Slovak Republic*, 2013, p29.

[71] Peter Kapitán, *Education Ministry vs. Academy of Sciences: What is the dispute actually about?*, Slovak Spectator, 2018. Available at https://spectator.sme.sk/c/20912777/ministry-of-education-and-slovak-academy-of-sciences-continue-to-clash.html

[72] MESRS, Breakdown of subsidies from the state budget to public universities for 2020: https://www.minedu.sk/rozpis-dotacii-zo-statneho-rozpoctu-verejnym-vysokym-skolam-na-rok-2020/

[73] 2020 State Budget Act: https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2019/468/vyhlasene_znenie.html

[74] VEGA, *Annual Report*, 2018: https://www.minedu.sk/data/att/14803.pdf

[75] KEGA, *Annual Report*, 2018: https://www.minedu.sk/data/att/14929.pdf

[76] KEGA, Annual Report, 2018: https://www.minedu.sk/data/att/14929.pdf

[77] Center for World University Rankings: https://cwur.org/

[78] A full explanation of the methodology can be found here: https://www.timeshighereducation.com/world-university-rankings/world-university-rankings-2020-methodology

Table 4: Top 4 Research Performing HEIs in Slovakia

Institution	Size	Examples of outputs	Structure	World research ranking[79]
Comenius University in Bratislava[80]	22,536 students 2018/2019. 2,078 university teachers and 395 researchers	10,046 publications in 2018	13 faculties and one science park	614
Pavol Jozef Šafárik University in Košice	7050 students 2019/2020 and 949 scientific degree lecturers in 2019/20[81]	2950 publications in 2018[82]	5 faculties and one science park	1,281
Slovak University of Technology in Bratislava	c. 15,000 students and more than 1,400 teachers and researchers in 2016	6 patents and 48 utility models in 2016	7 faculties and one science park	1,333
Technical University of Košice[83]	9,110 students in 2018. 757 teachers and 123 research personnel	3,564 publications in 2018. 7 patents granted and 20 utility models in 2018	9 faculties and one science park	1,894
Slovak Academy of Sciences	1,900 researchers and scholars	8.35 publications per researcher 2007-2017 (FTE adjusted)[84]	45 research institutes	N/A

Overall, there are a high number of HEIs in Slovakia for the size of the population. The OECD recommended in 2019 that the government "should consider reducing the number of universities and create larger, internationally visible research units".[85] Similarly, the SAS also has a large number of research institutes and a 2017 evaluation by a panel of international evaluators suggested restructuring the SAS and merging or reducing the overall number of institutes. However, it is not clear how far these reforms have been implemented, although discussions with SAS suggest the total number of institutes has been reduced.

2.2.4 Private actors

In Slovakia, research by private actors is mostly carried out by private research institutes and a few large domestically owned companies (RI transformed from previous state research institutes) in the automotive and ICT sectors, as well as the R&D departments of a few multinationals.[86] However, the level of research is very low, with business R&D intensity at 0.48 % of GDP, among the lowest in the

[79] Center for World University Rankings: https://cwur.org/

[80] Comenius University, *Comenius University in 2018/2019*, https://uniba.sk/fileadmin/ruk/ovv/Ine/CU_in_numbers_and_graphs_2018-2019_EN.pdf

[81] Slovak Rector's Conference, Higher Education in the Slovak Republic 2019, P13

[82] https://www.upjs.sk/public/media/14634/list-of-publications-in-2018.pdf

[83] Technical University Košice, *Annual Report 2018*, ihttp://web.tuke.sk/tu/vyrocne_spravy/soc_tuke2018.pdf

[84] https://www.sav.sk/uploads/dokumentySAV/4_SAS-2021_analysis.pdf

[85] Claude Giorno, *Increasing The Benefits Of Slovakia's Integration In Global Value Chains*, OECD, 21 May 2019, P33.

[86] Vladimír Baláž, Karol Frank and Tauno Ojala, *RIO Country Report 2017: Slovak Republic*, 2017, p13.

EU.[87] The 2019 European Innovation Scoreboard revealed that in-house innovation by SMEs was just 42.7% of the EU average.[88] One of the reasons for this is a gap in financing. According to the European Commission, national R&D funding available to SMEs was the lowest among all EU countries in 2018, and this funding level has declined steadily since 2011.[89] As a consequence, business R&D expenditure in Slovakia appears too low to substantially boost innovation performance.

Businesses engage in research and innovation activities through the provisions of the commercial code, passed in 1991 and amended most recently in 2018.[90] In 2014, almost 4,500 people were employed as R&D personnel (FTE) in the private sector, this number rose to over 6,500 in 2018, the share of total R&D personnel (FTE), public and private, was 23% in 2014 and 32% in 2018, showing promising progress in terms of human resources.[91]

A breakdown by R&D personnel by NACE[92] code can be seen in Table 5. By excluding pure R&D personnel and education personnel from the table, an indication of private sector activities can be illustrated. The largest growth in the private sector in terms of number of researchers is in manufacturing of fabricated metal, rubber and plastic and ICT. The sharpest drops or smallest growth has been for mineral products, engineering and chemicals. These patterns are mirrored by figures on spending, with the exception of the second and third largest area of growth in spending and much of the bottom half of the table.

Table 5 - R&D by NACE Code

NACE Code	R&D personnel			GERD (in thousand EUR)		
	2014	2018	% change	2014	2018	% change
Crop and animal production	45	52	15.56%	625	671	*7.36%*
Manufacture of other non-metallic mineral products	99	56	*-43.43%*	1,572	2,104	33.84%
Manufacture of fabricated metal prod.	78	251	**221.79%**	2,051	12,533	**511.07%**
Manufacture of computer, electronic and optical products	209	401	91.87%	3,498	7,090	102.69%
Manufacture of food products	28	49	75.00%	877	1,740	98.40%
Manufacture of chemicals and chemical products	138	154	*11.59%*	2,958	3,506	*18.53%*
Manufacture of rubber and plastic prod.	154	391	**153.90%**	15,959	22,001	37.86%
Manufacture of electrical equipment	474	710	49.79%	17,327	48,214	**178.26%**

[87] European Commission, *European Semester Country Report Slovakia*, 2019, P37.

[88] European Innovation Scoreboard 2019. Accessed via https://ec.europa.eu/docsroom/documents/35910

[89] European Commission *Small Business Act for Europe (SBA) Factsheet*, p13. Accessed via https://ec.europa.eu/docsroom/documents/32581/attachments/25/translations/en/renditions/native

[90] acccace, *Amendment to the Commercial Code in Slovakia effective as of January 1, 2018,* News Flash, 30 Aug 2017, https://accace.com/amendment-to-the-commercial-code-in-slovakia-effective-as-of-january-1-2018-news-flash/

[91] Statistics Office of the Slovak Republic, *Yearbook of Science and Technology in the Slovak Republic*, November 2019, p12.

[92] The Statistical Classification of Economic Activities in the European Community, commonly referred to as NACE, is the industry standard classification system used in the European Union. The current version is revision 2 and was established by Regulation No 1893/2006

Manufacture of machinery and equipment n.e.c.	606	1,314	116.83%	15,160	38,446	**153.60%**
Manufacture of motor vehicles, trailers, semitrailers	739	1,264	71.04%	74,163	117,854	58.91%
Computer programming, consultancy and related activities	766	1,789	**133.55%**	31,193	52,692	68.92%
Architectural and engineering activities; technical testing and analysis	306	301	*-1.63%*	5,160	6,515	26.26%
Other	1866	2,977	59.54%	91,597	93,915	*2.53%*

Source: Slovstat Statistical Yearbook 2019

Private actors conducting research in Slovakia are still few in number, although some research-intensive companies, outlined during the interview process for this study, are featured in the boxes below.

EVPU

The company was founded in 1965 and transformed into a joint-stock company in 1994. It focuses on production, R&D, repair, maintenance and trading of electrical components for transport, mechatronic systems, current power supplies and defence systems.

Some recent projects include:

- Cardiac protection in situations of increased production of free oxygen radicals: radiation and reperfusion injury (Recipient: Institute for Heart Research, SAS)
- Research and development of zero waste technology for the decomposition and selection of undesirable components from process gas generated by the gasifier
- Research and development of highly efficient energy sources and technologies for transport systems using principles of Industry 4.0
- Research of high-efficiency components of electric propulsion systems for rail vehicles and public transport vehicles

Source: https://www.evpu.sk/

GA Drilling

GA Drilling is a hi-tech company developing a technology platform, PLASMABIT®, for milling and deep drilling. The aim of the company is to reduce the cost barrier for deep drilling and to make deep geothermal energy more accessible. The first test of the PLASMABIT® Milling application will be performed in real conditions of an onshore well in Hungary upon a service agreement with MOL Group. In March 2018, the company received direct venture capital funding from Slovak Investment Holding.[93]

Source: https://www.sih.sk/en/aktuality/slovak-investment-holding-invests-in-the-renowned-slovak-ga-drilling-company

[93] https://www.sih.sk/en/aktuality/slovak-investment-holding-invests-in-the-renowned-slovak-ga-drilling-company

MultiplexDX
MultiplexDX is a biotech company, created to bring revolutionary technologies to the market of personalised molecular diagnostics. The mission of MultiplexDX is to eliminate cancer misdiagnosis by creating reliable, 100% accurate, quantitative and affordable diagnostic tests. In December 2019 it became the first ever Slovak company to be awarded an EIC Accelerator by the European Innovation Council (EIC). It is located at the Comenius University Science Park in Bratislava.

Source: https://www.multiplexdx.com/

VUJE
Started in 1977, VUJE is a research company and market leader in the field of nuclear power, services for the support and operation of transmission and distribution systems, including electromagnetic field and fuel cycle research. It is a lead partner in the V4G4 Centre of Excellence, established in 2013 with three other partners from Hungary, the Czech Republic and Poland. The centre provides a forum for exchange of technical, scientific and other related information in the field of Generation 4 nuclear reactors in particular with fast neutron spectrum, especially for Gas Cooled Fast Reactors (GFR). Activities include conferences, training courses, seminars, workshops, studies, research and publications.

Source: https://www.vuje.sk/

2.3 Legal framework for RTDI

Chapter 2.3 provides an assessment of the legal framework for RTDI in Slovakia, including the legal basis for research funding, tax deductions for R&D and the protection of intellectual property.

2.3.1 Legal basis for research funding

Public funding for RTDI in Slovakia comes from both national and European sources. National funding is provided within the framework of the EU's General Block Exemption Regulation (GBER) on state aid[94]. Articles 25 to 30 of the GBER declare state aid for research, development and innovation compatible with the state aid rules of Articles 107 and 108 of the Treaty on the Functioning of the European Union (TFEU). The central piece of legislation for national RTDI funding is the Act 172/2005 on the organisation of state support for research and development and on the amendment of Act 575/2001[95]. The act lays down basic definitions and the main responsibilities of the government, notably the Ministry of Education and the Research and Development Agency, which was established with the adoption of the act. The act further defines the different forms of funding (so-called purpose funding for RTDI projects and institutional funding intended mainly for the Slovak Academy of Sciences and Slovak universities) as well as basic principles for the application process. The budget for funding is fixed in accordance with Act 523/2002 on budgetary rules of the public administration[96].

[94] COMMISSION REGULATION (EU) No 651/2014, Official Journal of the European Union, 17 June 2014 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.187.01.0001.01.ENG

[95] Slovak Regulation 172/2005, Collection of Laws of the Slovak Republic, https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2005/172/20200425

[96] Slovak Regulation 523/2004, Collection of Laws of the Slovak Republic https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2004/523/20200101

This general legislation is complemented by several more specific legal acts. The Act 185/2009 on the incentives for research and development[97] establishes financial incentives for businesses to carry out R&D activities. Businesses can apply for subsidies for basic research projects or applied research projects as well as for pursuing intellectual property protection. Applying for funding under this act follows a simpler procedure than applying for funding under the EU structural funds; however, the total amount of these R&D incentives is comparably low.[98]

In addition, the Slovak government has proposed sector-specific government resolutions targeting the automotive sector – Resolution 110/2019 on the Action Plan for the Development of Electromobility in Slovakia[99] and Resolution 195/2019 on Measures to Remove Barriers to Sustainable Development in the Automotive Industry in Slovakia, including Supply Chains[100]. These regulations include provisions on the support of research and innovation activities with the objective of strengthening the role of domestic innovation in the Slovak automotive sector. The government discussed the implementation of Resolution 195/2019 on 15 January 2020. It took note of the report of the implementation of the measures in which the Ministry of Economy of the Slovak Republic stated that 30 of the 39 tasks had been fulfilled. However, the ministry also reported that the implementation by the relevant ministries was not sufficient and in most cases only performed formally.[101] The Association of the Automotive Industry also criticised the implementation of the measures.[102] The first evaluation of the implementation of the Action Plan for the Development of Electromobility in Slovakia by the Ministry of Economy shows that measures that do not require legislative changes are being fulfilled.[103]

Another relevant piece of legislation is the Act 57/2018 on regional investment aid[104] and several complementary government regulations and decrees. The act has been in force since April 2018 and aims to reduce regional disparities in Slovakia and to promote investments. It therefore does not focus solely on research and innovation, but also on investments in general and defines several broad types of investments that are eligible for public support. These eligible investments, in particular the support of so-called technology centres, apply to industrial research activities.

[97] Slovak Regulation 185/2009, Collection of Laws of the Slovak Republic https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2009/185/vyhlasene_znenie.html

[98] Forthcoming Baláž, V., Frank, K., Ojala, T. (2020) *Innovation Country Report 2019: High growth enterprises, innovation and productivity challenges*, Slovak Republic.

[99] Ministry of Economy, Resolution on the draft Action Plan for the Development of Electromobility in the Slovak Republic https://rokovania.gov.sk/RVL/Resolution/17589/1

[100] Ministry of Economy, *Proposal of Measures for the Removal of Barriers to the Sustainable Development of the Automotive Industry in Slovakia,* 04/16/2019 https://rokovania.gov.sk/RVL/Material/23740/1

[101] "Information on the fulfilment of tasks arising from the Measures to Remove Barriers to Sustainable Development in the Automotive Industry in Slovakia, including Supply Chains", Government of the Slovak Republic, meeting 15/01/2020, rokovania.gov.sk [online], available at: https://rokovania.gov.sk / RVL / Negotiation / 1025, accessed on 04/08/2020.

[102] In its own evaluation, the Association of the Automotive Industry stated that, in fact, only 17 tasks had been completed. Source: "Ministries helped the automotive industry only formally, says the Ministry of Economy", SME 15.1.2020, sme.sk [online], available at: https://ekonomika.sme.sk/c/22302829/rezorty-dostatocne-nepomohli-automobiloveho- industry.html, accessed on 04/08/2020.

[103] "How is the Ministry of Economy of the Slovak Republic doing in the implementation of the Action Plan for the Development of Electromobility?", MôjElektomobil 04/10/2019, mojelektromobil.sk [online], available at: https://www.mojelektromobil.sk/plnenie-akcneho-planu-rozvoja- electromobility /, accessed 04/08/2020.

[104] Slovak Regulation 57/2018, Collection of Laws of the Slovak Republic, https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2018/57/20180401

The principal legal act governing the funding from European sources is Act 292/2014 on the contribution provided by the European Structural and Investment Funds[105]. It sets the legal requirements for granting support under the EU structural funds as well as the responsibilities of the Slovak government and other public authorities, such as government agencies. The deputy prime minister's office was established as the central coordination body for the EU structural funds and is responsible for ensuring the fulfilment of ex ante conditionalities. The office was transformed into the Ministry of Regional Investment Development and Informatization of the Slovak Republic in 2020. The aim of these changes was to centralise and concentrate the agenda of regional development and ESIF at one ministry in order to improve the coordination of regional development, to optimise the implementation structure of the ESIF management, and to strengthen the principles of transparency, efficiency, economy, effectiveness and orientation on results. The act lays out the basic principles and procedures that regulate the application for and management and monitoring of projects funded by the EU structural funds. The act applies to the funding period 2014-2020. A government bill for a follow-up act to set the framework for ESIF for the programming period 2021-2027 was introduced in June 2020.[106]

2.3.2 Tax deductions for R&D

In 2015, the Slovak government put in place tax deductions for R&D investments, enshrined in §30c of the Act 595/2003 on income tax[107]. The objective of the measure was to incentivise businesses to spend money on R&D activities and to thus boost corporate R&D expenditure, especially by SMEs. Some undertakings might refrain from investing in R&D because of the risk that the R&D results will also benefit competitors, who have not made such investments. The tax deductions give investing undertakings a direct return for their R&D investments.

Although the initial deductions set in 2015 were 25% of research related costs and 25% of labour costs of employees who are less than 26 years old, the deduction rate has been increased several times. The first increase was to 100% of all eligible R&D expenditure[108] and, in 2019, to 150% effective in 2019 and 200% effective in 2020[109]. The eligible costs are direct costs (e.g. wage costs, costs of material or overhead expenses) and indirect costs (e.g. depreciation of assets or utility costs).[110] This means that in 2020, businesses will be able to deduct twice as much as what they have spent, in line with the eligibility criteria, on R&D from their taxable income. The tax deductions cannot be combined with other R&D funding mechanisms (e.g. funding through the ESIF).[111]

According to a report by the Slovak Financial Administration, these R&D tax deductions were requested for a value of EUR 9.2 million (by 83 undertakings for 335 projects) in 2015, for a value of EUR 16.82 million (by 112 firms for 520 projects) in 2016, for a value of EUR 40.41 million (by 165

[105] Slovak Regulation 292/2014, Collection of Laws of the Slovak Republic, https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2014/292/20180501

[106] Aktualizácia rámcovej pozície SR k novým prvkom revidovaného návrhu viacročného finančného rámca 2021 – 2027, vrátane Nástroja EÚ pre budúce generácie. Available at: https://rokovania.gov.sk/RVL/Material/24969/1.

[107] Slovak Regulation 595/2003, Collection of Laws of the Slovak Republic, https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2003/595/20200401

[108] European Commission, *European Semester Country Report Slovakia*, 2019

[109] European Commission, *European Semester Country Report Slovakia*, 2020

[110] Deloitte, *2015 Global Survey of R&D Incentives*, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/Tax/us-tax-countrypage-slovakia.pdf

[111] Forthcoming Baláž, V., Frank, K., Ojala, T. (2020) *Innovation Country Report 2019: High growth enterprises, innovation and productivity challenges*, Slovak Republic.

firms for 875 projects) in 2017[112] and for a value of EUR 121 million (by 264 firms) in 2018[113]. The volume of tax deductions as well as the number of undertakings applying has thus been constantly increasing. In 2017, almost half of the tax deductions (49%) have been requested in the metal production sector by a single company (US Steel Košice) for a total number of 42 R&D projects. In 2018, while 83% of the beneficiaries were SMEs, 72% of the deductions were granted to large enterprises, with US Steel again being the largest individual beneficiary.[114]

Although the tax relief policy was aimed at SMEs in Slovakia, there is an absence of actual preferential tax incentives for SMEs in relation to larger firms; in 2018 the OECD noted that such incentives exist in countries such as Poland, Belgium, Croatia, Spain, France and many other countries.[115] This may explain why uptake has largely been lacking in SMEs in Slovakia. Major sectors where the tax deductions were requested were the automotive sector (10% of the total requested tax deductions), the electrical engineering sector (8%) and the ICT sector (7%).[116] Tax deductions accounted for 11% of all public support for corporate R&D expenditure in 2017, which shows that the relevance of these deductions is still low in comparison with other funding mechanisms.[117]

2.3.3 Intellectual property protection

Protection of intellectual property in Slovakia is governed mainly by the Act No. 435/2001 Coll. on patents, supplementary protection certificates and on amendment of other acts, adopted in 2001 and last amended in 2009.[118] The act defines the different intellectual property protection mechanisms (patents, trademarks, licensing), as well as the procedures for applying for a patent and for enforcing intellectual property rights.

In the International Property Rights Index (IPRI), Slovakia ranks 18th of all the EU Member States (and is ranked 38 globally).[119] In comparison with the Western Member States with strong protection regimes (such as the Netherlands, the Nordic States, Austria or Germany), protection of intellectual property in Slovakia can be considered underdeveloped. Within the group of Visegrad countries though, Slovakia's intellectual property system compares more favourably. While Czechia leads this group by far, Slovakia's score is above those of Hungary and Poland (Table 6).

Table 6: Intellectual Property Rights Index (IPRI) 2019 – total scores

Country	IPRI 2019
Czechia	7.029
Slovakia	6.386
Hungary	6.218
Poland	5.996

[112] Silvia Appelt, *OECD Review Of National R&D Tax Incentives And Estimates Of R&D Tax Subsidy Rates,* 2018 https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5c1e91ecb&appId=PPGMS

[113] Superodpočet na výskum a vývoj uplatnilo v roku 2018 podstatne viac subjektov, available at: https://www.smartech.sk/novinky/takto-ovplyvnilo-zvysenie-superodpoctu-na-100-rok-2018

[114] Superodpočet na výskum a vývoj uplatnilo v roku 2018 podstatne viac subjektov, available at: https://www.smartech.sk/novinky/takto-ovplyvnilo-zvysenie-superodpoctu-na-100-rok-2018

[115] Silvia Appelt, *OECD Review Of National R&D Tax Incentives And Estimates Of R&D Tax Subsidy Rates,* 2018 https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5c1e91ecb&appId=PPGMS

[116] Forthcoming Baláž, V., Frank, K., Ojala, T. (2020) *Innovation Country Report 2019: High growth enterprises, innovation and productivity challenges*, Slovak Republic.

[117] European Commission, *European Semester Country Report Slovakia*, 2019

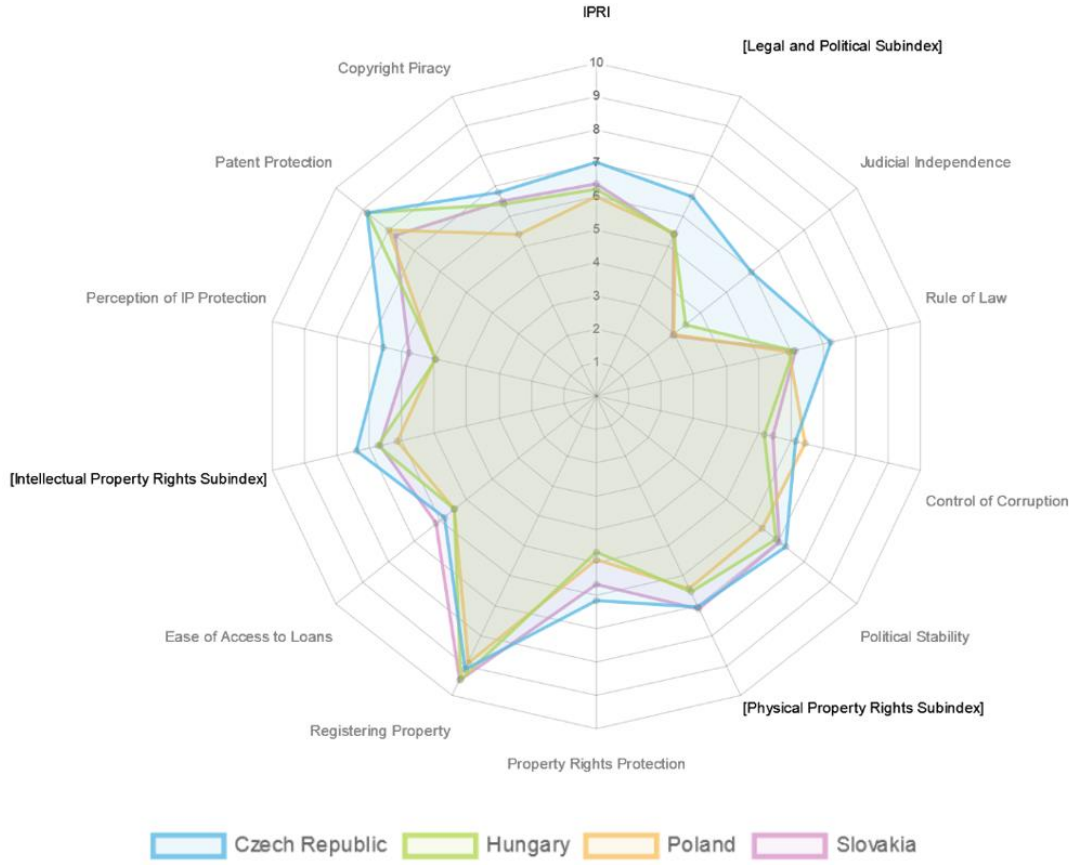
[118] Industrial Property Office of the Slovak Republic, *legislation in Force*, https://www.indprop.gov.sk/?legislation-in-force

[119] Property Rights Alliance, International Property Rights Index, 2019, https://internationalpropertyrightsindex.org/compare/country?id=23,20,12,5

Source: Property Rights Alliance, International Property Rights Index, 2019, https://internationalpropertyrightsindex.org/compare/country?id=23,20,12,5

Slovakia's intellectual property system scores particularly high when it comes to property registration procedures, meaning that the time and effort required to obtain an intellectual property in Slovakia is comparably low. On the other hand, Slovakia scores low in the legal and political environment sub-index, namely regarding the independence of the judiciary[120], the control of corruption and the enforcement of the rule of law[121] (Figure 6).

Figure 6: Intellectual Property Rights Index (IPRI) 2019 – Visegrad countries compared



Source: Property Rights Alliance, International Property Rights Index, 2019, https://internationalpropertyrightsindex.org/compare/country?id=23,20,12,5

Stakeholders interviewed for this report, notably representatives of the undertakings and revenue-oriented industrial research organisations, have stated that patents are not of high importance for their business models. The application procedure is generally not seen as a major issue; while some administrative steps are necessary it is altogether feasible for undertakings to obtain a patent. This statement from the interviews is in line with the IPRI indicators. However, the enforcement of intellectual property rights is more of a challenge. Especially at global level and in competition with multinational corporations, it requires high volume of resources and is often not successful. Instead, what counts more for businesses (according to interviewed stakeholders) is to perform cutting-edge

[120] The data source used for this indicator is the Global Competitive Index 4.0 2018 dataset, more specifically the response to the following survey question: 'In your country, how independent is the judicial system from influences of the government, individuals, or companies?' [1 = not independent at all; 7 = entirely independent]. Available at: http://reports.weforum.org/global-competitiveness-report-2018/.

[121] The data source used for these indicators are the respective indicators of the World Bank Worldwide Governance Indicators 2017. Available at: http://info.worldbank.org/governance/wgi/index.aspx#home.

R&D and be the first to bring the research results to the market. However, the overall improvable performance of the Slovak RTDI system (including the private sector, see also Section **Chyba! Nenašiel sa žiaden zdroj odkazov.**) indicates that this approach, although it may work for some companies, is not sufficient on a large scale for companies in Slovakia.

The academic sector faces, according to the Slovak Academy of Sciences (SAS), slightly different challenges related to patents. Fees required to register a patent can pose a problem for academic institutions and there is a lack of financial support. There is also a lack of experience with licensing, leading to cases where royalties do not cover the initial cost of obtaining intellectual property protection. Moreover, patents of state-owned institutions (such as the SAS) are owned by the state, which limits the institutions' courses of action (see also the following section).

2.3.4 Transformation of the Slovak Academy of Sciences

The Slovak Academy of Sciences is governed under the Act 133/2002[122] and has so far operated as a state-owned self-governing scientific institution. Under this statute, all the assets of the Slovak Academy of Sciences are owned by the state and only managed by the Academy. The Academy's options for owning the results of its research and holding patents are limited. The individual research institutes are formed by either a budgetary (e.g. SAS Institute of History) or a contributory (e.g. SAS Institute of Geotechnics) model, the key difference being that the contributory organisations can, under certain conditions, also receive commercialisation revenues. However, this system does still limit commercial activity, not least regarding the administrative process required to receive commercialisation revenues. This particularly complicates cooperation with businesses and private research institutions.

Since 2014, there have been plans to transform the Slovak Academy of Sciences by changing its legal structure to that of a public research institution.[123] This new statute would enable the Academy to own property (both physical and intellectual) and engage in commercial activities. The goal of this transformation is to give the Slovak Academy of Sciences more flexibility and more possibilities to broaden its activities and obtain public funding and income from other sources than directly from the state. Ultimately, the Slovak Academy of Sciences should become more competitive by having the same room for manoeuvre as similar scientific institutions in the other Member States.[124]

The legislation to put in place the new statute of public research institution was adopted in late 2017. However, due to a dispute between the Slovak Academy of Sciences and the Ministry of Education, the registration of the Academy under this new statute was not completed. While the Academy claimed that the ministry was stalling the registration process, the ministry stated that the Academy's application for registering as a public research institution was incomplete and as such it did not meet all the necessary conditions to complete the transformation. This was followed by legislation to amend the Act on the Slovak Academy of Sciences in late 2018. However, according to the Slovak Academy of Sciences this legal act does not enable the SAS to transform its statute.[125] The Supreme Audit Office has not found any major legislative obstacles to the transformation itself and recommends proceeding with the transformation according to the procedure regulated in §44 of the Act on Public Scientific Institutions, which would ensure a procedure equivalent to the transformation of other already existing state organisations conducting research. According to the

[122] Slovak Republic, *Act no. 133/2002*, Collection of Laws of Slovak Republic, https://www.zakonypreludi.sk/zz/2002-133

[123] Vladimir Balaz and Jana Zifciakova, *Rio Country Report: Slovak Republic*, JRC Science for Policy Report, 2015.

[124] *Academy of sciences is closer to transformation*, Slovak Spectator, 25. May 2017 https://spectator.sme.sk/c/20541494/the-academy-of-sciences-is-closer-to-transformation.html

[125] „Šajgalík: K transformácii Slovenskej akadémie vied dôjde, ak k tomu vláda pristúpi zodpovedne [The transformation of the Slovak Academy of Sciences will take place if the government approaches it responsibly]," webnoviny, 27.4.2020, webnoviny.sk [online], available at: https://www.webnoviny.sk/k-transformacii-sav-dojde-ak-sa-k-tomu-vlada-postavi-zodpovedne-tvrdi-predseda-sav/.

Supreme Audit Office, this would require including the SAS as a body that is entitled to proceed in accordance with this procedure.[126]

This analysis has not uncovered any evidence that the proposed transformation of the Slovak Academy of Sciences has any problems in terms of its content and so the current problem, which is in essence a legal and administrative one, must be resolved via ongoing discussions between the concerned parties and by taking the necessary steps to remove any formal obstacles.

2.3.5 Framework for higher education

The higher education system in Slovakia is governed by the Act 131/2002 on Higher Education Institutions[127] which sets the objectives of higher education institutions and regulates their establishment and functioning. The act makes a distinction between public higher education institutions, state higher education institutions (for police, military and health care) and private higher education institutions. It regulates the fields of study and the different possible study programmes (bachelor, master and PhD), the organisation of studies (including for instance admission and examinations), the status of students and university staff, and the financing of higher education institutions (including by state financing and tuition fees).

Higher education plays a key role in providing universities, research institutions and businesses with the necessary skills to conduct R&D and produce innovation. The quality of tertiary education in Slovakia is comparably low (among the lowest of all OECD countries).[128] Attempts to modernise the higher education landscape were hindered by an accreditation system that was criticised by the OECD for not being transparent and independent. For example, some of the members of the Accreditation Commission were themselves working at higher education institutions, which created potential conflicts of interest.[129]

The Slovak government has addressed these issues by adopting a reform of the accreditation system in the form of the Act 269/2018 on quality assurance in higher education[130]. The act has replaced the previous Slovak Accreditation Commission for Higher Education with a new body, the Slovak Accreditation Agency for Higher Education, which has more decision-making powers. The Accreditation Commission was an advisory body to the government that issued opinions to the Ministry of Education, which was making the final decisions based on these opinions. This authority to make decisions has been transferred to a new agency that was established in early 2019, and started operating in early 2020 as an independent public institution responsible for ensuring the quality of tertiary education in Slovakia.[131] To this end, the agency is authorised to issue standards for higher education study programmes, but also for internal quality assurance systems of universities (institutional accreditation), as well as for habilitation and inauguration procedures. Under specific circumstances, it also assesses the accreditation of newly established higher education institutions or study programmes. All Slovak higher education institutions are required to harmonise their study programmes and their internal quality assurance systems with the standards issued by the Accreditation Agency by 2022.[132]

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[126] Najvyšší kontrolný úrad Slovenskej republiky, Transformácia Slovenskej akadémie vie, 2018, available at: https://www.nku.gov.sk/documents/10157/fe31250c-c164-4392-b7d0-3b881ccfb6ff.

[127] Slovak Regulation, *131/2002*, Collection of Laws of the Slovak Republic, https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2002/131/20200425

[128] OECD, OECD Economic Surveys Slovak Republic, 2019, p6-7.

[129] OECD, OECD Economic Surveys Slovak Republic, 2019.

[130] Slovak Regulation, 269/2018, Collection of Laws of Slovak Republic, https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2018/269/vyhlasene_znenie.html

[131] Slovak Accreditation Agency for Higher Education, *About the Agency*, https://saavs.sk/o-agenture/

[132] Eurydice, *Quality Assurance in Higher Education: Slovak Republic*, 7 January, 2020 https://eacea.ec.europa.eu/national-policies/eurydice/content/quality-assurance-higher-education-63_en

The establishment of the agency also aims to harmonise the accreditation of tertiary education in Slovakia with European standards. The work of the agency is thus aligned with the European Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG), which were adopted in the context of the Bologna process. In addition, the agency is obliged by the Act 269/2018 to apply for membership of the European Association for Quality Assurance in Higher Education and the European Quality Assurance Register for Higher Education by the end of 2022.[133] As of March 2020 the agency had received more than 1,100 applications to be registered on its list of assessors overseeing the quality of HEIs in the country.[134]

A more detailed assessment of the higher education framework in Slovakia is currently being carried out by the OECD for the Institute for Strategies and Analyses of the Government Office of the Slovak Republic. The project, 'Improving the higher education system in the Slovak Republic', is funded by the Structural Reform Support Programme of the European Commission (DG REFORM), and it includes an analysis of the legal and regulatory framework for higher education and the development of policy options and an action plan to improve the higher education system. The results are expected to be published in 2021.

2.4 Financing and RTDI infrastructure

Chapter 2.4 provides an assessment of Slovak and international funding sources for RTDI. It will also address the availability and use of infrastructure for RTDI.

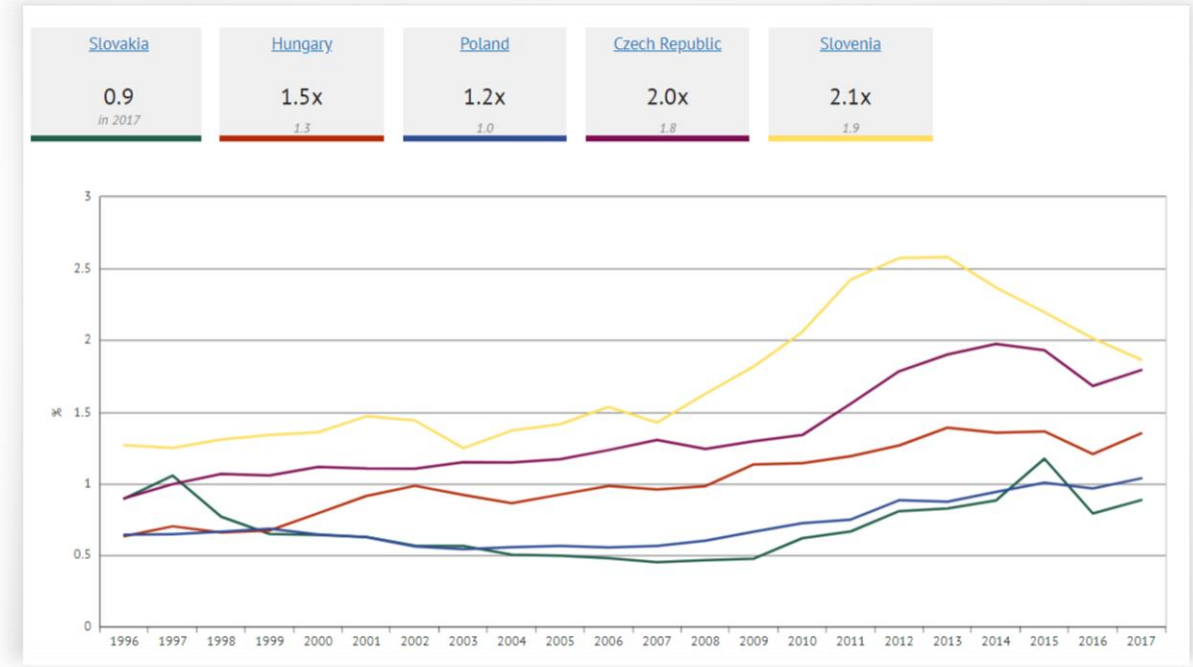
2.4.1 Funding of RTDI

Slovakia invests modestly in RTDI, compared with the EU-27 and the Visegrad countries and Slovenia. The figure below shows R&D expenditure as a share of GDP for the five countries and how spending has developed over the past two decades.

[133] Eurydice, *Quality Assurance in Higher Education: Slovak Republic*, 7 January, 2020 https://eacea.ec.europa.eu/national-policies/eurydice/content/quality-assurance-higher-education-63_en

[134] Slovak Accreditation Agency for Higher Education, *Announcement for applicants for the registration to the list of assessors of the Slovak Accreditation Agency for Higher Education*, 19 March 2020, https://saavs.sk/en/announcement-for-applicants-for-the-registration-to-the-list-of-assessors-of-the-slovak-accreditation-agency-for-higher-education/

Figure 7: R&D expenditure as a share of GDP (%) – Slovakia and comparators



Source: World Development Indicators (WDI)

Business expenditure on R&D (BERD) is also rather low compared to Visegrad countries and the EU-27. The table below provides BERD by NACE sector and euro per inhabitant.

Figure 8: BERD 2015-2018 by EUR per inhabitant

GEO/TIME	2015	2016	2017	2018
European Union - 27 countries (from 2020)	313,1	328,1	353,5	:
Czechia	101,3	106,2	122,2	118,3
Hungary	72,9	76,1	87,5	:
Poland	42,2	56,3	65,2	:
Slovakia	37,3	50,4	63,9	65,7

Source: Eurostat

Overall R&D expenditure data puts Slovakia's RTDI system in a wider context. Further data and statistics on Slovakian performance in RTDI is provided in Section 2.6.

2.4.1.1 Slovakia and European RTDI funding

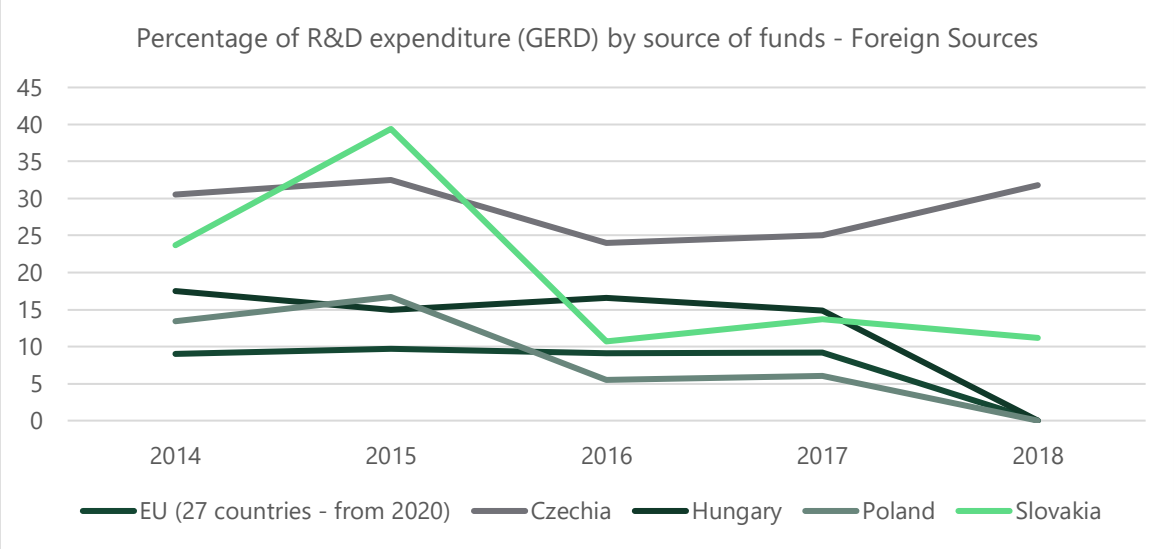
As a result of its modest national funding, international funding is an important aspect of Slovak RTDI funding overall. Indeed, Slovakia is one of the most dependent countries on European funds in the EU-27.[135]

As seen in Table 7, it is not necessarily problematic that Slovakia consistently relies more heavily on foreign funding than some of the other Visegrad countries. However, there is heavier reliance on ESIF funding, as signified by the large drop between 2015 and 2016.

[135] SWD(2019) 1024 final

By comparison, the other Visegrad countries do not have such prominent cyclical dips in their spending, indicating both smoother cycle management and less reliance on structural funds as a percentage of total foreign funding. The post-ESIF cycle drop for the Czech Republic was 13% of total GERD, for Hungary it was 12% and for Poland 4%, while for Slovakia a 32% drop between cycles was recorded.

Table 7: Percentage of R&D funding from foreign sources



Source: Eurostat

Like other modest innovators, Slovakia's participation in **Horizon 2020** is comparatively low. Slovakia ranks 24th out of 28 countries, both in terms of the number of participations and in terms of funding amounts. Slovakia's Horizon 2020 budget, which is just under EUR 103 million, only amounts to 0.22% of the overall Framework Programme budget. In comparison (not taking into account the total population or the percentage of researchers out of total population), Czechia's participation (in the EU net contributions) totals EUR 377.5 million, which equals 0.82% of the overall budget.

Slovakia's participation is clustered around the Bratislava region (55.5% of funding) and the Košice region (16%), which indicates that many Slovak regions lack sufficient competitiveness and networks for accessing Horizon 2020 funding (or that the high competition may disincentivise the development of proposals).

Table 8: Slovakia Horizon 2020 participation by NUTS3 region

Region (NUTS 3)	Participation	Net EU Contribution (EUR)
Banskobystrický kraj	21	2,334,498
Bratislavský kraj	360	56,229,204
Košický kraj	32	16,965,146
Nitriansky kraj	21	4,100,132
Prešovský kraj	15	1,341,783
Trenčiansky kraj	8	13,143,394
Trnavský kraj	24	2,733,131
Žilinský kraj	42	6,145,257
TOTAL	**523**	**102,992,544**

Source: ec.europa.eu

In terms of the type of organisations that benefit from the EU funding, Slovak participating organisations are dominated by private commercial organisations (42.9%) and higher education institutions (36%), with research organisations representing a smaller share (12.2%). Along with the Slovak universities, SAS is a major participant in European research programmes, both in projects which carry out R&I, as well as in ERA-Nets, which also play important roles in coordinating research and innovation efforts.[136]

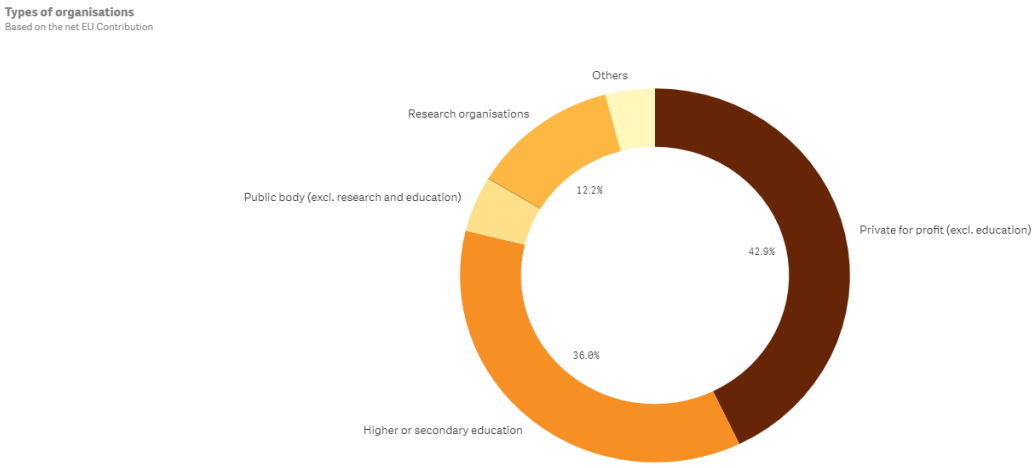
Looking more closely at HEIs, there is some correlation between international rankings and receipt of Horizon 2020 funds, as shown in Table 9 below. However, Pavol Jozef Šafárik University receives far less Horizon 2020 funding, despite being ranked no2 for research in Slovakia. The Slovak University of Agriculture in Nitra is further down, but it is a more specialised institution and so has a smaller pool of total Horizon 2020 calls from which to draw.

Table 9: Highest Ranked HEIs compared to receipt of H2020 Funding

Institution	H2020 net contribution (EUR)	Rank in H2020	Rank for Research in Slovakia (CWU)[137]
Comenius University in Bratislava	6.96 million	2	1
Pavol Jozef Šafárik University in Košice (global rank for research	1.63 million	11	2
Slovak University of Technology in Bratislava	4.54 million	3	3
Technical University of Košice	2.76 million	4	4

Source: European Commission https://ec.europa.eu/research/horizon2020/index.cfm?pg=country-profiles-detail&ctry=Slovakia

Figure 9: Horizon 2020 Slovakia participating organisations



Source: https://ec.europa.eu/research/horizon2020/index.cfm?pg=country-profiles-detail&ctry=Slovakia

The comparatively high level of participation of the private commercial organisations in Slovakia distinguishes the country from neighbouring Czechia, where HEIs acquire 45.2% of funding, in contrast to 29.6% for the commercial sector. Slovakia is more aligned with the situation in Poland

[136] UK Science & Innovation Network Country Snapshot: Slovak Republic. See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/906721/Country_Snapshot_final.pdf

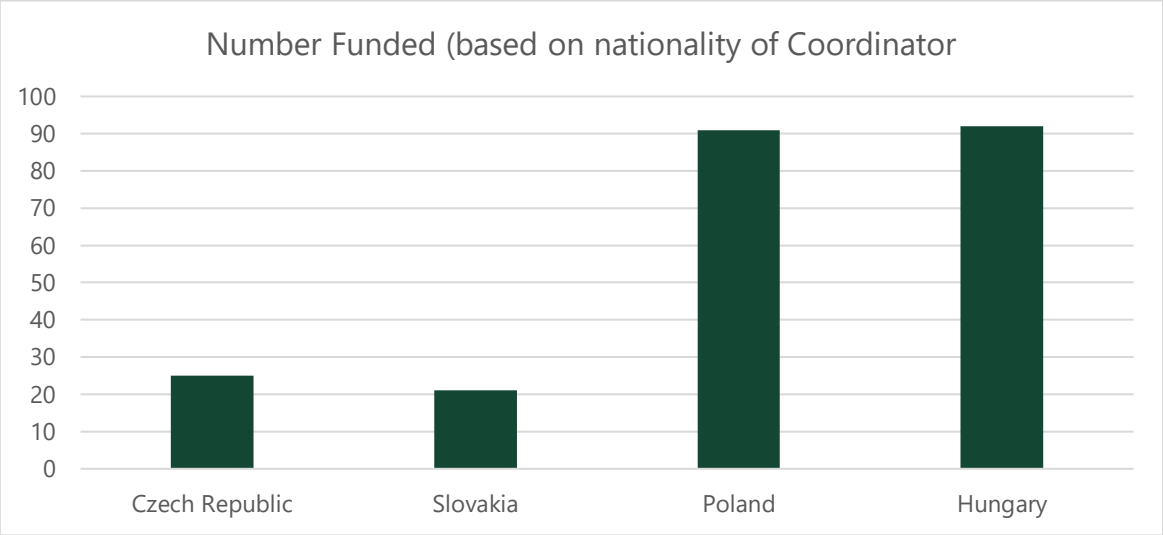
[137] https://cwur.org/

and Hungary. Both countries have a higher share of commercial organisations vis-à-vis the HEI sector.[138] As outlined in the 2015 monitoring report, Slovakia was the only country in the EU-13 with a top 50 private commercial company in terms of Horizon 2020 performance.[139]

More recently, since the establishment of the European Innovation Council (EIC) in 2017[140], Slovakian commercial organisations have also been successful in securing highly competitive SME instrument support in the form of EIC Accelerator grant. MultiplexDX, a Slovakian biotech company, was the first Slovak company to be awarded such support (December 2019), worth EUR 2.5 million (excluding EUR 500,000 co-funding contributions from the awardee).[141]

As Table 10 shows, Slovakia has the smallest number of grants. Bearing in mind the limited national funding offered to SMEs in Slovakia, when compared to other Visegrad countries, there is potential for substantial growth.

Table 10: EIC Accelerator Grants in Visegrad countries



Source: European Commission, EIC Accelerator data hub, https://sme.easme-web.eu/#

Interviews with stakeholders who support innovation-focused SMEs in Slovakia have emphasised the importance of these kinds of grants – in terms of the size of the projects, international prestige, and the need to support high-tech SMEs, also in the areas outside of manufacturing – and they wish to see more of a top-down approach towards SMEs in order to encourage a positive development.

There is relatively strong participation by the commercial organisations, and by internationally competitive HEIs. Although there are exceptions such the National Agriculture and Food Centre[142], in general Slovakia's research organisations, especially its research institutes, have participated less in the international collaboration projects. However, their smaller size relative to the HE sector should be taken into account.

[138] European Commission, *Horizon 2020 Key Figures*, https://webgate.ec.europa.eu/dashboard/extensions/CountryProfile/CountryProfile.html?

[139] European Commission, *Horizon 2020 Annual Monitoring Report 2015*, https://ec.europa.eu/research/evaluations/pdf/archive/h2020_monitoring_reports/second_h2020_annual_monitoring_report.pdf#view=fit&pagemode=none

[140] For a more detailed summary of the EIC please see: https://ec.europa.eu/research/eic/pdf/ec_eic_qa_032019.pdf

[141] MuiltiplexDX, *MultiplexDX Became a Proud Holder of the EIC Accelerator*, News, December 12, 2019 https://www.multiplexdx.com/post/multiplexdx-became-a-proud-holder-of-the-eic-accelerator

[142] http://www.nppc.sk/

A 2018 paper by Shearman and Zendulková points out the lack of research institute participation in the international grant schemes generally and Horizon 2020 specifically. According to this paper, analyses of Slovakia's participation in Horizon 2020 projects suggest that Slovak RIs have a particularly low success rate in the Horizon 2020 projects. The authors of this paper suggest two approaches to tackling this issue:

- Increasing the quality of grant applications of those RIs which have already proposed and been awarded international research grants by providing these organisations with specific support. Support could cover international project management training, proposal development, networking and partner support.
- Building the capacity of the RIs to apply for international EU grants and funding schemes (with Horizon Europe in mind). This could be achieved by thorough statistical, as well as bibliometric analyses performed using national and international information infrastructures on research and research-related data.[143]

Slovakia is one of the countries with the lowest rates of overall scientific co-publications per million inhabitants.[144] This suggests that the country is not actively participating in and benefiting from the international scientific knowledge flows favoured by the construction of the European Research Area. As may be expected due to their geographical and historical ties, Czechia is one of its main scientific partners.

However, **ESIF**, and previously the Structural Funds, have been playing such an important role in Slovakia, as regards to the construction of a new scientific base and infrastructure, that the role of the FPs is marginal in comparison.

As quoted from the forthcoming RIO report, "*the ESIF schemes account for the highest financial resources for research and innovation (R&I). The Priority Axes (PA) 1 and 2 of the Operational Programme Research and Innovation (OP R&I) support industry R&D centres, and long-term strategic research with EUR 1733.0m in period 2014-2023. These schemes coped with mismanagement and long delays in implementation. The OP R&I PA3 and PA4 (EUR 401.0m) mostly support simple technology transfers, product and process innovations by SMEs, and national projects for business environment. These schemes run well and are met with significant interest by potential applicants*."[145]

The majority of RTDI supported is funded via the European Regional Development Fund (ERDF), though smaller amounts of money – EUR 56.7 million out of EUR 2,410m – comes from the European Agricultural Fund for Rural Development (EAFRD).[146]

The graph below illustrates the current situation in terms of absorption of ESIF funding for RTDI (R&I), as compared to other themes.

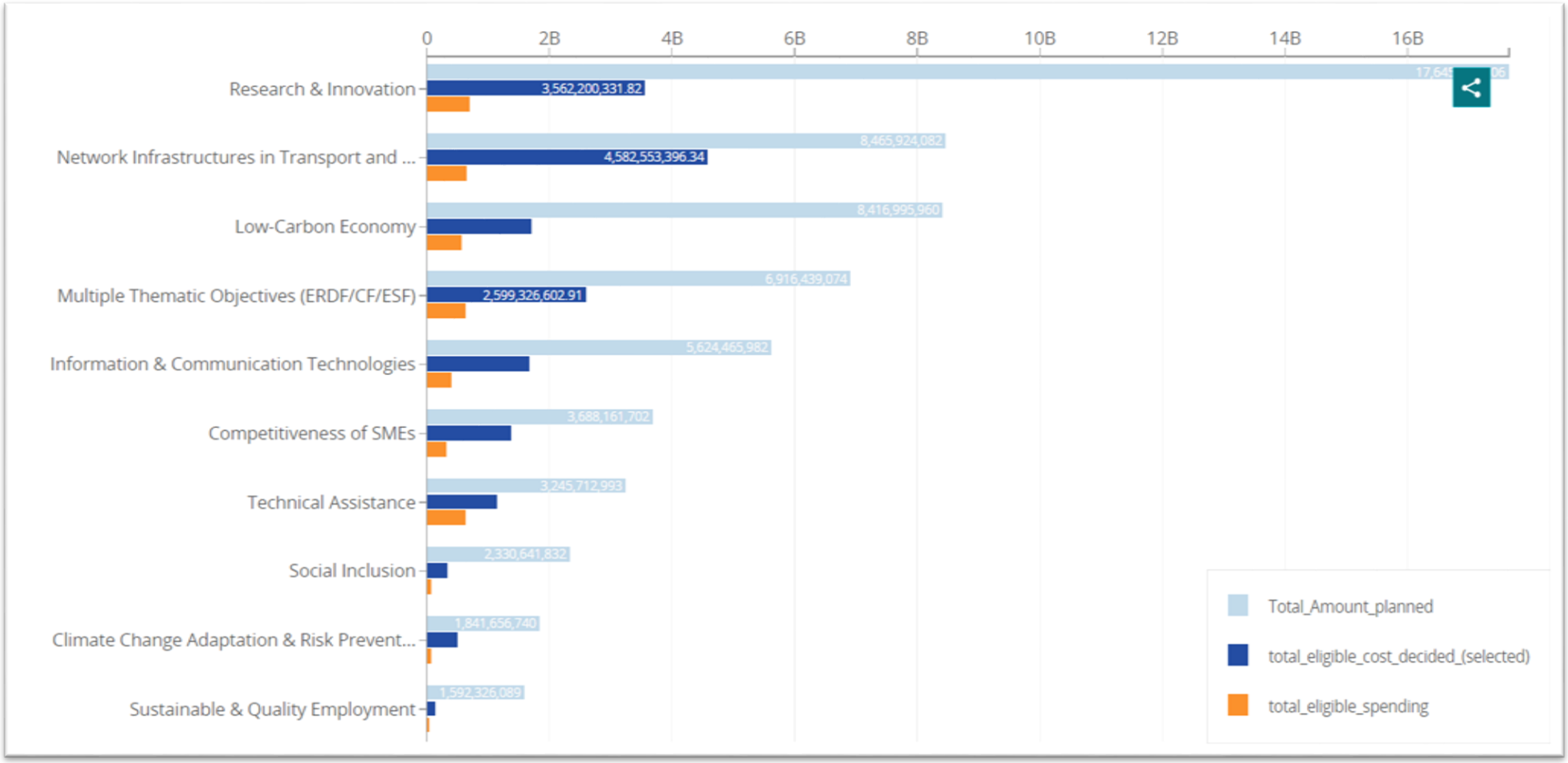
[143] Shearman and Zendulková (2018) *Use of National and International Research Infrastructures in Evaluation of International Project Award Potential of Slovak Research Institutions*, Slovak Centre of Scientific and Technical Information.

[144] European Commission, European Innovation Scoreboard 2019, https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en

[145] Forthcoming Baláž, V., Frank, K., Ojala, T. (2020) Innovation Country Report 2019: High growth enterprises, innovation and productivity challenges, Slovak Republic.

[146] European Commission, *Cohesion Data*, https://cohesiondata.ec.europa.eu/countries/SK

Figure 10: ESIF 2014-20 Implementation (total costs) by Thematic Objective ERDF – Slovakia (2014-19)



Source: Cohesion data accessed via https://cohesiondata.ec.europa.eu/countries/SK

As the above figure shows, of the available funds (EUR 17,645,081,106 for RDI), only EUR 3,562,200,332 has been allocated. Also noteworthy is that other potential innovation support (e.g. Competitiveness of SMEs) lags behind too, with regards to granting and allocating funding.

The 2019 EU Semester Report for the Slovak Republic summarises some of the frustrations around the delays and cancellations, concluding that *"the cancellation of various calls and administrative inefficiencies again resulted in the de-commitment of EUR 81 million funds (in 2018) from the Operational Programme Research and Innovation. This was despite efforts to enhance the transparency of the project evaluation process by engaging foreign experts, improving selection criteria and enhancing alignment with the Smart Specialisation Strategy."* [147]

Another important aspect is Slovakia's very low level of implementation with regards to the Technical Assistance (TA) allocation available as part of the latest programming period. By 2018, Slovakia had spent just 4% of the overall budget. This TA is intended for upgrading organisational structures, human resources development (e.g. salary top-ups or bonuses to retain staff) and the implementation of systems and tools for the better dispersion of the funds.[148] This TA budget would seem to be invaluable for Slovakia, considering the challenges outlined.

The Semester Report also points out that essential RTDI-related projects to increase capacities, promote technology and knowledge, enhance cooperation, mobilise private investment and support long-term strategic research have been launched only as of the end of 2018. [149]

Given the reliance of Slovak RTDI on Structural Funds investment, the face-to-face discussions with stakeholders focused on ESIF funds, and in particular the knock-on effects stemming from the lack of distribution of funding for the current programme period.

Those interviewed[150] highlighted a number of barriers that factored into this significant delay. These could be viewed as organisational, administrative and behavioural barriers.

Organisational barriers

There is a general consensus that the planning and preparation stage of the current programme period was effectively coordinated by the SGCSTI and by the Permanent Committee for RIS3. Indeed, the current RIS3 document was prepared in a timely manner and to a high standard.

However, the implementation has been problematic with the stakeholder consultations pointing to several organisational barriers. These appeared to stem from a lack of coordination between responsible ministries and dedicated agencies, as well as from a lack of transparent and consistent division of responsibility between the ministries and agencies for implementation. The lack of coordination itself can be seen as a result of managerial failures, inappropriate processes and the low quality of human resources.

The study team also understands that some calls for proposals were initially launched, but subsequently cancelled, since they did not conform to the ex ante conditionalities. The compliance with ex ante conditionality is the responsibility of the deputy prime minister's office (as named before July 2020, now Ministry for Regional Development and Investment), as outlined in the Act 292/2014. The English summary of the Interim Evaluation of Operational Programme Research and Innovation (2014-2020) mentions "several calls for proposals which caused an a-few-months delay in the programme implementation".[151] According to our interviews these calls included calls for proposals for clusters and other calls involving cooperation among different stakeholders since these calls were more time consuming (more complex to agree on) to finalise for publication.

Administrative barriers

Research performers, both private and public, pointed to the fact that the administrative requirements changed between the last (2007-2013) programme period and the current one. One public servant interviewed explained that in the past period, the administrative burden of much of the application process lay with the applicants, and that this burden has in

[147] SWD(2019) 1024 final

[148] John Bachtler, Martin Ferry and Fabian Gal, *Financial Implementation of European Structural and Investment Funds*, European Parliament, 2018, https://www.europarl.europa.eu/RegData/etudes/STUD/2018/621785/IPOL_STU(2018)621785_EN.pdf p65.

[149] SWD(2019) 1024 final

[150] A complete list of stakeholders can be found in Annex 2.

[151] Interim evaluation of Operational programme Research and Innovation (2014-2020) English Summary

theory been transferred to the managing authorities in the current 2014-2020 period. However, in practice, this planned simplification appears to have been ineffective. One sticking point was reported to be that all applicants must register as part of the proposal process, which entails submitting financial documentation covering the applicant organisation, which is said to be excessive.

The Slovak Public Procurement Office's involvement in the application process also adds additional time to the process.

The study team also understands that an additional bottleneck for deciding on funding to be awarded in response to the calls is due to the lack of (suitable) evaluators to assess the applications. This issue relates chiefly to national funding and was highlighted during interviews. The lack of suitable evaluators stems from the fact that only Slovak evaluators are used to evaluate applications and not international evaluators. Since the pool of Slovaks with relevant expertise in certain research topics is quite small, there are often issues with potential bias or vested interest, which affects the validity of the evaluation or slows down the evaluation process. Efforts should therefore be made to internationalise the project evaluation process.

Behavioural barriers

The stakeholder consultations showed a general lack of trust between stakeholders. This lack of trust appeared to go deeper than a 'public-private' sector divide.

The interviews also found a lack of process transparency. For example, stakeholders from the civil service, as well as from research-performing organisations, expressed disappointment that their input into RTDI governing and the decision-making processes was not taken into account in a transparent manner.

As a result of the political difficulties in implementation, one interviewee pointed out that the number of applications in a response to calls was "much lower" than in the previous programme period, i.e. ESIF calls for proposals have attracted fewer proposals. There seem to be three factors behind this:

1. Better access to alternative financing compared to the previous programme period.
2. The suffering reputation of the ESIF as a result of the severe delays in implementation and the media coverage following these events.
3. The centralised system of applications processing had proven slower than the previous set up and deterred applicants from submitting proposals, in particular for innovation support, where speed is essential to be competitive.

The current situation shows a number of knock-on effects resulting from the delay in implementation. Although efforts have been made to streamline the way in which the ministries (and their respective agencies) handle applications in order to speed up the calls for proposals cycle, funding is trickling very slowly. Research performers are waiting for months and even years to hear about the outcome of their proposals. Given that many institutions – in particular research institutes – are heavily reliant on competitive funding, this situation is making it difficult for them to operate effectively and might stop them from (e.g.) hiring research staff or expanding in new directions.

The problems experienced during the current programme period are also a cause for concern given the co-funding requirements that will be in place for Horizon Europe. Interviewees expressed the need to refrain from repeating the current problems for the 2020-2027 RTD programme, as this would risk severely hampering Slovak participation in European RTDI collaborations.

The Seal of Excellence – the ability to fund high-quality but ultimately unsuccessful Horizon 2020 projects through ESIF funds – was considered to be a very important instrument. To date in Slovakia, the Seal of Excellence principle has been applied and has successfully supported several SME instrument awards and Teaming awards.

However, according to a journal report and interview feedback, it was suggested that Slovakia lacked sufficient operational and practical synergies between Horizon 2020 and ESIF, since there was a mismatch in timing between the implementation of the Seal of Excellence initiative and the finalisation of the OPs for the current period. [152]. If this situation is confirmed by other literature and stakeholders, there will be a need to improve synergies in Horizon Europe. Given that the design of OPs under the new programme will be able to better take into account the Seal, however, the current situation may be short-term one, according to an interview with the Managing Authority consulted as part of the research.

The **EEA and Norway Grants** also provide opportunities for collaborative bottom-up innovation projects, also involving SMEs. Specific areas for support cover projects that aim to increase the

[152] Jan Petter Myklebust, *H2020 failing to ease Europe's research funding divide,* 17 February 2018, University World News, https://www.universityworldnews.com/post.php?story=20180217050748749

competitiveness of Slovak enterprises (EUR 20 million 2014-2021) and which aim to support social and economic development through culture (EUR 17.5 million). The funding is allocated through calls for proposals which have specific eligibility criteria.[153]

ESIF and Horizon 2020 constitute the major European grant programmes. In terms of innovation funding support in the form of loans, the **European Investment Bank Group (EIB Group**), comprising the EIB and its subsidiary, the European Investment Fund (EIF), is playing an increasingly important role as source of funds in Slovakia. The Group provided EUR 631 million in loans, guarantees and equity in Slovakia in 2018. This represents a substantial increase of 93% on 2017.

The majority of this funding related to competitiveness and innovation, since it was financed under the Investment Plan for Europe (Juncker Plan) and guaranteed by the European Fund for Strategic Investments (EFSI).[154]

In addition to the European Investment Fund, Slovak Investment Holding is also a key player for financing strategic sectors relevant to the RTDI landscape. Established under the name SZRB Asset Management on 1 May, 2014 and renamed 'Slovak Investment Holding' in 2018, the organisation is responsible for implementing financial instruments from the European structural and investment funds in the 2014-2020 programming period via the National Development Fund II. There have been substantial increases in funds being disbursed through the NDF II in the OP R&I (now OP II) from EUR 84.4 million to EUR 154.8 million in 2017 and EUR 249 million in 2018. [155]

The mandate of the Company with regards to research and innovation is:

> *"To support economically viable projects that are expected to return funds or save costs and which should contribute to economic growth and job creation. At the same time, financial instruments will be used to support the increase of SME competitiveness, to ensure access to financial resources for SMEs in Slovakia and to increase investment in SME support, especially in the field of technological development and innovation. The financial instruments will support new and start-up SMEs in the early stages of market entry, with a focus on supporting industry and services, including knowledge-intensive services (CIS) and new progressive sectors, as well as supporting the development of existing SMEs with an emphasis on increasing the competitiveness of their products."*[156]

A 2016 European Commission assessment of the previous formation of the company (SZRB Asset Management) found market failures or suboptimal investment situations in each of the areas investigated. To remedy these, it proposed six thematic funds, under a 'fund of funds' structure.[157] This was implemented in the 2018 transformation, albeit with four thematic funds not six. While it is too early to provide a full assessment of the effectiveness of this transformation, early indications are encouraging. In 2019 the company won a European award for its venture capital financial instrument for innovative small and medium sized enterprises, specifically for investments in GA Drilling, Boataround and GreenWay, indicating that the newly organised Slovak Investment Holding is becoming well regarded at the European level.[158]

[153] https://eeagrants.org/apply-for-funding

[154] Emerging Europe, *EIB support for Slovakia doubles in 2018*, February 1, 2019, https://emerging-europe.com/news/eib-support-for-slovakia-doubles-in-2018/

[155] Slovak Investment Holding, *Annual Report 2018,* https://www.sih.sk/data/files/vs_sih_web_ang_ok-326.pdf

[156] Slovak Investment Holding, *Allocations with Regards to Operational Programme Research and Innovation*, https://www.sih.sk/en/stranky/operacny-program-vyskum-a-inovacie

[157] European Commission, Ex-ante assessment for financial instruments in Slovakia, European Investment Bank, 2016, https://www.fi-compass.eu/sites/default/files/publications/case-study_esf01d_slovakia.pdf

[158] Slovak Investment Holding, *Investments from the Slovak Investment Holding received a European award!,* 11 December 2019, https://www.sih.sk/en/aktuality/investicie-zo-slovak-investment-holding-vyhrali-celoeuropsku-sutaz

Although Slovakia's major international/European funding streams stem from the four above-mentioned sources, there are of course other mechanisms and programmes for international cooperation.

The **EEA and Norway Grants** programme, of which the Business Development, Innovation and SME Fund (most relevant for this study) is implemented by the Research Agency. It is providing EUR 20 million over the 2014-2021 period. The programme takes a bottom-up approach to address identified needs and challenges of the business sector. It supports projects led by Slovak enterprises and funding is awarded through open calls for proposals. Funding is generally focused on support for businesses to develop, apply or commercialise green, welfare and ambient assisted living technologies, processes, solutions, products or services. Grants also support exchange of students and staff, and in this regard Slovakia has lagged behind other beneficiaries. In 2016-2017, for example, Slovakia placed 45 researchers and students in participating countries, while Poland placed 944, Hungary placed 136 and the Czech Republic placed 241.[159] Grants can also be awarded to support the education and employment potential in Slovakia in the sectors of green industry innovation and welfare and ambient assisted living technologies.[160] The drafting and signing of the six programme agreements, which plan how the funds are to be disbursed, were delayed in Slovakia; including Business Development, Innovation and SMEs. This particular programme was delayed due to national legislation and obligations resulting from the Slovak state aid rules and was only signed in August 2019.[161]

A recent rapid evidence assessment study suggests that one impact of the innovation programme in Slovakia to date has been the creation of 80 jobs in the green innovation sector.[162]

A fourth forum for cooperation is the **COST Network** (European Cooperation in Science and Technology). COST Actions do not fund research and innovation projects per se, but do support travel and workshop activities, thereby providing opportunities. The budget for COST activities, which can include meetings, conferences, workshops, short-term scientific missions, training schools, publications and dissemination activities, comes for the pooling of participating countries' resources.

Slovakian participants' total budget was EUR 320,828 in 2018, hence the amount of funding involved is rather small.

Slovakia's participation in 2018 vis-à-vis other member countries is shown in the below figure.

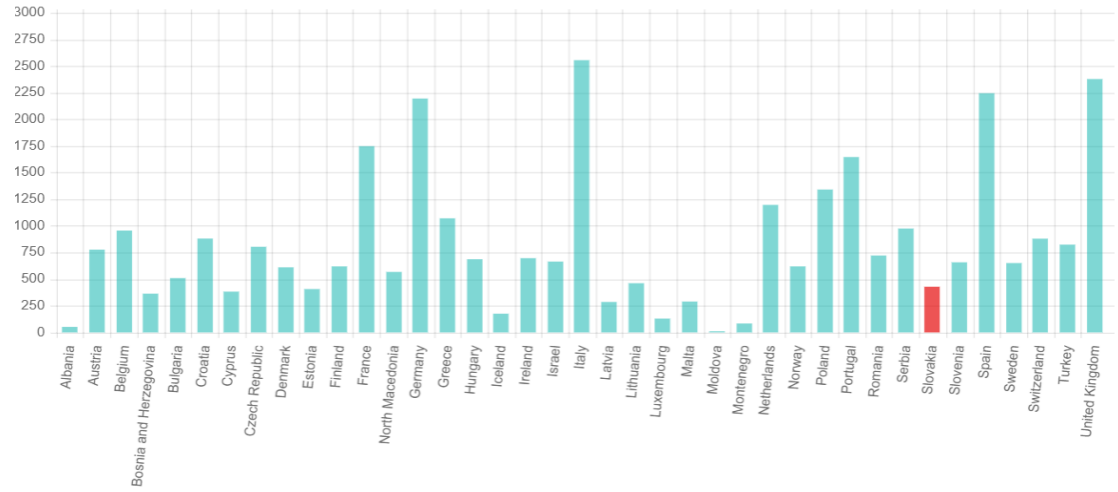
[159] Iceland, Liechtenstein and Norway Grants, Working Together For A Better Europe: Annual Report 2016/2017, 2017, https://eeagrants.org/sites/default/files/resources/EEA%20and%20Norway%20Grants%20annual%20report%202016-2017.pdf p75.

[160] Iceland, Liechtenstein and Norway Grants, *Programme agreement signed for the Business Development, Innovation and SMEs programme in Slovakia*, News, 16.12.2019, https://eeagrants.org/news/programme-agreement-signed-business-development-innovation-and-smes-programme-slovakia

[161] Iceland, Liechtenstein and Norway Grants, *Programme Agreement between Norway and Slovak Republic*, 2019, , https://eeagrants.org/sites/default/files/resources/Programme%20agreement%20SK-INNOVATION.pdf p7

[162] Rampton and Bosch Chen, *New Technologies supported by the EEA and Norway Grants 2009-2014*, 2019.

Figure 11: Individual participation in all COST Action activities 2018



Source: COST.eu

Albeit a marginal funding source, Slovakia's overall participation has been increasing steadily. In 2014, Slovakia participated in 51% of actions, and in 2018 in 62% of actions.[163]

Box 1: Financial guarantee schemes

Beyond supporting Slovak SMEs to participate in European innovation programmes, other avenues to encourage innovative SMEs are through loan guarantee schemes (often called partial credit guarantee schemes). Currently, governments in more than 100 countries participate in such schemes. In 2016, an EC study found that 25 guarantee schemes to support lending to SMEs were active in the nine European regions studied between 2007 and 2013, and more than 120 across the EU.

The idea behind loan guarantee schemes as an instrument to promote SME lending implicitly assumes that there is a market failure in the provision of debt finance to SMEs, and that by altering the risk-return payoff for private banks, private banks will increase their willingness to lend to informationally opaque and/or asset poor SMEs, as long as they have viable funding proposals.

However, the design of such schemes varies considerably across Europe. A study by Swedish Agency for Growth Policy Analysis[164] compared schemes across a range of European countries, including Slovakia, in order to assess the effectiveness and efficiency of different designs. The study found that there is considerable variation in the size of the scheme administrative team across countries. While the median administrative team in Europe is 21 people, with considerably smaller teams in Switzerland, UK, and the Netherlands, there are very large teams in Slovakia and France. As the administrative costs represent a cost that must be netted out of any formal economic cost benefit analysis, it follows that in countries with large administrative costs, it becomes more difficult for schemes to generate positive economic benefits.

[163] COST, *Country Fact Sheet: Slovakia*, 2018, https://cost.eu/wp-content/uploads/2019/09/COST_CountryFactSheets_3_HR_Slovakia.pdf

[164] Swedish Agency for Growth Policy Analysis (2017) *Loan Guarantee Schemes as a policy instrument for financing entrepreneurial businesses*

Figure 12: Financial guarantee schemes administrative staff

Source: Swedish Agency for Growth Policy Analysis

As far as the study team understands, the key guarantee schemes currently in operation in Slovakia have been established through the EIF and Československá obchodná banka a.s. (ČSOB). Those organisations signed the first two SME guarantee agreements in Slovakia under the European Fund for Strategic Investments (EFSI) in 2016. Under the first deal, a COSME guarantee will allow ČSOB to provide EUR 100 million of loans to more than 5,800 small enterprises in Slovakia over the next three years. Many of these small SMEs and micro enterprises currently have limited access to finance.[165]

2.4.1.2 National RTDI funding

National funding for RTDI in Slovakia is allocated or sought through a number of public bodies. The below table provides an overview of the most significant sources for research performers.

Table 11: Overview of national RTDI funding – main sources

Project/Call-based funding				
Agency	Description			
Slovak Research and Development agency SRDA[166]	General Call, maximum EUR 250,000 per project 1 call per year.	Bilateral Challenges EUR 5,300 per project. EUR 80,000 budget in total per call, multiple calls per year.	Bilateral Research Challenges 1-2 calls per year. Between EUR 120,000-250,000 per project depending on call. Total call budget between EUR 400,000-800,000	Multilateral challenges Between EUR 10,000-15,000 per project, depending on the number of countries involved. Total call budget in 2019 was EUR 150,000

[165] European Investment Fund, *Investment Plan for Europe: First EFSI deals in Slovakia as EIF and ČSOB agree EUR 135 million support for Slovak SMEs*, News, 26 September, 2016, https://www.eif.org/what_we_do/guarantees/news/2016/efsi_innovfin_cosme_csob.htm

[166] Slovak Research and Development Agency, *Statute of the Slovak Research and Development Agency*, 2005, https://www.apvv.sk/agentura.html?lang=en

Project/Call-based funding	
Agency	Description
Scientific Grants Agency VEGA	In 2018 VEGA funded projects to the total value of EUR 50,145,077 with an average of EUR 52,180 per project. [167] This consisted of 5,261 projects from HEIs and 921 from the SAS.
Cultural Grant Agency KEGA	In 2019 KEGA committed a total of EUR 3,900,000 for 506 projects, which ranged in value from EUR 2964 to EUR 713, 012.[168]
Slovak Business Agency	PROJEKT KET4CLEANPRODUCTION provides micro-grants of EUR 50,000 to SMEs focussed on clean production. In 2018, five technology queries were submitted from companies to obtain a financial micro-grant.[169]

The RTDI sector in Slovakia has great potential but suffers from long-term underfunding, dating back decades. Analyses from the OECD, EC and other authoritative literature[170] have recommended that Slovakia increase public R&D expenditure to 1.2% by 2020[171].

Partial progress has been made with regards to HEI funding. Since 2015, Slovakia has been consistently increasing funding for public HEIs. However, most recent increases (2019) have been negated by inflation, and the increased funds were used mainly to increase salaries. Consequently, operational costs are more or less constant. As a result, Slovakia is still looking to catch up to pre-2008 crisis levels. The need to recover from the more recent COVID-19 crisis, which is only partially within the power of Slovak authorities and stakeholders, given Slovakia's dependency also on the recovery of neighbouring economies (as discussed in Chapter 1), is another challenge.

Competitive RTDI funding is supported through several different direct and indirect instruments and by several agencies:

The Slovak Research and Development Agency (SRDA) is the most important research funder for basic and applied research and development. The SRDA has seen its budget increase from EUR 0.15m in 2001 to EUR 39.5m in 2018 for support of project financing[172]. The agency supports research performing organisations, including government research institutes, universities, private enterprises and non-profit organisations though the following instruments:

- Open calls for basic and applied research projects
- Specific calls on selected topics
- Support to Slovak researchers and organisations in European, international and bilateral programmes.

University researchers and the Slovak Academy of Sciences can also apply for smaller grants supporting basic research (VEGA grants) and the outcomes of this research can be further expanded

[167] Scientific Grant Agency, *VEGA Annual Report 2018,* https://www.minedu.sk/vysledky-riesenia-skoncenych-projektov-vega/

[168] Cultural and Educational Grant Agency, *KEGA Annual Report 2019*, https://www.minedu.sk/data/att/15742.pdf

[169] Slovak Business Agency, *Annual Report 2018,* http://www.sbagency.sk/sites/default/files/vyrocna_sprava_sba_2018.pdf

[170] For example Baláž, V.; Frank, K.; Ojala, T.; RIO Country Report 2017: Slovak Republic., EUR 29181 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-81482-2, doi:10.2760/427548, JRC111379 and OECD Economic Surveys: Slovak Republic (e.g. 2010, 2019)

[171] Boris Strečanský Centre for Philanthropy n.o (2015) *Slovakia Country Report EUFORI Study*

[172] Slovak Research and Development Agency, *2018 Annual Report*, https://www.apvv.sk/buxus/docs/agentura/vyrocne-spravy/apvv-vs-2018.pdf

by HEIs in the educational process (KEGA grants).[173] Generally these grants are seen as hugely important, given the limited national funding options for research performers.

State aid in the form of subsidies for scientific and technical services is granted to entrepreneurs and businesses for the support of R&D. There are also incentives (stimuli) for research and development to encourage businesses to invest in and carry out more research, and to increase their investment in R&D[174].

Public funding for RTDI predominantly supports public sector institutions. Public sector institutions include 23 public and state universities, 45 SAS institutes and specialised research institutes that operate under the auspices of state administration bodies.[175]

The non-profit sector has less support from state funding. Philanthropic culture in Slovakia has been growing over the past 10 years, mainly thanks to the country's significant economic growth. However, in terms of its scale and scope, it lags behind Czechia and Poland. This is partly due to historical reasons and the country's relatively late modernisation. In last few years, several interesting private foundations have emerged in Slovakia, based on the initiative of high net-worth individuals. However, although RTDI may be funded by non-profit organisations and foundations, a dedicated charity has yet to set up to support innovation.[176]

As documented in the section **Chyba! Nenašiel sa žiaden zdroj odkazov. Chyba! Nenašiel sa žiaden zdroj odkazov.** and **Chyba! Nenašiel sa žiaden zdroj odkazov.** of this report, the private sector currently lags behind in R&D activities, although there are several targeted policies and funding programmes that aim to increase the number of researchers in private companies.[177]

Business RTDI is led by a small number of companies in the automotive and ICT sectors. Although there are interesting developments among SMEs in Slovakia, overall, SMEs struggle to compete with low costs of production inputs and they therefore are less innovate than the EU average.[178]

More recent support has been designed to encourage improved collaboration between public and private RTDI actors. Such instruments include support to clusters, innovation vouchers and tax reliefs. For example, SIEA runs an innovation voucher scheme financed through ESIF funding, and the MoE prepared a demand-oriented call for clusters under the OP R&I. A 2019 country comparison with regards to voucher schemes can be seen in Table 12, which outlines that Slovakia's voucher schemes are significantly smaller than those of other Visegrad countries and indicates room for expansion in this regard. Furthermore, the schemes in Slovakia are orientated towards supporting collaboration, whereas voucher schemes are usually intended to support early stage product or service creation to bridge 'the valley of death'.[179]

In addition to supporting the R&D capacities in the established industries and companies, creation of new technological start-ups is also supported through the establishment of centres such as the Business Innovation Centre (BIC) Bratislava[180]. BIC Bratislava was set up in 1991 and was followed by the creation of a further 15 centres by 2009. However, the literature highlights that these centres lacked a sustainable funding model, and BIC Bratislava appears to be the only one that was able to

[173] European University Association (2020) Public Funding Observatory

[174] Boris Strečanský Center for Philanthropy n.o (2015) Slovakia Country Report EUFORI Study

[175] EURAXESS Members in Focus: the Slovak Republic

[176] Boris Strečanský Center for Philanthropy n.o (2015) Slovakia Country Report EUFORI Study

[177] EURAXESS Members in Focus: the Slovak Republic

[178] Baláž, V.; Frank, K.; Ojala, T.; RIO Country Report 2017: Slovak Republic.

[179] This term refers to the phase between research, innovation and product deployment

[180] Business Innovation Centre, Bratislava: https://www.bic.sk/

ensure a consistent funding pipeline through public and private funds.[181] Further reforms to support start-ups, including the initiatives in the 2011 MINERVA 2.0 strategy, have also suffered from poor implementation, and there were few signs their having an impact on technology transfer-related initiatives (MINERVA 2.0 strategy).[182] Again, implementation was a more crucial issue for start-up support than having a well-defined strategy.

Table 12: Innovation vouchers, V4 country comparison 2018

	Type	Size	Eligibility	Purpose	Dispersal
Slovakia	Creative Voucher	EUR 5,000 per voucher. Total envelope was EUR 125,000 in 2018. (funded by ESIF)	SMEs	To teach companies and educational institutions how to cooperate with regards to research and innovation	In 2018, 25 vouchers were granted (full budget). In previous years, 40 to 50 vouchers were granted per year
	Innovation vouchers [183]	Max per voucher is EUR 10,000	Business entities	Support cooperation between business and research institutes	Planned budget in 2019: EUR 150,000, 2020: EUR 300,000
Czech Republic	Innovation voucher	The voucher is between EUR 1.939 to 11.637	Businesses, research institutions, state administration and NGOs	To be spent on the purchase of advisory, expert and support services in the field of innovation	N/A
	Innovation voucher	Up to EUR 19,395. The total envelope was more than EUR 5.7 million	SMEs	Innovation projects, creative services, coaching and mentoring, foreign incubators international trade fairs and exhibitions	Since 2009, 2019 applications were submitted that led to the granting of 810 vouchers
Poland	Training vouchers for SMEs	Covers 50%-80% of a project value (ESF funded)	SMEs	Vouchers enable SMEs to attend training services	About 4,500 SMEs up to 2018
Hungary	Innovation Voucher	The total envelope is of HUF 60.6 million (EUR 185 million)	SMEs with marketable product, technology or service	To involve micro firms and SMEs into the innovation chain	Until 3 May, 2019, 64 applications had been received, and 13 were successful

Source: Victor Backer and Gonzalez Salido, Voucher Schemes in Member States, European Commission, 2019, https://ec.europa.eu/information_society/newsroom/image/document/2019-32/member_states_use_of_voucher_schemes_0D31F683-AA92-B7FF-684433BCBD8A4F3A_61225.pdf

Research Performers in Slovakia feel that there is generally a funding gap at higher Technology Readiness Levels (TRL), which should be filled by further government support. An explanation of

[181] Paulo Andrez, Hannes Leo, Sigrid Johannisse, Jari Romanainen, *Specific Support to Slovakia Boosting the Slovak startup ecosystem,* Horizon 2020 Policy Support Facility, Joint Research Council, 2017. https://rio.jrc.ec.europa.eu/sites/default/files/report/KI-AX-17-001-EN-N%20SK.pdf

[182] Paulo Andrez, Hannes Leo, Sigrid Johannisse, Jari Romanainen, *Specific Support to Slovakia Boosting the Slovak Start-up Ecosystem,* Horizon 2020 Policy Support Facility, Joint Research Council, 2017. https://rio.jrc.ec.europa.eu/sites/default/files/report/KI-AX-17-001-EN-N%20SK.pdf p67

[183] Ministry of Economy, Scheme DM 15/2017 to support the cooperation of business entities and research institutes in the form of Innovation Vouchers (2017-2020), https://www.economy.gov.sk/inovacie/podporne-nastroje/vouchre

what each of the nineTRL levels mean, and the corresponding funding system as interpreted by this report, can be seen Table 13.

Indeed, it appears that the initial jump from laboratory to deployment in the intended product environment lacks sufficient support, and the vouchers available to companies at the highest TRLs (7-9) is overall lower than in comparable countries. While significant tax incentives exist which could augment the overall level of support, section 2.3.2 of this report shows that their use is dominated by a number of large companies and that there is low uptake among SMEs or start-ups, partly due to the complexity of the administrative procedures.

Table 13: Technology readiness levels in Slovak national funding

TRL	Description	National Funding
TRL 0	Idea. Unproven concept, no testing has been performed	SRDA/VEGA
TRL 1	Basic research, principles postulated and observed but no experimental proof available	SRDA/VEGA
TRL 2	Technology formulation, concept and application have been formulated	SRDA/VEGA
TRL 3	Applied research, first laboratory tests completed, proof of concept	SRDA/VEGA
TRL 4	Small-scale prototype, built in a laboratory environment	SRDA/VEGA
TRL 5	Large-scale prototype, tested in intended environment	**Perceived lack of support by interviewed stakeholders**
TRL 6	Prototype system, tested in intended environment close to expected performance	**Perceived lack of support by interviewed stakeholders**
TRL 7	Demonstration system, operating in operational environment at pre-commercial scale	**Perceived lack of support by interviewed stakeholders**
TRL 8	First of a kind commercial system, manufacturing issues solved	Vouchers
TRL 9	Full commercial application, technology available for consumers	Vouchers

2.4.2 RTDI Infrastructure

Slovakia has taken significant steps in upgrading its RTDI infrastructure. Along with the other EU-13 countries, it has made use of Structural Funds in updating its research infrastructure. For example, in the 2007-2013 OP R&D, infrastructure upgrades made up almost 50% of the agreed funding for priority areas.[184]

In the 2007-2013 programme period, Slovakia invested more than EUR 1.4 billion of its European funds in building and modernising its RTDI infrastructure. This amounted to around 10% of the overall allocation[185]. According to study interviews, the focus in the current period should be on

[184] European Commission, *Operational Programme 'Research & Development' for Slovakia*: 2007-2015, https://ec.europa.eu/regional_policy/en/atlas/programmes/2007-2013/slovakia/operational-programme-research-development

[185] Slovak Liaison Office for Research and Development, *Contribution of the Slovak Republic to the ERA. New Research Infrastructure*, News, 15 October 2015 https://www.slord.sk/aktuality/newresearchinfrastructure/

ensuring that investments support the use of RI, i.e. that there are sufficient equipment, human resources and knowhow available to i) put the RI technology to effective use, ii) maintain its upkeep.

Infrastructure investments were made also with the intention of supporting cooperation between academia and industry, i.e. with the objective of improving technology and knowledge transfer between RTDI actors. [186]

Between 2007-2014, the key investments located in universities and research institutions were as follows:

- Educational infrastructure (75 projects, total of EUR 292.4m)
- Centres of excellence (around EUR 3m per grant; 107 projects, total of EUR 244.1m)
- Centres of competence (up to EUR 7m per grant; 8 projects, total of EUR 50.8m)
- Universities research parks and research centres (between EUR 25 to 40m per grant; 15 projects, total of EUR 446.5m). [187, 188]

Significant investments continue in the current programme period. The year 2019 saw the largest ever such infrastructure investment with the two largest Slovak universities – the Slovak University of Technology and Comenius University – investing a total of EUR 111m on the modernisation and renovation of RI and scientific capacity. The funding was provided by the European Commission, the European Investment Bank, the Slovak government (a total of EUR 105.4m) and the universities themselves (EUR 5.5m).[189]

Although the amounts spent on RTDI infrastructure show an understanding of their importance and role in the RTDI system, the literature review and stakeholder interviews suggest that Slovakia may be overlooking opportunities to ensure investments are truly effective.

Ensuring compliance with state aid rules on the use of research infrastructure by private companies is an ongoing problem, according to policymakers and research performers, in particular relating to government research facilities. Other European countries and organisations also recognise the challenges but no guidance is forthcoming from the Commission and the EU-level organisations such as the European association of leading national innovation agencies (TAFTIE). For example, it is legal for private companies to use public RI infrastructure if the economic activities consume exactly the same inputs (e.g. material, equipment, labour and fixed capital) as the non-economic activities and if the capacity allocated each year to the economic activities is not more than 20% of the relevant entity's overall annual capacity.[190]

The Slovak Republic currently has no European Strategy Forum on Research Infrastructures roadmap.[191] ESFRI is a key forum for RI strategy. Given Slovakia's substantial investments in RI over the past decade, the lack of a roadmap is somewhat illogical.

[186] Interview feedback

[187] Slovak Liaison Office for Research and Development, *Contribution of the Slovak Republic to the ERA. New Research Infrastructure*, News, 15 October, 2015 https://www.slord.sk/aktuality/newresearchinfrastructure/

[188] Ministry of Education, Science, Research and Sports, *Operational Programme Research and Development: Annual Report 2014*, p11 https://www.minedu.sk/vyrocne-spravy-op-vyskum-a-vyvoj/

[189] Comenius University, *The largest ever investment in science and research in Slovakia: The Slovak University of technology and Comenius University receive EUR 111 million*, News, 15 October, 2019, https://fmph.uniba.sk/en/news-detail/back_to_page/fakulta-matematiky-fyziky-a-informatiky-uk/article/historicky-najvaecsia-investicia-do-slovenskej-vedy-a-vyskumu-slovenska-technicka-univerzita/

[190] Knowledge Transfer Ireland, *KTI Practical Guide to State Aid Considerations in Research, Development & Innovation for RPOs and Industry*, 2019, https://www.knowledgetransferireland.com/Model-Agreements/Practical-Guides/Practical-Guide-to-State-Aid-Considerations-in-Research-Development-and-Innovation-for-RPOs-and-Industry.pdf p10.

[191] A list of current ESFRI Roadmaps can be found here: https://www.esfri.eu/national-roadmaps

The latest EU Semester report for the Slovak Republic (2019) also concludes that "the use of critical EU funding for research and innovation remains inefficient". The EU assessment proposes that the sums invested in physical modernisations have not been accompanied by equally critical investments to ensure maintenance and staffing.[192] This assessment was echoed by interviewees consulted as part of this study. See also section 3.1.5.

2.5 Collaboration between RTDI actors

As initially presented at the beginning of Chapter 2 (introduction), a systems view of RTDI puts collaboration and coordination at the centre of the RTDI framework. Moreover, the RTDI system described has many of the elements of the triple (or quadruple) helix model[193] that has been extensively used in the context of innovation promotion, as part of European regional development strategies and in particular to promote Smart Specialisation.[194]

In the same way, over the course of past 15 years, R&I policy has become wider and more interlinked with other policy areas (e.g. environmental, social, industrial policy and competitiveness).[195] Innovation funding dedicated to thematic priorities has also been increasing. This trend can also be seen at EU level, with the increased focus on steering R&I towards societal needs and societal challenges, thus incorporating policy areas which tended to be more peripheral to innovation policy, such as health, agriculture, energy and so on. As a result of this trend, it is becoming more important to understand how different elements within each R&I system operate as a common structure.

Innovation has also increasingly been seen as 'open', involving interaction with customers and also with other researchers sharing a common interest, rather than simply as the internal concern of enterprises. Many now subscribe to this multi-faceted conception of innovation, including the European Commission with its 'Open Innovation 2.0' strategy and the Open Innovation Strategy and Policy Group, which publishes an annual yearbook detailing case studies from which Member States can draw best practices.[196] Consequently, it is becoming increasingly important to support the mobilisation of the entire R&I systems, in order to address social and economic challenges.

A key conclusion of this report is that Slovak RTDI has great potential, although it faces financial and behavioural barriers. In 2014-2015, research capacity and research potential in Slovakia was centred in the public sector, where two-thirds of RTDI funds were spent (Table 14). This changed between 2016-2018, and while it is encouraging that over half of the expenditure now occurs in the private sector, it must be noted that the level of total expenditure is still less than in 2016. This is due to the cyclical nature of structural funds as outlined on pages 14 and 26 of this report.

A key aim should be for overall levels of funding to surpass 2016 levels, while maintaining this 50/50 ratio. Although there is funding to incentivise collaboration, both internationally through bi- and multilateral programmes, as well as nationally, the majority of national public sector research does not lend itself to or require cooperation between public and private research performers. Consequently, the culture of cooperation is lacking, which means that lack of trust, lack of networks,

[192] SWD (2019) 1024 final

[193] See for instance an early statement of the model in Henry Etzkowitz & Loet Leydesdorff, (2000) The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university–industry–government relations, * Research Policy, vol 29, pp 109–123.

[194] For example: https://ec.europa.eu/regional_policy/en/projects/best-practices/sweden/2689 and more recently https://www.triplehelixassociation.org/european-funded-projects-hlx4eu

[195] For further details, please see Kincsö Izsák, Paresa Markianidou and Slavo Radošević, Lessons from a Decade of Innovation Policy,
European Commission (2013), p13.
http://ec.europa.eu/DocsRoom/documents/5220/attachments/1/translations/en/renditions/native

[196] https://ec.europa.eu/digital-single-market/en/news/open-innovation-publications

lack of cooperative behaviour is also an issue. Of course, this is a generalisation of the system as a whole, and there are exceptions, in particular among younger generations of researchers and/or researchers who tend to have had a more international or intersectoral career.

Table 14: Business Sector R&D expenditure

	2014	2015	2016	2017	2018
Total national expenditures (EUR 1,000)	669,632	927,272	640,835	748,955	750,947
Use of resources in Business sector (EUR 1,000)	246,678	259,189	322,720	405,321	406,077
%	37%	28%	50%	54%	54%

Source: Statistical Office of SR, YEARBOOK of Science and Technology 2019

From the point of view of the private sector, much of the literature available[197] is focused on the fact that RTDI is dominated by MNCs and rarely undertaken within Slovak borders. This is a major factor, although further circumstances also constitute a barrier to private sector RTDI and are outlined in the section **Chyba! Nenašiel sa žiaden zdroj odkazov.**3.

After the Velvet Revolution and with the start of privatisation of state companies, many existing R&D departments operating under state-controlled enterprises were separated and isolated from each other in terms of their activities. Today, they only constitute around 10% of business R&D expenditure (EUR 18 million).[198]

In the area of financing innovations, Slovakia has also lacked venture capital due to insufficient competitiveness. In 2010, the amount of invested venture capital was 0.03 % of the Slovak GDP[199] although more recent data suggests a positive trend. International bodies, such as the European Investment Banks, also contributed towards innovation capital. The EIB invested EUR 2.47 billion in Slovak projects in 2014-2016.[200] Since 2016 there has been a large increase, and in 2019, the EIB Group (the EIB and the European Investment Fund), leveraged EUR 14.44 billion in innovation alone, from a total of EUR 72.09 billion.[201] In total, around 2,300 small businesses benefited from EIB Group operations in 2019.[202]

Working in another silo, according to a 2015 report by the Centre for Philanthropy, non-profit organisations appear not to have been fully recognised by official R&D support institutions as eligible recipients of government funding or as participants in R&D programmes. They have received only around 0.4% of total GERD consistently in the period 2014-2019.[203] Indeed, this appears to be a challenge faced across the EU-13, with Poland, Czech Republic and Hungary exhibiting similar figures.[204] Nevertheless, this has led to a lack of cooperation between the non-profit sector and other research performers in Slovakia. Non-profits also have a much lower success rate than other researcher performers, at around 10% for national funding schemes compared to 25-30% for SAS, HEIs and businesses.[205] It should also be noted that the philanthropic sector, while growing, is small

[197] Baláž, V.; Frank, K.; Ojala, T.; RIO Country Report 2017: Slovak Republic., EUR 29181 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-81482-2, doi:10.2760/427548, JRC111379, Draft Innovation Strategy of the Slovak Republic for 2007 to 2013, SWD(2019) 1024 final

[198] Boris Strečanský Centre for Philanthropy n.o (2015) Slovakia Country Report EUFORI Study

[199] Boris Strečanský Centre for Philanthropy n.o (2015) Slovakia Country Report EUFORI Study

[200] EBRD (2017) Slovak Republic Country Strategy

[201] EIB Country Factsheet, Slovakia 2019, https://www.eib.org/attachments/country/factsheet_slovakia_2019_en.pdf

[202] https://www.eib.org/en/press/all/2020-044-eib-group-support-for-projects-in-slovakia-stood-at-eur-251m-in-2019

[203] Slovstat 2019 yearbook, p3.

[204] https://ec.europa.eu/eurostat/databrowser/view/tsc00031/default/table?lang=en

[205] https://www.apvv.sk/buxus/docs/agentura/vyrocne-spravy/apvv-vs-2017-en.pdf p25

in Slovakia and does not focus on RTDI support, which is another explanation of the comparatively low levels of activity.[206]

The topic of collaboration was a high priority for many stakeholders, who often volunteered the topic during the interviews held for this study in Bratislava in February 2020. The subsequent sub-chapters summarise overall impressions from those discussions.

2.6 Performance of the Slovak RTDI system

Chapter 2.6 builds on the data and analysis from the previous sections of Chapter 2 and makes an assessment of the performance and quality of the Slovak RTDI system.

The general impression from the literature[207] is that the RTDI system is underperforming in a variety of indicators, but that – given the limited resources available – the underlying quality of the outputs produced should be recognised.

Moreover, Slovakia, despite being a small and centralised country, is rather fragmented in terms of the number of universities, and the number of industry and employer associations. For example, there are 20 public universities, 10 private universities and three state universities and colleges in Slovakia.[208]

Although the regions have limited competency in RTDI, there are also eight regional governments that also undertake, at different levels, some innovation policy activities, including developing regional smart specialisation strategies.

2.6.1 Performance and quality of RTDI governance

RTDI in Slovakia is highly centralised and organised horizontally across a number of ministries but with two key bodies (Ministry of Economy and Ministry of Education, Science, Research and Sports) leading the coordination. This set up is not unusual and can be found in other EU countries (e.g. Czechia[209], Sweden[210]). Indeed, with the widening scope of RTDI, governing systems have tended to centralise this policy area so as to allow it to be cross-sectional.

The performance of the governing system could be summarised as strong on planning but weak in implementation. This description appears to be particularly accurate when assessing the handling of the current ESIF funds, which suffered from severe delays. [211] Similarly, one stakeholder described RTDI policy as "an orphan" that had landed between the chairs of multiple ministries.

The performance of MESRS, which holds a key coordinating role, could be improved. For example, MESRS has struggled to implement larger policies such as merging of the funding agencies envisaged under the Smart Specialisation Strategy(Chapter 6 of RIS3). It has also been unable to steer the creation of an ESFRI roadmap, which indicates that MESRS could improve how effectively it manages Slovakia's membership in key international fora.

[206] Boris Strečanský Center for Philanthropy n.o (2015) Slovakia Country Report EUFORI Study

[207] For example Baláž, V.; Frank, K.; Ojala, T.; RIO Country Report 2017: Slovak Republic., EUR 29181 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-81482-2, doi:10.2760/427548, JRC111379, European Commission (2018) Digital Transformation Monitor Slovakia: Smart Industry and European Commission (2019) European Innovation Scoreboard 2019

[208] timeshighereducation.com/student/where-to-study/study-in-slovakia

[209] National Research, Development and Innovation Policy of the Czech Republic 2016–2020. See http://www.czech-research.com/wp-content/uploads/2016/09/NRDIP_2016-2020_eng.pdf

[210] Swedish Ministry of Enterprise, Energy and Communications, *The Swedish Innovation Strategy*, 20120 https://www.government.se/contentassets/cbc9485d5a3446729632258581182 73b/the-swedish-innovation-strategy

[211] Baláž, V.; Frank, K.; Ojala, T.; RIO Country Report 2017: Slovak Republic., EUR 29181 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-81482-2, doi:10.2760/427548, JRC111379.

Looking at RTDI governance more widely, a history of lack of Gross domestic Expenditure on Research and experimental Development (GERD) makes it a difficult policy area to govern and in which to make a substantial impact.

The Slovak draft innovation strategy, which was produced for the 2007-13 period, states that "no comprehensive innovation strategy has been adopted in Slovakia" and that "there is no comprehensive functioning innovation system that should comprise institutions, policies, programmes and tools creating conditions for supporting to innovations that increase the competitiveness of Slovakia's economy."[212] Slovakia has thus put in a lot of effort over the past 15 years to develop priorities for innovation and the concept of the knowledge economy. It has largely used EU policy as a model for its development.[213] Indeed, the five domains selected for the Smart Specialisation Strategywere agreed as recently as 2017.[214]

This study's interviews with policymakers collected details on how 'peripheral' RTDI ministries, but with emerging portfolios (e.g. Ministry of Agriculture, Ministry of Environment), are increasingly working to organise themselves internally by *inter alia* undertaking inventories of research activities within their responsibility remits so as to better support RTDI performers.

Policymakers also reflected upon the **lack of long-term vision** for innovation. This was a recurring theme that was brought up as one weakness of the current system. There was a consensus that the current coordination focused on relatively short-term planning, without the guidance of an overarching and agreed document that would outline a vision of RTDI for Slovakia for the next 20 years. The current working practices are therefore at risk of being rather short sighted and excessively relying on the status quo (e.g. focus on manufacturing), while also potentially missing new opportunities (e.g. bioeconomy).

Along with a lack of long-term vision, interviewed policymakers also raised **lack of trust, transparency and coordination** as barriers for achieving effective governance. Furthermore, there is a **lack of in-house ministerial knowledge and training in results-based management and in RTDI management**. It was acknowledged that although the ministries have very bright and dedicated individuals currently working for them, they still struggle to maintain themselves as an attractive workplace.

2.6.2 Performance and quality of research performers

The Slovak RTDI system is characterised by some clear pockets of excellence found in research institutes and HEIs, for example the Slovak Hydrometeorological Institute and SAS Institute of Chemistry, mixed with areas of potential. Lack of national funding has contributed to low international scores in terms of the quantity and quality of scientific output measured by the number of publications or the percentage of top-cited publications.[215] While lack of finance is not the only cause of underperformance, it is a major one. Indeed, structural, organisations and administrative barriers also exist, but they are even harder to overcome when the system is underfunded. The Slovak Academy of Sciences is the Research Performer with highest publication output, around 30% of the national output. Together with Comenius University, which the second highest, they make up around 50% of total research output.[216] Research performance faces several clear challenges as highlighted by both interviews and literature during the course of this study:

[212] Draft Innovation Strategy of the Slovak Republic for 2007 to 2013

[213] Draft Innovation Strategy of the Slovak Republic for 2007 to 2013

[214] SWD(2019) 1024 final

[215] Ministry of Education, Science, Research and Sports, *Report on the State of Research and Development in Slovakia,* 2012.

[216] Discussion with Deputy Prime Minister's Office for Investments and Informatization

- Difficulties with retention of younger generation of researchers (looked at in this section)
- Lack of SMEs and large companies carrying out internationally competitive research (looked at in 2.6.3)
- Difficulties fostering a collaborative and cooperative research culture (looked at through the report)
- Absence of capacity at high levels of technology readiness and weak culture of knowledge transfer (outlined earlier in this report 2.4.1.2.).

One clear challenge which hinders Slovakian research performance is the significant draw of other Member States and the resulting brain drain in the country. The current trajectory forecasts that by 2060 Slovakia could lose up to 10% of its population due to intra-EU migration.[217] More specific to scientific output, in the period 2014-2017 Slovakia increased its share of total high-skilled intra-EU movement by 41%, just behind Croatia with 46% and Hungary with 51%.[218] Scholars have noted how this intra EU-migration has had a negative effect on a number of scientific indicators in Slovakia and other 'new' Member States, including cross-border collaboration.[219] From the research and interviews, this study concludes that the difficulty of retaining research staff is linked to three main factors:

1. The salaries of younger researchers in Slovakia are significantly lower than elsewhere in Europe. For academic staff, the salary depends on their classification into salary classes and salary grades according to the demands of the work. This increases with the years of experience. At present, the minimum tariff salary for salary grade 1 (the lowest) is EUR 734 per month. With the experience of over 40 years added to the salary class 11 grade 14 (the highest class and grade available), it is EUR 1550.5.[220] The earning potential in neighbouring Austria far outstrips these scales, which has resulted in many younger researchers leaving Slovakia. For example, the gross monthly salary for a university professor in Austria is EUR 4,891.10. This amount increases to a maximum of EUR 6,817.90 if there is at least one positive evaluation of activity and after a certain number of years of service.[221] When this trend is broadened out into total spending per scientist (full-time equivalent), Czechia spends nearly twice as much, while Austria and the Scandinavian countries spend three to five times more per scientist than Slovakia.[222] Evaluation of researcher activity is also a key aspect lacking in Slovakia. Without quality of outputs factoring into salary scales, talented researchers in Slovakia are not incentivised to increase the quality of their work. Some institutions have taken drastic measures to retain key staff; for example, one technical university interviewed for this study reported that, for certain key project staff, they doubled the salaries and used future research projects as collateral.

[217] Lutz et al, *Demographic Scenarios for the EU*, EU SCIENCE HUB, 2019, https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/demographic-scenarios-eu p48.

[218] Cavallini et al, *Addressing brain drain: The local and regional dimension*, European Committee of the Regions, 2018, https://cor.europa.eu/en/engage/studies/Documents/addressing-brain-drain/addressing-brain-drain.pdf

[219] Doria Arrieta et al, *Quantifying the negative impact of brain drain on the integration of European science*, SCIENCE ADVANCES12 APR 2017. Available at: https://advances.sciencemag.org/content/3/4/e1602232?utm_source=TrendMD&utm_medium=cpc&utm_campaign=TrendMD_0

[220] EURYDICE, *Conditions of Service for Academic Staff Working in Higher Education: Slovakia,* 16 April 2020 https://eacea.ec.europa.eu/national-policies/eurydice/content/conditions-service-academic-staff-working-higher-education-65_en

[221] EURYDICE, *Conditions of Service for Academic Staff Working in Higher Education*: *Austria*, 20 July, 2018 https://eacea.ec.europa.eu/national-policies/eurydice/content/conditions-service-academic-staff-working-higher-education-1_en

[222] https://www.sav.sk/uploads/dokumentySAV/4_SAS-2021_analysis.pdf

2. A number of 'push' factors incentivise young researchers to leave Slovakia, as highlighted by anecdotal evidence from within the higher education sector of uncoordinated procurement of state-of-the-art equipment and a lack of funding to maintain it. Funding for maintaining research infrastructures in other Member States can be provided in a number of ways, including EU and national competitive funding, grants from both regional and central government and subsidies.[223] There is also lack of incentives for coordination and cooperation of existing resources, as well as a dearth in finance for 'core facilities'. Examples were raised during the interviews, such as adding equipment sharing and dissemination of output conditionality to funding for equipment. This is also partly due to public funding being delivered to HEIs as block funding, not linked to quality, which is then divided by the institution's senior management. As a result, funding prioritises student numbers and teaching over research. Furthermore, several of those interviewed noted a lack of merit-based salary incentives (outlined in more details in point 1). This has resulted in a general feeling of fatigue among the research community.
3. The third factor directly related to the Smart Specialisation Strategy and resulting calls deploying structural funds is a lack of clear communication or sense of strategic direction from the central government regarding the publication of calls. Those interviewed frequently felt that relevant calls and grants were not sufficiently promoted, and, on several occasions, senior academics were asked for comments on grants by the media without knowing that a call had been published. This points to poor communication coordination from the agency responsible for publishing structural fund calls, as well as poor communication within HEIs themselves and blockages at senior management levels, who appear to be the chief recipients of high-level call information.

With regards to the brain drain, other EU-13 countries have sought to reverse the trend through a mixture of financial and reform-based incentives. For example, the SOMOPRO initiative in Czech Republic, which is now in its third iteration. Funded by a mixture of ESIF, Marie Curie and FP7 funds, this programme is a grant scheme aimed at attracting skilled researchers from the Czech Republic to the region.[224] Elsewhere, Romania has a one-month grant for expat scientists to return to the country and see how it has changed since they left, in terms of opportunities and facilities for the research community.[225]

Cooperation between researchers and industry is notoriously weak in Slovakia, and the two sectors remain isolated from each other. Indeed, the call requirements under the Smart Specialisation Domains require both academic researchers and entrepreneurs to collaborate on proposals. While this is intended to incentivise collaboration and facilitate technology transfer throughout the innovation pipeline, the research community in Slovakia often noted the difficulty in finding private companies which would be willing and able to conduct research – for example, engaging large multinational car manufacturers. This limited their ability to apply for calls. The root cause of this is a combination of a small number of firms involved in R&D and the overall siloed approach of the research community, even within the public sector. One indicator is the below-average growth rates of Slovak co-authored publications in the period 2007-2017, which had declined compared to the period 1993-2006.[226]

[223] https://www.esfri.eu/sites/default/files/ESFRI_Roadmap2021_Public_Guide_Public.pdf

[224] Cavallini et al, *Addressing brain drain: The local and regional dimension*, European Committee of the Regions, 2018, https://cor.europa.eu/en/engage/studies/Documents/addressing-brain-drain/addressing-brain-drain.pdf p44.

[225] Anita Tregner Mlinaric, *We need directed policies to transform brain drain into brain circulation,* ScienceBusiness, 30 Jan 2020, https://sciencebusiness.net/viewpoint/viewpoint-we-need-directed-policies-transform-brain-drain-brain-circulation

[226] Tomáš Jeck and Vladimir Balaz, *European Co-operation in Science: Evidence From The European Co-authorship Patterns*, Conference Paper, 2018, https://www.researchgate.net/publication/329522719_EUROPEAN_CO-OPERATION_IN_SCIENCE_EVIDENCE_FROM_THE_EUROPEAN_CO-AUTHORSHIP_PATTERNS p221.

For domestic funding, research performers can apply for two categories of large grants, 'basic research' and 'applied research'. The general call success rates for applied research were roughly the same as those for basic research in the national funding scheme, at 25.3% and 24.7% respectively back in 2016. This dropped slightly to 20.6% for applied research and 24.1% for basic research in 2017.[227] However, since the applied research requires an industry partner, researchers have expressed a reluctance to use this grant.[228] In some cases, they informed the study team that they consciously miscategorise their projects as 'basic research' rather than 'applied research' because of the perceived difficulty in finding an industry partner that would be able to carry out the work.

This issue appears to be compounded by the fact that the large multinationals present in Slovakia (for example in the automotive and pharmaceutical sectors) do not have a mandate to conduct research domestically. That said some success was noted in certain areas, such as the pharmaceutical sector. The interviews revealed that, in specific cases, researchers were able to actively engage with company headquarters in other Member States (e.g. Germany) to secure research projects in Slovakia. However, the methods for doing so were not deemed to be very replicable. These projects largely gained momentum through personal contacts and experiences working abroad (in Germany) and there does not appear to be any 'quick fix' in this regard. A longer-term strategy for increasing exchange programmes and fostering internationalisation of the research base may produce more of these personal connections.

Both the Slovak Academy of Sciences (SAS) and the HEIs face a challenge with regards to facilitation of collaborative research between teams, internally and externally. For the SAS, this was noted most recently following an interdependent evaluation by an international panel in 2017.[229] Interviewees noted that this is partly due to the research culture within Slovakian institutions, where researchers appear reluctant to collaborate outside of their own teams. Another reason is the quality of the research environment, including incentives and support for mobility and collaboration, with 82% of respondents to a 2018 survey saying that this was the main reason they left Slovakia to work elsewhere in Europe.[230]

However, opportunities for improving Slovakian research performance do exist and there are several projects that could serve as good models for future systematic support. For example, the M-ERA.NET, SASPRO and COST actions, (below), all co-financed from the SAS budget, could serve as best practice examples for central government funding programmes. The overall number of researchers participating in these programmes is still relatively low. For example, Slovakia has the lowest participation rate of all Visegrad countries for COST,[231] although the rate has been increasing consistently since 2014.[232] One reason for this could be ineffective communication of opportunities to the research base. For example, when going through the COST website, Slovakian researchers are directed to an SRDA webpage that has been archived, with no updates since 2009.[233]

M-ERA.NET is an EU-funded network or 32 EU and non-EU countries, which was established in 2012 to improve the coordination of European research programmes and related funding in

[227] The 2018 annual report featuring the 2017 figures was published in 2019 and is the latest set of data for these calls. Source: https://www.apvv.sk/buxus/docs/flipbook/apvv-vs-2018-en/index.html

[228] Slovak Research and Development Agency, SRDA Annual Report 2017, https://www.apvv.sk/buxus/docs/agentura/vyrocne-spravy/apvv-vs-2017-en.pdf p24.

[229] Ľuboš Pilc, *Two SAS institutes are among Europe's top, five are among the worst*, Pravda, 2017. Available at https://spravy.pravda.sk/domace/clanok/420945-sav-dva-ustavy-akademie-patria-k-europskej-spicke/

[230] Poll: Slovak scientists abroad are not keen on returning to Slovakia, *Slovak Spectator, 2nd August 2018*, Available at https://spectator.sme.sk/c/20883997/poll-slovak-scientists-abroad-are-not-keen-on-returning-to-slovakia.html

[231] COST, *Who we are: Members: Slovakia*, https://www.cost.eu/who-we-are/members/SK/

[232] COST, *Country Fact Sheet: Slovakia*, 2018, https://www.cost.eu/wp-content/uploads/2019/09/COST_CountryFactSheets_3_HR_Slovakia.pdf

[233] Archive website of OMS APVV, September 30, 2009, http://oms.apvv.sk/section155.html

materials science and engineering. As a core activity, a series of joint calls for transnational RTD projects are being implemented. These calls will offer the European RTD community an opportunity to access coordinated funding across Europe and to gain access to leading knowledge worldwide.

As of 2019, Slovakia has taken part in two projects via the network: 'New exchange-coupled manganese-based magnetic materials' and 'Graphene-ceramic nanocomposites for tribological application in aqueous environments.'[234]

SASPRO is an EU co-funded programme of the Slovak Academy of Sciences which funds researchers to come to the academy for a fellowship lasting between 12 and 36 months. The programme is designed to stimulate incoming mobility, and includes the return of Slovak scientists from abroad.

Under this programme, the reintegration scheme is intended for Slovak nationals who have carried out their main activity in third countries at least three years prior to the application submission and who have resided or carried out their main activity in the Slovak Republic for a maximum three months prior to the application submission. Out of 38 fellows funded by the programme, 16 are Slovak returning scientists.[235]

COST is an EU framework programme-funded intergovernmental mechanism consisting of 38 members, a cooperating member and a partner member. This allows researchers from these countries to embark upon networking opportunities by participating in science and technology networks called COST Actions. It allows researchers from these countries to embark upon bottom-up networking opportunities by participating in science and technology networks called COST Actions.[236]

2.6.3 Performance and quality of the private sector

Business expenditure in R&D appears too low to substantially boost innovation performance. Overall, business R&D remains one of the lowest in the EU and has centred around medium high-tech manufacturing, which is dominated by multinational firms. The share of Business Expenditure on Research and Development (BERD) was 0.18% GDP in 2007, growing to 0.45% in 2018, which is still significantly lower than the EU-28 average of 1.45% of GDP.[237]

The 2019 EU Industrial R&D Investment Scoreboard ranks no Slovak company among the 1,000 largest R&D spenders in Europe.[238] In Slovakia, business research is mostly carried out by a few large domestically owned companies in the automotive and ICT sectors, and R&D departments of a few multinational corporation (MNC). The MNCs have been slow to relocate their research units to Slovakia. Literature looking specifically at Swiss MNC's indicates that they relocate research to host countries because the host country is able to offer new technologies to raise its total productivity

[234] M-Era.net, *Success Story Brochure*, 2018, https://m-era.net/links/success_story_brochure_2018

[235] Slovak Academy of Science, *Programme SASPRO – Mobility Programme of the Slovak Academy of Sciences: About,* https://www.saspro.sav.sk/

[236] COST, *Who we are: About COST*, https://www.cost.eu/who-we-are/about-cost/

[237] Vladimir Baláž, and Frank, K.; Ojala, T, *RIO Country Report 2017: Slovak Republic*, Publications Office of the European Union, 2018 and Eurostat, *Business expenditure on R&D (BERD) by size class and source of funds*, Last update: 18-03-2020 available at: https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do

[238] Hector Hernández et al, *The 2019 EU industrial R&D investment scoreboard*, Publications Office of the European Union, 2019, https://op.europa.eu/en/publication-detail/-/publication/bcbeb233-216c-11ea-95ab-01aa75ed71a1/language-en

and competitive advantage.[239] This 'reverse knowledge transfer' is hard to measure, but Lamia and Piscitello hypothesise that MNC R&D activities in host countries only increases home country productivity when they invest in knowledge-seeking R&D. Consequently, investment in host research has a negative effect on home productivity when they invest in knowledge-exploiting R&D.[240] The Slovak government has in recent years used investment stimuli to promote knowledge-intensive foreign direct investment. In 2015, for example, it funded a technology centre for experimental development, design and innovation in industry automation (EUR 0.6m and 30 jobs) and another technology centre for experimental design of the car interiors (EUR 0.8m and 44 jobs). However, these activities should be evaluated to refine their knowledge-seeking elements vis-à-vis their knowledge exploiting elements, in order to further incentivise MNC activity in Slovakia.

Over the past decade, the trade balance in high-tech and medium-tech goods of the Slovak economy increased greatly, well above the EU average and with high total productivity. The telecommunication and sound-recording apparatus sector, for example, was a significant contributing factor. However, a 2013 study indicated that these strengths were slow to correspond to higher R&D levels.[241] Furthermore, falling levels of FDI into Slovakia since 2008 mean there is less opportunity to incentivise R&D investment by large foreign companies.[242]

As a result, a source of major productivity over the past few years, technology imports, is evaporating due to declining inflows of FDI. In 2013 a strong decline was observed in non-R&D innovation expenditure and in license and patent revenues from abroad.[243] With regards to SMEs, the 2019 European Innovation Scoreboard data indicates that the share of in-house innovating SMEs was still much lower in Slovakia than elsewhere in the EU, although it did increase by 26% between 2011 and 2018.[244] The EU average is 42.7%.

As outlined in section 2.2.4, the dearth of private sector actors in the RTDI system in Slovakia and lack of cooperation between academia and those businesses that do participate is a major weakness of the system. In the private sector, domestic firms, including a great number of SMEs and a few large companies, are characterised by low R&D expenditure and productivity levels.[245] As a result, the production system remains dominated by technology imports, supported by foreign direct investment. This set up means there is little reason for the research system to engage with the private sector actors. The falling FDI levels have correlated with increased levels of human resources for RTDI in the private sector, as illustrated in section **Chyba! Nenašiel sa žiaden zdroj odkazov.**, but there remains a lack of collaboration with the public sector. Discussions with private sector stakeholders highlight the difficulty of navigating the RTDI structures of the public sector and finding the right individuals to drive collaborations. On the other hand, public sector interviewees noted that the private sector was not large enough to find collaborators to engage with on any impactful level. Looking at the increasing figures for human resources focused on RTDI in the business sector, the latter seems to be an increasingly inaccurate interpretation of the current state of play. One common forum for public-private collaboration is incubators or shared working spaces. While HEIs in Slovakia often have incubators or common working spaces with SMEs, the interviews revealed that the

[239] Lamia Ben Hamida and Lucia Piscitello, *The impact of foreign R&D activities on the MNC's performance at home: evidence from the case of Swiss manufacturing firms*, Revue d'économie industrielle, 143 | 2013, 11-33.

[240] Lamia Ben Hamida and Lucia Piscitello, *The impact of foreign R&D activities on the MNC's performance at home: evidence from the case of Swiss manufacturing firms*, Revue d'économie industrielle, 143 | 2013, 11-33.

[241] European Commission, *Innovation Union Progress at Country Level*, 2013, p242.

[242] *Slovakia: Foreign Investment*, Santander Markets, May 2020, https://santandertrade.com/en/portal/establish-overseas/slovakia/investing?&actualiser_id_banque=oui&id_banque=17&memoriser_choix=memoriser

[243] European Commission, *Innovation Union Progress at Country Level*, 2013, P242

[244] Slovakia Country Profile, *EU Innovation Scoreboard*, European Commission, 2019, https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en

[245] OECD, OECD Economic Surveys: Slovak Republic, 2019, https://www.oecd.org/economy/surveys/Slovak-Republic-2019-OECD-economic-survey-overview.pdf p6.

majority of these companies are not focused on research and so cannot collaborate with the public research institutes or HEIs. More research is needed into the precise nature of occupancy for these spaces before a remedy can be suggested.

In terms of opportunities, Slovak SMEs have shown promising performance in the SME instrument, now under the European Innovation Council. Some cases studies can be seen in Figure 13. In 2018, the success rate for Slovakia was 2%, compared with 3% for the Czech Republic, with a total of 21 and 25 supported SMEs respectively, although Slovakia is building its capacity in this regard.[246] In 2019 this figure was 18 for Slovakia and 21 for the Czech Republic.[247]

Furthermore, if existing tax relief procedures for companies carrying out R&D in Slovakia can be simplified, it will incentivise further innovation investment. This issue is explored further in section 2.3.2. Finally, the interviews conducted for this study suggested that the existing system of innovation vouchers is not fit for purpose and should have a larger budget. If this problem can be overcome then more companies may be able to carry out early-stage research and development activities. More information and analysis on this topic is provided in **Chyba! Nenašiel sa žiaden zdroj odkazov.**.

Figure 13: Examples of EIC/SME Instrument Projects in Slovakia

PEWAS SRO

https://www.pewas.sk/sk/spolocnost

The project is called New seed treating method, hydrostimulation, for higher crop yields in water deprived regions.

This company has coordinated a project to develop the PEWAS Aquaholder™ Seed+ concept of hydrostimulating seed treatment (AQS). It was developed as a response to a serious problem of drought in agriculture. It is a unique seed coating method for higher seed emergence and crop yields in water deprived regions.

- Total budget: EUR 71,429
- Start date: 01/03/2018
- End date: 30/04/2018

HOLIG GROUP a.s.

http://www.holig.sk/

The project is called Technology for 2G biofuel and biosolvents production verified in a pilot plant.

The companies are coordinating a project that will provide unique BIO2G biorefinery technology for production of a second generation environmental-friendly biofuel (biobutanol) and biosolvents (bioacetone, bioethanol) from lignocellulose raw materials.

- Total budget: EUR 71,429
- Status: Ongoing

SAFTRA PHOTONICS SRO

[246] European Commission, *Innovation kitchen: HORIZON 2020 SME Instrument Impact Report*, 2018, https://ec.europa.eu/easme/sites/easme-site/files/smei_2018_impact_report_final_may_2018.pdf p34.

[247] https://ec.europa.eu/easme/sites/easme-site/files/2019-eic-report.pdf

http://www.saftra-photonics.org/en/home

The project is called Disruptive portable device for pre-screening of Persistent Organic Pollutants – POPs – in food products and water.

This project is coordinated by a Slovak company that is aiming to commercialise, NanoScreen, a portable sensing device that will detect in-situ contamination in any food matrix and water with most deleterious POPs at a cost-effective price and in a reduced time-span. It is also aiming to simplify the procedure, allowing multiplexing.

- Total budget: EUR 71,429
- Start date: 01/12/2015
- End date: 30/04/2016

3 Drivers and barriers for innovation

Chapter 3 is dedicated to mapping drivers and barriers (also referred to as bottlenecks) for innovation in Slovakia.

In accordance with the study scope, this chapter will cover systematic drivers and barriers along with key sector analyses covering digitalisation, automation and the robotics sectors.

The analysis of barriers and drivers supporting RTDI is especially importance given the enabling conditions – Common Provisions Regulation – set for the next programming period of European Funds and detailed in Regulation COM (2018) 375 final.

This regulation constitutes the adoption of a proposal for the next Multiannual Financial Framework for the period 2021-2027. Although the regulation does not replace existing regulation governing the 2014-2020 period, the aim of Regulation COM (2018) 375 is to reduce fragmentation and to deliver a common set of basic rules for EU funds.

The main objectives of the architecture and provisions of the proposed Common Provisions Regulation are to:

1. Substantially reduce unnecessary administrative burden for beneficiaries and managing bodies while maintaining a high level of assurance of legality and regularity. This is the key guiding principle of the reform, and includes a large number of simplifications and alignments across the regulations – but especially in terms of:

i. The roll-over of management and control systems (and other measures which facilitate programme launch). Greater use of "proportionate arrangements", where lower risk programmes can rely more on national systems.

ii. The use of simplified cost options and payments based on conditions.

iii. Financial instruments.

2. Increase flexibility to adjust programme objectives and resources in the light of changing circumstances and also in terms of voluntary contributions to EU-level directly managed instruments.

3. Align the programmes more closely with EU priorities and increase their effectiveness. This includes:

i. Aligning the intervention logic and reporting with the Multiannual Financial Framework headings and increasing concentration requirements on priority areas.

ii. Forging a closer link with the European Semester process.

iii. Setting more meaningful enabling conditions that need to be maintained throughout the implementation period.

The adoption of the Regulation means that ex ante conditionalities in the 2014-2020 period will be replaced by "enabling conditions".[248] These will be fewer but more focused in nature, and monitored and applied throughout the period in contrast to the 2014-2020 period.

One important practical consequence is that the Member States will not be able to declare expenditure related to specific objectives until the enabling conditions are fulfilled. This condition is in place to ensure that all co-financed operations are in line with the EU policy framework.

The Regulation should also address the fact that in recent consultations on the effectiveness of cohesion policy, stakeholders found complex procedures to be by far the main obstacle to success, followed by heavy audit and control requirements, lack of flexibility, difficulty to ensure financial

[248] Regulation COM (2018) 375 final.

sustainability and delays in payments.[249] Although this was an EU-wide finding, it equally also applies to the situation in Slovakia.

Indeed, the high-level group of experts that was convened to discuss the simplification of cohesion policy as part of evaluative exercises of the past programme period (2007-13) made a number of conclusions[250] that resonate with barriers identified in the Slovak Republic including:

- **The application of fewer, clearer and shorter rules**. *This report concludes that there is a number of acute challenges with the disbursement of ESIF funding for innovation in Slovakia.*
- **More reliance on national management and control systems and procedures as opposed to EU-level ones**. *This recommendation would in practice entail increased responsibility of the Slovak Managing Authorities to design, implement and maintain improved monitoring process.*
- **Avoid re-appointing institutions for the next programming period**. *This may ease the designation of Managing Authorities for the next programme period and allow those that have performed well to continue their operations from 2021 onwards.*
- **Easier modification of national programmes.** *Given the challenges that Slovakia has been through with the innovation-related Operational Programmes in the current period, administrative delays need to be avoided in the next programme period.*

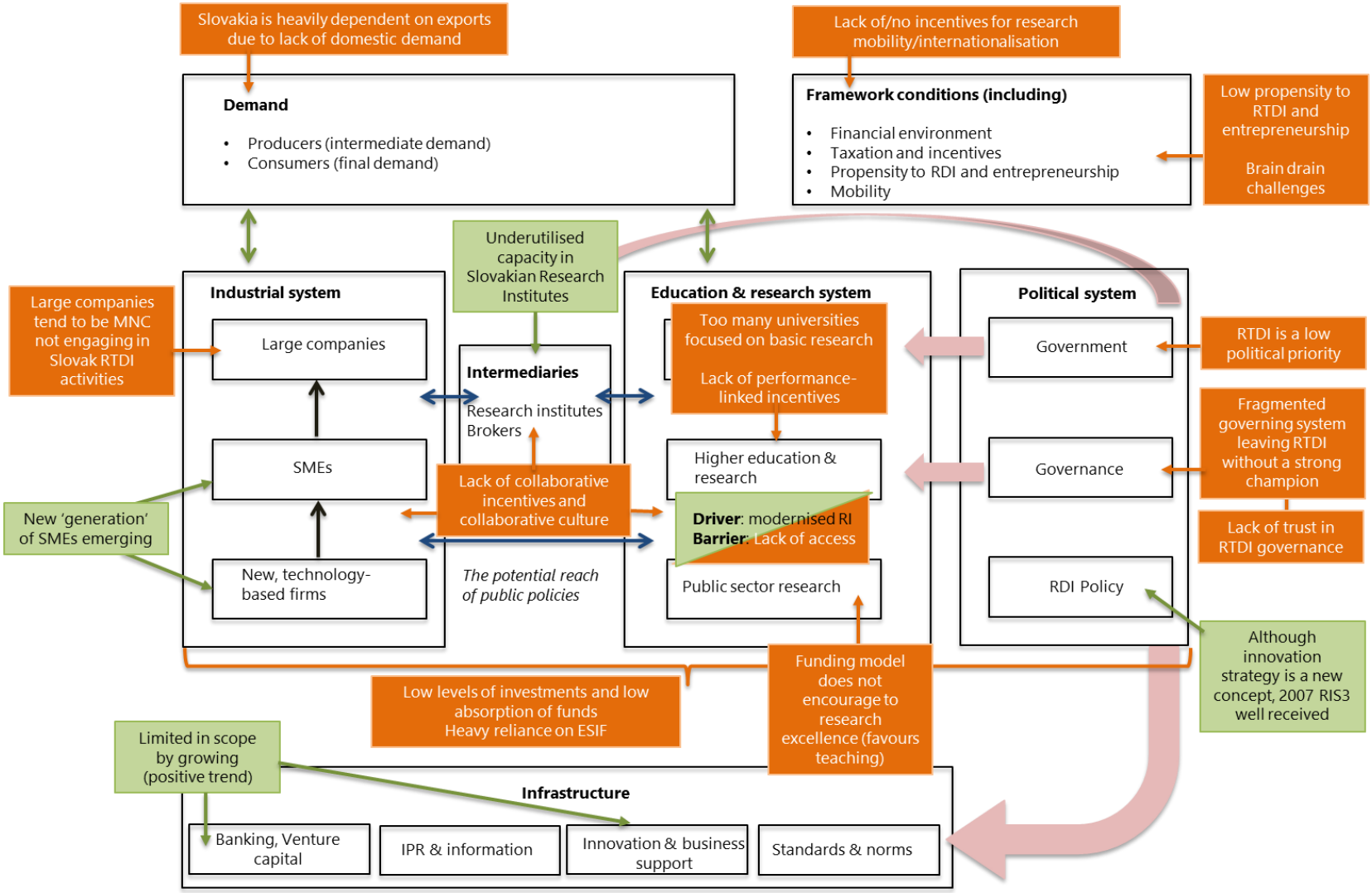
3.1 Systemic drivers and barriers

The aim of Chapter 3 is to systematically map drivers and barriers to improving the effectiveness of RTDI in Slovakia. The next sections of this chapter will present this study's findings with regards to strengths and weaknesses of Slovak RTDI across the innovation system model.[251]

The figure below provides a (high-level) illustration of the nature of drivers and barriers. These key examples of strengths and weaknesses are then further discussed.

[249] Regulation COM (2018) 375 final.
[250] Regulation COM (2018) 375 final.
[251] Kuhlmann and Arnold (2001) System of Innovation, described in RCN in the Norwegian Research and Innovation System

Figure 14: Slovak RTDI – drivers and barriers



3.1.1 Political system

There is a consensus that the political system governing Slovak RTDI is not effective. As outlined in Chapter 2, international assessments made by the EC and the OECD have pointed to weaknesses stemming back many years, and based on new primary evidence this study concurs with previous assessments.

Although this study, as well as previous assignments[252], have struggled to clearly detail the factors behind these barriers, it is sufficiently clear that they are predominantly political in nature.

The governance of RTDI in Slovakia has many elements common to other European countries – RTDI is a policy which is coordinated between a number of ministries (see Chapter 2). Although a shared ministerial responsibility of RTDI is not a drawback per se, a lack of coordination at the political level is clearly hampering efforts in Slovakia.

This study's investigations, summarised in Chapter 2.2.1, point to several issues that need to be addressed:

Accountability and transparency are lacking which makes it difficult to trace, identify and rectify the bottlenecks to effective governance. Without accountability and clear procedures, it will be difficult to improve coordination and implementation as it is currently organised. Agreed decisions that have been taken at the coordinating forum appear not always to be followed through and/or take a disproportionate amount of time to implement.

A robust results-based monitoring and evaluation framework also appears to be predominantly absent. This point has many aspects. For example, anecdotal evidence points to political interests blurring the evaluation of grant proposals, which undermines trust and transparency of the funding process. From an ex-post perspective, an overreliance on administrative data and a lack of data on results, will make it difficult for Slovak RTDI governing bodies to know what funding is effective or less effective.

A large number of agencies are in charge of implementation of ESIF and national RTDI funding. Some of these have a stronger reputation than others. Given the changes that are to be brought in with the implementation of Regulation COM (2018) 375, now would seem an opportune moment to review RTDI implementing agencies and redesign coordination based on evidence of their effectiveness. This could be an opportunity to not only improve administrative procedures but also to better coordinate different pools of funding available.

Finally, many Slovak stakeholders are concerned about a **lack of a long-term vision for Slovak RTDI.** Currently, there is a focus on solving immediate problems. However, rapid changes to the manufacturing sector (such as digitisation) will require not only short-term action but an agreed longer-term strategy for Slovakian RTDI. This includes a need for an agreement on new areas to be prioritised for investment. Indeed, Slovak RTDI has excellent research infrastructure, promising research groups, innovative businesses dedicated policymakers and innovation support staff who can contribute to an improved performance, should they be provided with better governance and support structures.

[252] For example, the Interim evaluation of Operational programme Research and Innovation (2014-2020), which states that "*It is not easy to name the exact causes of the current state of the program. Thorough analyses show that this state is primarily caused by a combination of systemic and administrative flaws throughout all degrees of management and implementation system of ESIF and OPs; starting with delays in defining basic rules for a functioning system of ESIF management, delay in functionalities for primary system of programs' operations, delay in meeting ex ante conditionality criteria on program level, as well as not abiding of defined methods for selection of operations on different levels of management of the program.*"

Ultimately, a lack of effective coordination in combination with a lack of strategic agenda has undermined trust in policymaking and **led to some fatigue among research performers and entrepreneurs and a lack of trust in the policymaking process.**

3.1.2 Education and Research system

A number of drivers and barriers can be found in the Slovak education and research system. These are documented in greater detail in Chapter 2 and are summarised below.

The current main drivers of the Slovak education and research system are the top performing HEIs, which contribute to much of the high-quality output in Slovakia. However, there are strong (potential) drivers in the form of:

- The **top performing universities and niche universities** that show some innovative practice in contributing to regional innovation activities (Slovak Agricultural University in Nitra, for example).
- **Slovak Research Institutes with the potential to showcase strong collaborative links** but that appear to struggle with funding.
- In **triple helix constellations** such as competence centres and some strong clusters.

The **Slovak Academy of Sciences is another key driver of research excellence, but delays in modernising the legal form** of the institution have led to a missed opportunity in allowing SAS to play a more effective role in RTDI cooperation and commercialisation.

A **current weakness is the comparatively low levels of internationalisation and collaboration** with non-Slovak researchers and with industry. In our assessment, there is a need for both institutional and policy-driven incentives to link collaborative behaviour with career progression. To an extent, this is happening naturally since younger Slovak researchers appear to be (according to anecdotal evidence) more prone to study and work abroad and are generally better at networking. However, progress driven by generational changes will be fairly slow.

Poland has set up a dedicated government agency tasked with the promotion of international academic mobility and internationalisation of Polish science – the National Agency for Academic Exchange (NAWA).[253]

Despite strong pockets of research, the **Slovak Education and Research (E&R) system is overall disconnected** from other key parts of the innovation system.

With regards to education, the Slovak **education system is not sufficiently effective** at supporting STEM research and innovation in particular, and there is a lack of supply of suitable skilled new talent. These issues are further addressed in Chapter 4. In brief, the Slovak education system does not currently fully support its own knowledge-intensive industries with enough graduates. However, the education system is only one side of this challenge. The other side of the issue is the problem of brain drain.

Demand and supply in higher education, i.e. attracting students to disciplines with strong skills needs, can be supported through scholarship incentives. In Slovenia, STEM studies have been promoted through more favourable scholarship policies and as a result there has been a small increase in the share of students enrolled. The gender balance of students choosing STEM studies has also improved over time. In 2004 only 7% of women were enrolled in STEM tertiary education; in 2010 the number increased to 11% and to14.3% in 2016/17 . [254]

[253] The website for the agency can be found here: https://nawa.gov.pl/en/nawa

[254] Bučar M, Jaklič A and Gonzalez Verdesoto, E, *RIO Country Report 2017: Slovenia*, Publications Office of the European Union, 2018.

The major barrier to research is a **lack of mutually beneficial conditions for public-private collaboration**. Universities are still offer predominantly financially and professionally incentives to carry out basic research. The large number of universities operating in Slovakia also appears to undermine effectiveness and quality of the outputs.

The fragmentation of the Slovak HEI system is also relevant when assessing the funding model for Slovak Research Institutes. **Funding is very limited and spread across a large number of institutions.**

Slovak Research Institutes, which tend to carry out more applied research, claim that they have a comparative disadvantage compared to HEIs as a result of unfavourable funding models – RIs tend to receive 50% core funding compared to HEIs receiving 100%. Given the underperformance of RIs in international research (e.g. H2020, see Chapter 2), **revised funding models** which better promote scientific excellence and internationalisation could better support the development of both HEIs and RIs.

In response to EC recommendations, Czechia has been working on the development of a revised methodology of research organisations (Metodika 2017+) for some time. The new system envisages a gradual implementation of informed peer review, which should better guide the evaluation system of institutional funding for research performers. It is expected to be fully implemented by the end of 2020. Implementation has been gradual and increases in institutional funding are being allocated only based on the new methodology.[255]

3.1.3 Industrial system

The Slovak industrial system is characterised by what could be described as a dual nature. On the one hand, it is populated by **a smaller number of large multinational companies** which contribute with significant employment and turnover. However, as described in Chapter 2, they are not sufficiently involved in RTDI activities. This situation has developed in Slovakia thanks to past government strategies that aimed to attract FDI as a way of supporting the economy.

On the other hand, **domestic industry is quite young and overall characterised by low R&D expenditure** and productivity levels. An insufficient number of domestic companies collaborate with the public research institutes or HEIs.

Since Slovakia's traditional industrial strongholds – manufacturing and the automotive sector – are seeing rapid changes, industrial diversification is an increasing priority.

Several **promising sectors – ICT, robotics, the green and bio economies – offer opportunities**. Given Slovakia's world leading position in automotive manufacturing, there will also be a need to ensure that the automotive and wider manufacturing industries are sufficiently innovative for Slovakia to continue to compete internationally.

Although **developments are promising, they are still small scale**. The Slovak government has little experience in supporting innovation given a long history of reliance on FDI. As a result, Slovakia is facing a learning curve in supporting domestic industry. This will require strengthened public-private collaboration, including triple helix-based cooperation. Slovakia's record of supporting these types of initiatives is mixed (see Chapter 2), hence it will be important to build on past best practice as well as draw upon lessons learned from other countries.

In order to effectively tackle current barriers, it will equally be necessary to confront the **structural skills challenges** described in this report (see Chapter 4) and to encourage improved support for entrepreneurship and the development of stronger entrepreneurship skills.

[255] Shrolec, M., and Sanchez-Martinez M., RIO Country Report 2017: Czech Republic, EUR 29164 EN, Publications Office of the European Union, 2018.

The 2018 Polish RIO report concluded that "Poland has a vibrant start-up scene, with 2,677 identified start-ups, around half of which are funded from own resources, and 59% being micro-enterprises". The same study also highlights that numerous intermediary organisations support start-ups and offer mentoring, incubation, and acceleration services, as well as co-working spaces. Google, Microsoft and Samsung have all established corporate start-up incubators in Poland, and numerous large companies, including state-owned enterprises, pursue corporate venturing strategies, using the support of Polish public agencies. Investments in innovative start-ups are enabled by dedicated funds. [256]

A 2018 CEDEFOP analysis[257] also provides recommendations on how to mitigate skills shortages, which the analysis suggests is a joint responsibility between firms and public bodies. Recommended actions include the following:

Actions for firms	Actions for the government/public authorities
• Adopt a long-term approach to hiring and managing talent via the offer of good-quality jobs.	• Design new vocational programmes or schools
• Target individuals on the basis of their potential rather than on accumulated prior work experience, also sourcing relatively unexploited talent (females, older workers, migrants)	• Set up qualification frameworks and systems of validation and recognition of the sizeable stock of informal skills
• Increase participation in work-based training programmes is another well-established avenue for plugging skill gaps of new hires	• Strengthen creativity, innovation and other key competences as part of Vocational Education and Training (VET) education curricula
• Prepare training that takes place directly in the workplace when studying (such as apprenticeships) since this is a particularly effective means of placing individuals into more skill-intensive jobs	• Design effective skill anticipation systems, which can provide accurate and up-to-date labour market intelligence

Source: CEDEFOP 2018

These recommendations provide general points of good practice that could be further tailored to current needs in Slovakia. It should nevertheless be recognised that Slovak firms, in particular in the traditional manufacturing sector, will need human and financial support from relevant ministries and other stakeholders in order to be able to offer better quality employment and become more attractive employers, for example.

3.1.4 Intermediaries

Intermediary organisations play an important role in the innovation system since they tend to operate between private industry and public sector organisations and HEIs. According to smart specialisation theory,[258] intermediary organisations, such as research and technology organisations, play multiple roles in smart specialisation:

1. Contribute to entrepreneurial discovery process

[256] *Klincewicz K., Marczewska M., Szkuta K., RIO Country Report 2017: Poland,* EUR 29150 EN, Publications Office of the European Union, 2018.

[257] Cedefop, *Insights into skill shortages and skill mismatch: learning from Cedefop's European skills and jobs survey*. 2018, Publications Office of the EU, http://data.europa.eu/doi/10.2801/645011

[258] European Commission, *What are RTOs?,* Smart Specialisation Platform, https://s3platform.jrc.ec.europa.eu/web/guest/rtos

2. Facilitate connections among actors
3. Build research and technology capacities and contribute to technology transfer.

A number of intermediaries in Slovakia are able to take on these types of tasks. However, overall the 'intermediary sector' is still being developed. Given the challenges described above affecting governance, the education and research system, and the industrial sector, **the strengthening of intermediaries in the Slovak RTDI system should also contribute to tackling the barriers identified in those areas as well**.

Interviews carried out for this report showed that there is an overall consensus that cooperation between public and private RTDI performers exists but that it is not sufficiently widespread or systematic to produce lasting change. A change in culture towards more inclusive activities is therefore required. Collaboration mostly occurs at present on an ad hoc basis and not at an institutional level but involving individual or groups of individuals.

Organisations and entrepreneurial associations that operate in the middle range of Technology Readiness Levels (TRLs), such as research institutes, competence centres and clusters, are typical organisations which may help unlock more effective and widespread networking and exchanges.

Slovakian cluster organisations were considered to have a lot of potential as well as contributing to innovation output, but they were underutilised and not given due prominence. They are also dominated by industry with less engagement by public sector actors. In addition, support for clusters under ESIF had not been very successful in this programme period since the call for proposals was issued in 2020. However, the concept of clusters is worth investing in. Examples of well-functioning clusters included the IT cluster linked to the Technical University in Košice.

Another important development over the past decade or so has been the construction of University Science Parks in Slovakia. These were described by some interviewees as "a game changer" and there was also a consensus that the science park programme has been well designed and effective. Although more recently established competence centres and clusters have been making important contributions to RTDI, the **science park model was actually pointed out as a good practice example in Slovakia for furthering innovation in particular.** This is despite the fact that in the science park programme, cooperation with business was voluntary, while in the competence centre and cluster programmes cooperation between public and private entities is obligatory.

Given the role of intermediaries in the EDP, another aspect of supporting intermediary organisations is the potential to support bottom-up and regionally driven innovation.

3.1.5 Infrastructure

As described in Chapter 2.4.2, **Slovakia has taken significant steps in upgrading its RTDI infrastructure.** Structural Funds financing has played a significant part in these investments. Although research infrastructures are a key element in the RTDI system, they also continue to require finance and maintenance once they have been developed/purchased. Large-scale research facilities are expensive to build and to run since they require skilled human resources to use and to maintain them.

As such, the **mere presence of infrastructure in a RTDI system does not mean that it is a driver of innovation since it also needs to be effectively put to use**. It is therefore positive that current ESIF funding is partly dedicated to supporting the purchase of equipment, human resources and knowhow on maintaining the infrastructure in place.

However, **important barriers remain which hamper the return on investment**. As outlined in Chapter 2.4.2, there are issues around access to cutting-edge infrastructure which tend to be located at university grounds and thus infrastructure tends to be used as part of research carried out by that

institution. Since Slovak HEIs focus on basic research ensuring that industry and entrepreneurs have full access to infrastructure should also be a priority. This assessment can be done in several ways.

For example, in Czechia, the Ministry of Education, Youth and Sports commissioned an interim evaluation of large-scale infrastructure using international peer review and conforming to the evaluation standards of the European Strategy Forum on Research Infrastructures (ESFRI). The results are being considered in the forthcoming decision on funding of the infrastructures – both from the national budget and ESIF – to ensure that investments are sustainable.[259]

A 2018 ESFRI report points out that effective use of research infrastructure is a key responsibility in the management of RI. It also points out that 'interactions' or collaborations should be managed as a part of the overall mission of RI and of a pro-innovation strategy of individual RIs. To realise this, they require dedicated mechanisms and, in some cases, dedicated staff able to interface with the whole range of potential stakeholders of the facility. Industrial cooperation is also an obviously important factor that strengthens the RI long-term sustainability and contributes to the broadening and diversification of international cooperation links.[260] According to this study's investigations, much of this proactive kind of management appears to be missing in Slovakian RI.

3.1.6 Framework conditions and demand

Framework conditions for entrepreneurship and innovation are a very important factor in becoming an attractive prospect for investments and innovative activities. Framework conditions are vital for supporting innovation activities that are also able to adapt to developments in an increasingly competitive global economy.

Specifically, rules and regulations should provide good conditions for creativity and the creation of value and they should enable collaboration and exchanges while also protecting those involved.

Examples of regulation that are important in the RTDI system are the design of the tax system, standards and intellectual property rights.

The functioning and the **effectiveness of framework conditions appear not to be a major concern** for Slovak RTDI performers or policymakers, who point to other more immediate barriers. There are, however, some sticking points such as the **delayed transformation of SAS**, which, once completed, should provide a more modern and competitive academy.

The European Innovation Scoreboard 2019, which notes some of the following strengths and weaknesses

Table 15: Overview of Slovakia performance – Innovation Scoreboard 2019

Slovakia innovation scoreboard strengths	Slovakia innovation scoreboard weaknesses
• Sales of new-to market and new-to-firm product innovations • Employment fast-growing enterprises of innovative sectors • Medium and high-tech product exports	• Finance and support, including venture capital expenditures • Intellectual assets, including Patent Cooperation Treaty patent applications • Attractive research system • Lifelong learning

Source: European Innovation Scoreboard 2019

[259] Shrolec, M., and Sanchez-Martinez M., *RIO Country Report 2017: Czech Republic*, 2018, Publications Office of the European Union.

[260] ESFRI, *Innovation-oriented cooperation of Research Infrastructures European Strategy Forum on Research Infrastructures Innovation Working Group*, 2018 https://ec.europa.eu/info/sites/info/files/esfri_scripta_vol3_2018.pdf

Other **existing barriers include a lack of fully effective tax incentive system for innovation and weak enforcement of IPRs**. However, although these barriers exist, they appear smaller in magnitude from the stakeholders' point of view.

Indeed, **the lack of domestic demand**, which is forcing Slovak innovators to export internationally in order to grow, sometimes appears to be a more significant barrier than domestic framework conditions.

Another barrier which could be viewed as a framework condition is the regional disparities present in Slovakia and the fact that much of the innovation activities that are carried out are concentrated in the capital city of Bratislava and in the Košice region.

3.2 Sectoral drivers and barriers

This section presents a brief analysis of three sectors – digitalisation, automation and the robotics sector – and outlines some key Slovak strengths and weaknesses (which in turn could be linked to specific drivers and barriers) to innovation that are specific to these particular industries.

3.2.1 Digitalisation

Given Slovakia's high share of manufacturing, especially the automotive sector, it is strongly impacted by the trend towards digitalisation through, for example, the move towards electric drivetrains and smart vehicles. This move is shifting the value-adding activities within the automotive industry towards digital components.

Since one in 10 Slovak employees is working in the automotive industry[261], digital transformation in the car manufacturing value chain will have a notable impact. To cushion the impact and to ensure Slovakia can remain internationally competitive, its workforce will need to be supported in adapting to change and improving their digital skills. If workers' skillset cannot be adapted, there is a risk of loss of employment opportunities.

A shift to a more digital economy will require Slovak enterprises to develop new business models and to adapt their processes in line with the global trends. New business models will have increasingly have common features including: cross-jurisdictional scale without mass; a heavy reliance on intangible assets, especially intellectual property (IP); and a heavy reliance on data, user participation and their synergies with IP.[262]

According to the Slovak Investment and Trade Development Agency, currently the ICT sector contributes 4.6% to GDP. The Slovak government adopted a Strategic Document Concept for Smart Industry, with a view to implementation by 2020. The plan specifically aimed to increase the competitiveness of Slovak businesses, create favourable conditions for automation trends in manufacturing, improve the start-up environment, support innovation, facilitate investment in digital solutions and ensure the availability of a sufficiently skilled workforce.[263]

According to the latest European Semester report (2019), the adoption of digital business practices is progressing, but from a low level. For example, according to European Commission analysis, the Slovak Information Technology Association estimates that an additional 10,000 experts are needed to support Slovak businesses. Targeted efforts in education and (re)training and improved labour

[261] SWD (2019) 1024 final

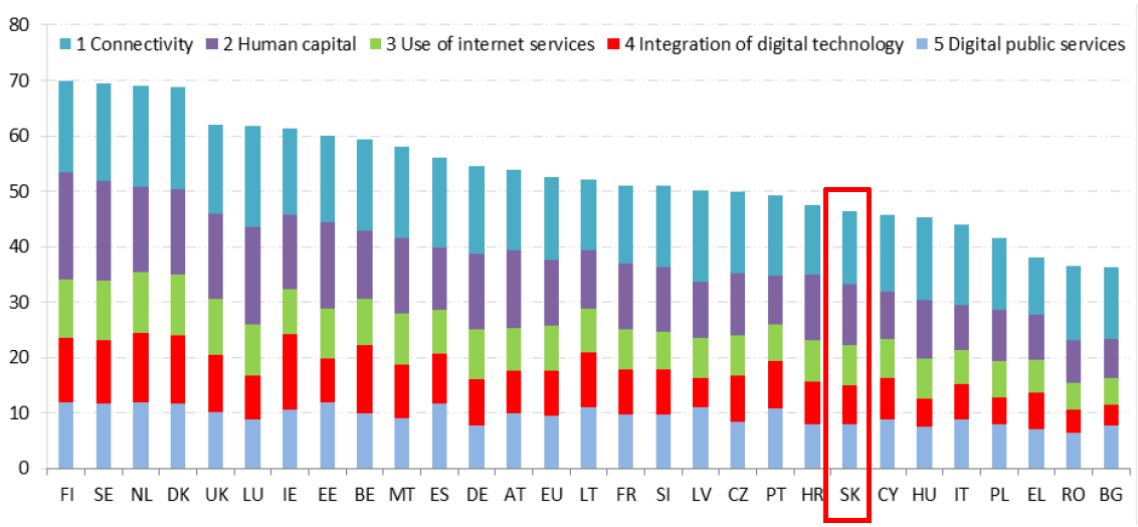
[262] OECD DIGITALISATION, BUSINESS MODELS AND VALUE CREATION. Chapter 2. Digitalisation, business models and value creation

[263] SWD (2019) 1024 final

mobility could help mitigate this shortage, thereby increasing allocative efficiency and thus the productivity of the wider economy.[264]

Slovakia's overall digitalisation level, measured by the EC's Digital Economy and Society Index (DESI) for 2019 was on par with its neighbours. Poland and Hungary were a bit behind, whereas Czechia and Slovenia were somewhat more highly ranked than Slovakia. However, all Visegrad countries and Slovenia were ranked lower than Austria and Germany and lower than the Nordic countries.[265]

Figure 15: DESI Index 2019



Source: European Commission

Based on the above figure, Slovakia performed well in human capital, thanks to the share of population with at least basic and above basic digital skills, which were both above the EU average. The country has also improved in the connectivity, use of internet services and especially in the digital public services dimensions.

Slovakia has been significantly extending its fast and ultrafast broadband coverage. The share of Slovaks who never used the internet is declining. A growing share of Slovak internet users shop and sell goods and services online, and nearly three quarters of them participate in social networks. Slovakia performs well in the open data indicator and is improving digital public services for businesses.[266]

Slovakia's overall score in all the dimensions remains below the EU average, but judging by its DESI index performance, Slovakia is on a modest upward trend, although this statement needs to be caveated with the following, as the forthcoming RIO report points out:

"*In case of a rather monocentric country like Slovakia one must be cautious that such country-wide digital infrastructure assessments must not reflect the conditions in the major agglomeration area (i.e. Bratislava).*"[267]

[264] SWD (2019) 1024 final

[265] Gunter Deuber and Oliver Marx, *Digital Slovakia: Selectively at the top, but not enough for an overall top spot yet*, 29. April 2019, Discover CEE, http://www.discover-cee.com/digital-slovakia-selectively-at-the-top-but-not-enough-for-an-overall-top-spot-yet/

[266] European Commission, *Digital Economy and Society Index (DESI) 2019 Country Report Slovakia*, 2019.

[267] Forthcoming Baláž, V., Frank, K., Ojala, T. *Innovation Country Report 2019: High growth enterprises, innovation and productivity challenges, Slovak Republic*, 2020.

3.2.2 Automation and robotics

Automation of industry and robotics are closely interlinked. Both sectors are also highly important to the Slovak economy given its reliance on high-end manufacturing.

The current RIS strategy puts significant emphasis on automation and robotics, suggesting that "by 2020 the companies will use capacities of research, development and innovation centres built for the needs of smart specialisation sectors, which will develop next generation demand products, technologies and materials".[268]

The following sections provide a brief summary of the current literature on automation and robotics respectively, but this evidence is not sufficient to provide a full analysis. Further research in this regard will be needed through other activities of this assignment.

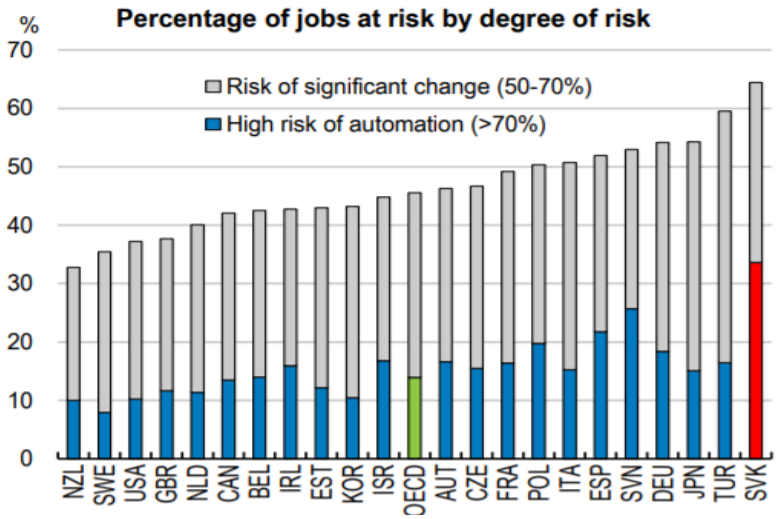
3.2.2.1 Automation

The recent OECD Economic Survey of Slovakia (2019) [269] provides some insights into automation of the manufacturing sector and into Slovakia's position in an international context.

The analysis recognises that much of Slovakia economic success stems from having a role in the value chains of car manufacturing and electronics industries. However, due to rapid technological developments, Slovakia will need to become more competitive – not necessarily through offering competitive wages, but by offering further skills and expertise.

The below figure shows the extent to which Slovak jobs are at risk as a result of increasing automation:

Figure 16: Employment and automation risks



Source: OECD

OECD's analysis is also echoed by PWC (using OECD data but a revised methodology). Its 2018 report on automation revealed a range of estimates across countries for the share of existing jobs with potential high rates of automation by the 2030s. It singles out a number of Eastern European countries including Slovakia (44%) which have relatively high automation potential.[270] The same

[268] *Smart Specialisation Strategy for the Slovak Republic (the RIS3 document)* via the Government Resolution no. 665/2013

[269] OECD, *OECD Economic Surveys Slovak Republic*, 2019.

[270] PWC, *Will robots really steal our jobs? An international analysis of the potential long-term impact of automation*, 2018.

report also concludes that Slovakia (along with Germany and Italy) could see relatively higher automation rates in the long run as well.

These analyses both point to specific challenges to be addressed including:

- Reverse the trend of exporting relatively low value-added products.
- Invest in human resources and training to address the current skills shortages in order to continue to attract international investment.
- Broaden the range of industries in which Slovakia plays a part in the global value chain.
- Support smaller or domestically owned firms to become more competitive internationally and to become contenders for global value chains.

3.2.2.2 Robotics sectors

Thanks to it being an intricate part of modern manufacturing, Slovakia has the 15th highest robot density in the world. Slovakia, along with Slovenia, is a robotics innovation leader in Central and Eastern Europe, according to the International Federation of Robotics.[271]

Slovakia has over 151 robots per 10,000 employees in the manufacturing industry, outranking countries like China, Finland and France. Slovakia is also well above the European average of 106 robots per 10,000 employees.[272]

According to market reports, Slovakia houses several promising RTDI institutions and laboratories, including but not limited to:

- The Institute of Control and Industrial Informatics (ICII) at the Slovak University of Technology, which carries out research on industrial robotics, mobile robotics, mobile manipulators and service robotics.
- The Centre for Intelligent Technologies (CIT) at the Technical University of Košice, which focuses on the promotion and support of intelligent technologies in Slovakia.
- The faculty of Mechanical Engineering at the Technical University of Košice.

The Cluster for Automation Technologies and Robotics (AT+R), located and established in Košice in 2010, was promoted by stakeholder interviewees as being a successful robotics actor. Its key activities include transfer of new technologies, and training programmes in development, production and business internationalisation.

At a policy level, Slovakia is also proactive in the area of robotics, which is summarised in the Slovakia AI Strategy Report in which Slovakia outlines its ambition to invest in EU-led networks of Centres of Excellence for promoting Artificial Intelligence. The Slovak strategy also recognises the precarious position of AI in Slovak RTDI suggesting that an

"*analysis of the current state of Slovak research in the field of artificial intelligence points to small research capacities, fragmentation of national research capacities and low funding. This does not allow Slovakia to take a strong position at the level of European initiatives and thus exploit its potential artificial intelligence at European and world level. The current system does not support national and international cooperation between research teams and naturally results in the low recognisability of Slovak research in the field of artificial intelligence abroad.*" [273]

[271] SWD (2019) 1024 final

[272] *Top robotics research institutions and labs in Slovakia*, Robotics Biz, November 17, 2019, https://roboticsbiz.com/top-robotics-research-institutions-and-labs-in-slovakia/

[273] European Commission, *Slovakia AI Strategy Report.* https://ec.europa.eu/knowledge4policy/ai-watch/slovakia-ai-strategy-report_en

Yet, the strategy also suggests that Slovakia has the potential to become internationally competitive at AI. One basis for this ambition is the Slovak Centre for Artificial Research intelligence[274], established in April 2019. This is a public-private initiative which aims to integrate over 50 key actors in AI in Slovakia.

The strategy also lists a few activities it needs to achieve in order to tackle the challenges in attaining a strong RTDI community in AI:

- Encourage the pooling and coordination of national research and application activities intelligence to further increase the attractiveness of Slovakia at the international level; and
- Make research and development of artificial intelligence more attractive at national level in order to stem the outflow of talent and build a critical mass of excellent AI researchers which will allow a multiplicative effect, including through the recruitment of such scientists from abroad.

Although these activities must be accompanied by an implementation plan, it is positive to see that the strategy also envisages promoting AI in a wider sense within the RTDI system e.g. by raising awareness of opportunities for AI in society, introducing lifelong programmes of education and reskilling, and by promoting the application of technologies with elements of AI joint projects researchers and workers from the private sector.[275]

[274] https://slovak.ai/?lang=en

[275] European Commission, *Slovakia AI Strategy Report.* https://ec.europa.eu/knowledge4policy/ai-watch/slovakia-ai-strategy-report_en

4 Current and planned policy measures

The final chapter before the conclusions provides an overview of the industrial transition measures that have been implemented in the Slovak economy since 2014. (The year of the adoption of the current RIS3). It also provides an assessment of currently available (or gaps in) skills sets related to research, innovation and transition of the Slovak economy.

4.1 Key industrial policy measures

Before moving on to describing the measures in question, it is important to note that Slovakia has a short history of innovation support. The first major policy published was The State Science and Technology Policy Concept for 2000-2005, which was replaced in 2007 by the Innovation Strategy and the Long-term Objective of the State S&T Policy up to 2015.[276] Prior to 2010, the national priority was to attract as much FDI as possible in order to create employment and to support lagging regions with economic investments.[277]

According to the European Semester report analysis, conversely, policy support for developing new technologies was not a priority, since it the then government expected that foreign investment would also bring access to technology and knowhow. However, in practice, technology transfer did not generally extend to Slovak companies but remained in the international corporations that brought it in the first place. It should also be borne in mind that there is a growing body of evidence that suggests the links between FDI inflows and tech transfer are inconclusive and reflect perceptions rather than actual transfers, except under specific conditions and in specific ways, for example tech transfer relating to productivity.[278] In Slovakia specifically, this can be seen in the automotive sector, where foreign-owned firms account for most R&D spending in the sector but these investments are mainly directed at improving production processes without high domestic technological diffusion. This limits knowledge transfer within the sector.[279]

Bearing in mind the above, direct innovation support has a short history. The number of explicit national innovation measures in Slovakia has been very low in comparison with other EU countries. [280] Instead, innovation support seems to have – according to Slovakian analysis[281] – focused on improving framework conditions for business environment (e.g. tax credits), social development and reform processes. RTDI support has only been a priority after the Competitiveness Strategy for the

[276] Slovak Government and Ministry of Education, *Long-term Objective of the State S&T Policy up to 2015*, 2007, http://www.inovasyon.org/pdf/Slovakia.LongtermObjectives.S&TPolicy.by2015.outlines.pdf

[277] Ministry of Economy of the Slovak Republic, *Draft Innovation Strategy of the Slovak Republic for 2007 to 2013,* https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/organisation/slovenska-republika/ministry-economy-slovak-republic

[278] Carol Newman, John Rand, Theodore Talbot and Finn Tarp, T*echnology transfers, foreign investment and productivity spillovers,* European Economic Review, 2015.

[279] European Commission, *Country Report Slovakia: 2020*, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020SC0524&from=EN p15.

[280] Ministry of Economy of the Slovak Republic, *Draft Innovation Strategy of the Slovak Republic for 2007 to 2013,* https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/organisation/slovenska-republika/ministry-economy-slovak-republic

[281] Ministry of Economy of the Slovak Republic, *Draft Innovation Strategy of the Slovak Republic for 2007 to 2013,* https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/organisation/slovenska-republika/ministry-economy-slovak-republic

Slovak Republic[282] was adopted in 2010 since this was the strategy which began to break the previous focus on FDI (see previous paragraph).

According to the recent (2019) EC Semester assessment, *"the [direct innovation] tools currently applied are mostly unsystematic, focusing on companies not having sufficient funds for innovations at their disposal."*[283]

4.1.1 RIS3 Implementation Plan – measures

The 2017 RIS3 Implementation Plan includes a list of 14 policy measures and 11 legislative and implementation measures put into practice between 2017 and 2018, as part of the realisation of the strategy (p36).[284] Responsibility for implementation of the measures lies with the ministries responsible for RIS3.

The measures are not listed in full, but a number of measures are highlighted below, since they are (more closely) linked to industrial transition, as opposed to the strengthening of RTDI:

- **Creation of a research infrastructure (RI) mapping system** (4). This measure would, when operational, respond to the needs of the industry for better access to state-of-the-art research infrastructure. The mapping system aims to guarantee RI *"sustainability and links to the key industries and dynamising the creation and growth of a critical mass of research and innovation teams"*.[285] Although there is documentation on measures relating to research infrastructure (for example as part of the Slovakia AI Strategy Report), there is little evidence documenting progress with the mapping initiative.
- **Ensuring human resources for an innovative Slovakia** (13). This measure refers to the roll-out of a reform programme of education policy to better align secondary schools and higher education institutions with labour market requirements, also taking into account demographic developments. That is, the reform aims to tackle the long-standing mismatch of educational attainment and labour market needs. Specific examples of these kinds of initiatives are outlined in the box below, although the extent of their implementation cannot be determined. The way in which the 2019 source describes the measures indicates that all three examples are either about to commence or are planned for the future. Given the major distractions caused by the COVID-19 crisis, it is possible that at least some of the activities planned may be postponed.

Box 2: Examples of human resource and educational measures

1. *"The Ministry of Education is to prepare a programme for informatisation of education until 2030: this programme will include the provision and updating of the ICT infrastructure of the educational system, but will also target the improvement of the quality of education. To address the latter issue, the government will encourage the reform of educational programmes to develop competences and skills needed in the digital transformation, including AI-related competences;*
2. *The office of the deputy prime minister of the Slovak Republic for Investments and Informatisation (ODPMII) in collaboration with relevant ministries will analyse the current condition of digital skills in Slovakian SMEs and come up with measures and standards to increase digital literacy of its employees;*
3. *The Ministry of Education and the ODPMII are setting up an expert group for coordination of educational activities in artificial intelligence. Among others, this expert group will work on mapping and analysing relevant international and Slovakian educational programmes in order to assess where and how reforms*

[282] Competitiveness Strategy for the Slovak Republic until 2010. Resolution No. 140/2005 on 16 February 200

[283] SWD (2019) 1024 final

[284] Operational Programme Research and Innovation, *Implementation plan: Research and Innovation Strategy for Smart Specialisation of the Slovak Republic, 2015.*

[285] Operational Programme Research and Innovation, *Implementation plan: Research and Innovation Strategy for Smart Specialisation of the Slovak Republic, 2015,* p37.

could be introduced. Recommendations for educational reforms should also be based on consultations with relevant stakeholders as school, public authorities and business sector."

Source: Slovakia AI Strategy Report (2019)

- **Set up of a Technology Transfer System (TTS)** (14) This measure refers to improving practical conditions for the efficient use of public facilities for technology transfer, including institutional and commercial financing of the operation of the public research infrastructure workplaces supported by ESIF in particular. The TTS should also ensure increased protection and commercialisation of intellectual property. This measure is currently being implemented by the Slovak Centre of Scientific and Technical Information (SCSTI), funded via ESIF. It aims to further develop the National technology transfer centre, established between 2007-2013 with participation of SCSTI, Slovak Academy of Sciences and the seven largest technology universities represented by their Technology Transfer (TT) offices.

The legislative and implementation measures cover aspects such as finance of RTDI, tax breaks on RTDI expenditure, public-private cooperation and the reform of HEI financing. The overall aim of these measures is to improve competitiveness of funding, promote collaboration and simplify current frameworks.

Overall, the content of the measures is well aligned with the issues and concerns raised by both public and private sector stakeholders during the interview discussions, which are documented throughout this report. That said, the stated timeline for implementing the measures – both policy and legislative measures – are now one to three years in the past. That concerns were still evident in the spring of 2020 suggests delays or challenges in implementation:

- Creation of a research infrastructure mapping system (deadline December 2017)
- Ensuring human resources for an innovative Slovakia (deadline June 2018)
- Set up of a technology transfer system (deadline 2018).[286]

The overall conclusion from the interview programme strongly suggest that the focus of the past few years has been on mitigating for the delays in calls for proposals and that efforts have been focused on securing the funding stream rather than on measures that are forward-looking in nature.

4.1.2 Other policy measures

With regards to wider industrial measures, our initial mapping of these is loosely centred around the RIS3 domains.

4.1.2.1 Manufacturing and industry

Manufacturing and industry measures are directed by the Slovak Smart Industry Action Plan, the latest version of which was drafted in 2018.[287] This was developed as a response to the Industry 4.0 revolution, which is characterised by breakthroughs in digital technology and innovative applications deployed in traditional industry and in manufacturing.[288]

The term "Industry 4.0" was initially coined by the German government. The term describes and encapsulates a set of technological changes in manufacturing and sets out priorities of a coherent policy framework with the aim of maintaining the global competitiveness of German industry. Industry 4.0 describes the organisation of production processes based on technology and devices autonomously communicating with each other along the value chain: a model of the 'smart'

[286] Operational Programme Research and Innovation, *Implementation plan: Research and Innovation Strategy for Smart Specialisation of the Slovak Republic, 2015,* p41.

[287] OECD, *OECD Skills Strategy Slovak Republic: Assessment and Recommendations, OECD Skills Studies*, 2020, OECD Publishing, 189.

[288] European Commission, *Digitising European Industry: Reaping the full benefits of a Digital Single Market*, 2016.

factory of the future where computer-driven systems monitor physical processes, create a virtual copy of the physical world and make decentralised decisions based on self-organisation mechanisms. The concept takes account of the increased computerisation of the manufacturing industries where physical objects are seamlessly integrated into the information network.

Source: Industry 4.0 (2016) study requested by the European Parliament's Committee on Industry, Research and Energy (ITRE). Authors: Centre for Strategy & Evaluation Services LLP

Given the prominence of industry, especially automotive manufacturing, this action plan is a key policy steering instrument for ensuring continued economic competitiveness.

The plan has six aims:

1. Raise awareness and promote cooperation among industry (to tackle workers' fear of employment losses);
2. Promote research orientated towards Smart Industry;
3. Focus on manufacturing and 'Factories of the Future';
4. Improve access to finance;
5. Identify the future needs of the labour market and guide education and skills-development in that direction.
6. Enact an innovation-focused legislative framework and e-Government.

According to a 2018 EC assessment[289], the action plan has no dedicated budget but is expected to draw up specific measures to be financed out of existing industry funding pools and ESIF. Thus, implementation of the plan is closely linked to the implementation and allocation of ESIF funding. Anecdotal feedback from the stakeholder interviews suggest that there have been successful calls in this domain, but the number of funding applications received in response to calls for proposals has been lower than anticipated. An interview with the agency responsible for these calls suggested that calls published under the Transport for the 21st century stream did not see a great response in terms of the number of applications received. Although the reason for this could not be strictly evidenced, the agency suspected that the calls simply did not attract researchers' attention since they were 'too applied' and that researchers preferred to work on broader horizontal issues.

4.1.2.2 Digitisation

A long-term *National Vision of Digitalisation in Slovakia 2030* was published by the office of the deputy prime minister in 2019.[290] The strategy is broad and covers Artificial Intelligence, Internet of Things, 5G technology, Big Data and Analytical Data Processing, Blockchain and High-Performance Computing. The strategy outlines high-level goals for achieving economic growth and increased competitiveness through digitalisation.

Some of the trends and technologies outlined in the vision are also applicable to the abovementioned Smart Industry Action Plan. The findings of the Action Plan were summarised and transformed into the *National Vision of Digitalisation in Slovakia 2030*, through which it formed the basis for the digital transformation of Slovakia as follows:

> "By 2030, Slovakia will become a modern country with innovative and environment-friendly industry built on knowledge-based digital and data economy with effective public administration ensuring smart use of the territory and infrastructure and with an information

[289] European Commission (2018) Digital Transformation Monitor Slovakia: Smart Industry

[290] The Office of the Deputy Prime Minister of the Slovak Republic (2019) The Strategy of the Digital Transformation of Slovakia 2030. See https://www.vicepremier.gov.sk/wp-content/uploads/2019/11/Brochure-SMALL.pdf

society whose citizens fulfil their potential and live high-quality and safe lives in the digital era."[291]

Out of other initiatives, many of the activities tackling digitalisation challenges come from private businesses and business associations in Slovakia. For example, the Industry4UM initiative,[292] which connects businesses and serves as a discussion platform to exchange best practices and finding solutions with regards to digitalisation and the Spolupracuj.me platform, which encourages cooperation among businesses.[293]

A few Digital Innovation Hubs in Slovakia have recently opened. Since 2018, three entities are receiving mentoring and coaching support in this area through an EU project called 'Smart Factories in new EU Member States', coordinated by Pricewaterhouse Cooper and Oxford University Innovation (Oxentia).[294] The Institutions receiving this support are Slovak University of Technology in Bratislava, Regional Advisory And Information Centre Prešov and the University of Žilina. The project is training 34 institutions from the EU-13 in total. Additionally, there is a number of support measures to provide additional incentives for R&D, such as vouchers, start-up support or innovation funds. It is foreseen that between 2017 and 2023 at least EUR 7.6 million will be spent on support vouchers; a comparison of the different voucher schemes in the Visegrad countries can be seen in Table 12 in section 2.4.1.

Several initiatives in Slovakia address the cooperation between businesses and developing skills for the digital age (pillar 5 of the Digitising European Industry initiative).[295] The public sector has mostly been active in building the necessary capacity for the digital age in terms of human resources.

For instance, the Ministry of Education, Science, Research and Sport works together with private entities to produce programmes developing digital skills. Two examples of such a project are the *Learning for the 21st century* project launched in 2016, and the *IT Academy – education for 21st century* launched in 2019. The former supports the development of the IT sector in the education system that is foreseen to utilise EUR 17.8 million by the end of 2020 from ESF and ERDF.

Two more initiatives identified with regards to developing digital skills, Dual Education and the Digital Coalition, were launched by a business association and a State Institute for Vocational Training. The Dual Education project, which started in 2016 and is funded under ESF and ERDF, will receive EUR 33.6 million by its end in 2020.[296] The Dual Education system, however, has underperformed and not reached its target number of 12,000 students by 2020, having only had 2,800 as of the beginning of 2018.[297] The Digital Coalition has reached over 30,000 people so far and is currently undertaking an 'IT fitness test' to get an understanding of the levels of skills in Slovakia.[298]

[291] The Office of the Deputy Prime Minister of the Slovak Republic (2019) The Strategy of the Digital Transformation of Slovakia 2030. See https://www.vicepremier.gov.sk/wp-content/uploads/2019/11/Brochure-SMALL.pdf

[292] https://industry4um.sk/en/industry4um/

[293] www.spolupracuj.me

[294] European Commission, *34 new Digital Innovation Hubs selected to participate in a training programme*, News Article, 12 January 2018, https://ec.europa.eu/digital-single-market/en/news/34-new-digital-innovation-hubs-selected-participate-training-programme

[295] See European Commission, *Shaping Europe's Digital Future: Digiting Europe Initiative*, https://ec.europa.eu/digital-single-market/en/policies/digitising-european-industry

[296] VVA and WIK (2019) MONITORING PROGRESS IN NATIONAL INITIATIVES ON DIGITISING INDUSTRY: Country report Slovakia, https://ec.europa.eu/information_society/newsroom/image/document/2019-32/country_report_-_slovakia_-_final_2019_0D31C79C-EC95-A759-9A4EFF789FEB2FB2_61219.pdf

[297] Radka Minarechová, *Slovakia threatened with returning funds for dual education*, 23. Nov 2017, Slovak Spectator, https://spectator.sme.sk/c/20702693/slovakia-threatened-with-returning-funds-for-dual-education.html

[298] European Commission, *Slovakia: Factsheet on the Digital Coalition, 2018* and website of National Coalition for Digital Skills and Occupations of the Slovak Republic, https://digitalnakoalicia.sk/

4.1.2.3 Population health and health technology

The Strategic framework for health for 2014-2030 constitutes the main document that should determine the medium and long-term direction of Slovak health policy.[299]

Judging by its introductory text, it appears to be a first initiative to identify the current problems of Slovak health sector, to find measurable indicators and to set objectives achievable by 2030. As such, this strategic framework is to be supported by key tools designed to achieve specific goals.

However, debates exist around the initial drafting of the strategy and its level of detail. The Slovak Medical Chamber, for example, notes how during drafting of the strategy, a number of governmental and non-governmental agencies and organisations in the health care sector were not informed of the ongoing work They were therefore unable to contribute to the final document. Furthermore, the Chamber says that the information campaign was poor and promotion of this major project among the Slovak professionals and the general public was lacking.[300]

The strategy is divided into four priority areas:[301]

- Investing in own health throughout the course of life and empowering people;
- Tackling the major health challenges in the region: noncommunicable and communicable diseases;
- Strengthening people-centred health services, public health capacity and emergency preparedness, surveillance and response; and
- Forming healthy communities and supporting the environment for the health of people.

As with the delivery of the current programming period, the previous 2007-2014 period also suffered from administrative blockages and delays. For example, due to delays in the establishment of a public *ehealth* system (intended to be launched during the previous programming period) it was only launched in 2017.[302] In the meantime a private system was developed which had already gained a significant market share of a third of the Slovak population. This meant resources in an already fiscally pressured healthcare system had to be diverted to ensure that overlaps and or compatibility issues between the two systems were avoided.

With regards to this area therefore, there is significant room for improvement in both inclusive and transparent strategy development and implementation.

Slovakia also participates in European Institute of Innovation and Technology (EIT) Health, which started operating in 2016. EIT Health is a Knowledge and Innovation Community (KIC) supported by the European Institute of Innovation and Technology, an EU body created to find solutions to global challenges. Slovakia is part of the Regional Innovation Scheme (EIT RIS). The first call in 2019 appears to have generated a good response in Slovakia, with at least one company posting a call for partners on the EIT website.[303]

[299] Ministry of Health of the Slovak Republic, *Strategic framework for health for 2014 – 2030*, https://www.health.gov.sk/Zdroje?/Sources/Sekcie/IZP/Strategic-framework-for-health-2014-2030.pdf

[300] Slovak Medical Chamber, *Strategic framework for health for 2014 – 2030: Commentary of the Slovak Medical Chamber*, https://old.lekom.sk/upload/Analyya_slovensky_1457545296.pdf p5.

[301] Ministry of Health of the Slovak Republic, *Strategic framework for health for 2014 – 2030*, https://www.health.gov.sk/Zdroje?/Sources/Sekcie/IZP/Strategic-framework-for-health-2014-2030.pdf

[302] Robert Kuenzel and Vladimir Solanič, *Improving the Cost-Effectiveness of Slovakia's Healthcare System,* Economic Brief 041, December 2018, https://ec.europa.eu/info/sites/info/files/economy-finance/eb041_en_0.pdf p10.

[303] The name of the company is STEMI: https://eithealth.eu/project/eit-health-ris-innovation-call/

4.1.2.4 Healthy food and environment

Slovakia is currently in the process of developing a **bioeconomy strategy.** Although its publication date is not confirmed, the content of the strategy will focus on international cooperation and coordination.[304]

One of the key documents that will need to shape the forthcoming Slovakian strategy is the EU equivalent initiative – A sustainable Bioeconomy for Europe: strengthening the connection between economy, society and the environment (Updated Bioeconomy Strategy).[305] The EU strategy is based on three pillars, which focus on the scaling up of bio-based sectors in Europe, and also covers investments and (new) markets, the support to local bioeconomies across Europe, and understanding the ecological boundaries of the bioeconomy.

Although a national strategy is currently not in place, a number of other relevant programmes are in place:

- Slovakia is a signatory of the BIOEAST initiative, which was established in 2017 as a programme for countries in Central and Eastern Europe and which was initiated by the Visegrad countries and later joined by Bulgaria, Croatia, Estonia, Latvia, Lithuania, Romania and Slovenia. The BIOEAST initiative is in essence a shared strategic research and innovation framework for working towards sustainable bioeconomies in the Central and Eastern European countries. The BIOEAST country signatories have signed a Common Declaration. This "enforces the cross-sectorial thinking, and commitment of the different ministries to develop their strategic agendas in bioeconomies, to develop partnerships in key priority areas and the need for policy support from the next EU research and innovation framework programme, HORIZON EUROPE."[306]
- Regional RIS3 for Nitra was intended to be published in 2014 but was delayed until mid-late 2016.[307] The proposed strategy, action plan and implementation plan include reference to:
    - Promising sectors (mainly agriculture but with reference to automotive, energy, biotech as well);
    - Priorities of economic and innovation development;
    - Instruments and innovation infrastructure (including implementation and sources of financing); and
    - Key areas of scientific specialisation.
- National Action Plan for energy from renewable energy sources. Drafted in 2010 and running until 2020, it promotes a combination of renewable energy sources (RES) and low-carbon technologies to reduce fossil fuel consumption and greenhouse gas emissions.[308]
    - The priority is use of biomass and biofuels
    - Promotion of renewable sources across sectors and for domestic use
    - Focus on energy security and industrial diversification

[304] Stakeholder feedback

[305] European Commission (2018) A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment

[306] https://bioeast.eu/home/

[307] Development program of the Nitra self-governing region can be found here https://www.unsk.sk/zobraz/sekciu/dokumenty-regionalneho-rozvoja

[308] Ministry of Economy and Construction of the Slovak Republic, *National Renewable Energy Action Plan*, 6 October 2010, https://ec.europa.eu/energy/topics/renewable-energy/national-renewable-energy-action-plans-2020_en

- Rural Development Programme of the SR (2014 – 2020). Adopted in 2015, it outlines Slovakia's priorities for using EUR 1,559 million from the EU budget and EUR 539 million of national funding for the period. The programme is mainly focused on the increase of competitiveness of agriculture and forestry sectors (aiming to support investments on 1,250 farms and 400 food enterprises), while ensuring the appropriate management of natural resources and encouraging climate friendly farming practices, with around 20% of agricultural land managed to protect biodiversity, soil and/or water resources.[309]
- Bioeconomy strategy paper for the Nitra Self-Governing Region (2019).[310] This paper was drafted in 2019 and provides and overview of the key bioeconomy challenges in Slovakia and relevant opportunities for the Nitra region. It focuses on five areas:
    - *Effective agriculture*. Measures in this area include the implementation of preventive measures for soil protection, an increase in organic fertilisation, a measuring system for the quality of the humus layer, anti-erosion measures, land use minimisation and land readjustments, including the merging of owner-divided plots.
    - *Water Management*, including irrigation systems restoration as well as new irrigation equipment construction using innovative technologies.
    - *Crop production* measures, including a gradual change of sowing plans, reduction in total land used for cereals and oilseeds, an increase of potato production, compound feed, malted barley, temperate fruits and vegetables, natural additives and nutritional supplements, medicinal plants and organic food to increase the added value, land yields per hectare and agricultural production employment.
    - *Animal production*. The measures proposed include the creation of a system of subsidy support, the provision of human resources, support of domestic compound feeds production, free-range cattle breeding and increasing the number of dairy cows at least to the level of 2010, gradually increasing the pigs breeding and small livestock in suitable locations under environmental protection conditions.
    - *Food Industry Development*. Proposed measures include defining food production as an area of national interest, establishment of a working group that will implement the national food strategy, creation of a long-term investment plan, coordination of a national subsidy system, generation of investment and financial mechanisms, creation of a competitive food production base, including the higher value-added food production development value as well as organic food, support for marketing and sale of homemade food, cooperation with retail chains and increasing the export of domestic food inside and outside of the EU.

  The strategy notes how Slovakia has huge potential in the area of bioeconomy, and the strategy will continue to be elaborated over the coming year, with the intention of using ESIF funds to implement it. The paper also proposes a national strategy for bioeconomy, summarised below.

The bioeconomy is seen as an emerging industry with great potential in Slovakia. Current bioeconomy RTDI activities also show a level of international competitiveness through participation and coordination of large-scale EU projects. For example, the Power4Bio project, Box 3 below. Slovakia also has a strong and active bioeconomy cluster, with four active projects, three from EU structural funds and one from the Ministry of Economy.[311] In 2017 Slovakia's activities in the bioeconomy had a total turnover of EUR 11,430 million and employed more than 174,000 people.[312]

[309] Klaudia Halászová et al, *Rural Development Strategy NSK 2016-2022*, 2015, https://www.unsk.sk/zobraz/sekciu/dokumenty-regionalneho-rozvoja

[310] This paper was shared with the study team for the purposes of inclusion in the report, it remains unpublished.

[311] The website of the Slovak Bioeconomy Cluster can be found here: http://bioeconomy.sk/en/

[312] Bio-Based Industries Joint Undertaking, *Country Factsheet: Slovakia,* 2018, https://www.bbi-europe.eu/sites/default/files/Slovakia.pdf

It was considered, not only by bioeconomy stakeholders, that the potential of the industries that make up the bioeconomy is politically underestimated.

Box 3: Power4Bio Project

Power4Bio Horizon 2020 project.

The POWER4BIO project aims to increase the capacity of regional and local policymakers and stakeholders to structure their bioeconomy and to support the emergence of a thriving bio-based sector. Adequate knowledge and best practice exchange and networking within and among regions across the EU.

The project has 17 partners from 11 countries, including the Slovak Agricultural University.

Source: https://power4bio.eu/

With regards to **eco-innovation**, Slovakia's strategy and performance of activities is measured through the Eco-Innovation Scoreboard (Eco-IS). The most recent country report from 2017 places Slovakia 20th in the EU-28, which constitutes an improvement from 23rd place two years ago.[313]

However, the research and innovation policy framework remains weak and fragmented, according to the scoreboard.[314] Secondly, the public sector has low levels of innovation activity. This is attributed to low public funding for R&D in environmental and energy sectors and a lack of human resources for R&D. Subsequently, Slovakian eco-innovation measures are relying on EU funds.

The private sector shows more encouraging signs. Slovakia outperforms many EU countries with a number of companies holding ISO14001 certification relating to standards of environmental management. Slovakia has the 12th highest number of companies with the ISO14001 certification of the EU-27, higher than Austria and the Baltic countries, but lower than the other Visegrad countries.[315] The high number of companies holding the certification demonstrates that Slovakia's private sector's aspiration for higher environmental standards. Indeed, this strong performance contributed to the close to average score of Slovakia (SK 75: EU 100) for eco-innovation activities.[316]

The **circular economy** is also gaining visibility on the policy discourse in Slovakia and some framework conditions are being created to facilitate the progress, such as the ones in waste management policy.[317]

The strategy documents covering the area of circular economy include, among others, the Strategy of the Environmental Policy of the Slovak Republic until 2030[318], the Waste Management Plan of the Slovak Republic[319] and the Waste Prevention Plan of the Slovak Republic. The measures aimed at research and innovation capacities development and using advanced technologies contributing to building the circular economy, implementing eco-design, increasing the efficiency of materials,

[313] European Commission, *Eco-Innovation Action Plan: Slovakia Country Profile*, https://ec.europa.eu/environment/ecoap/slovakia_en

[314] European Commission, *Eco-Innovation Action Plan: Slovakia Country Profile*, https://ec.europa.eu/environment/ecoap/slovakia_en

[315] International Organization for Standardization, *ISO Survey of certifications to management system standards*, https://isotc.iso.org/livelink/livelink?func=ll&objId=18808772&objAction=browse&viewType=1

[316] European Commission, *Eco-Innovation Action Plan: Slovakia Country Profile*, https://ec.europa.eu/environment/ecoap/slovakia_en

[317] European Commission, *Eco-Innovation Action Plan: Slovakia Country Profile*, https://ec.europa.eu/environment/ecoap/slovakia_en

[318] Greener Slovakia: Strategy of the Environmental Policy of the Slovak Republic until 2030 https://www.minzp.sk/files/iep/greener_slovakia-strategy_of_the_environmental_policy_of_the_slovak_republic_until_2030.pdf

[319] Waste Management Plan of the Slovak Republic for 2016 – 2020 https://www.minzp.sk/files/sekcia-enviromentalneho-hodnotenia-riadenia/odpady-a-obaly/registre-a-zoznamy/poh-sr-2016-2020_vestnik_en-2.pdf

water, energy and production processes and waste prevention should be supported as an integral component of the Strategy for Smart Specialisation of the Slovak Republic.

Furthermore, in late 2019, seven partners from the public, private and NGO sectors founded a platform called 'Circular Slovakia', in collaboration with the Dutch Embassy and the Dutch Chamber of Commerce.[320] The parties signed a memorandum on cooperation at the Ministry of Environment. This platform aims to increase discussion between the public and the private sector, as well as between businesses about opportunities and barriers in the circular transition resulting in new projects and partnerships. Simultaneously, Circular Slovakia will share good practice examples nationally and internationally while raising awareness of circular economy.[321]

4.2 Skills and skills gaps

There is a recognised skills gap in Slovakia, mainly relating to healthcare professionals, automotive industry specialists and technicians, ICT specialists and support workers, and teachers.[322] For the sectors concerned in this report, the factors behind skills shortages appear to be a mixture of i) educational attainment and labour market needs, ii) low educational performance, iii) lack of interest in STEM occupations, and iv) demographic changes. Overall, Slovak tertiary education places too little emphasis on practical experience and this contributes to a significant educational mismatch with the labour market.

Up until the COVID-19 crisis, unemployment had been falling steadily from 19% in 2004 to just 5.5% in March 2020.[323] This past trend has resulted in a steady demand for labour and an increase in the number of foreign workers. As described in the introduction of this report, the COVID-19 crisis has already caused short-term significant damage to the Slovak economy. Major risks going forward include: a prolonged epidemic lowering the importance of short-term and one-time measures to mitigate damages to the economy and the labour market; the reliance on the recovery of neighbouring countries, given that Slovakia is an export-oriented economy; and although Slovakia, reacted to the pandemic swiftly and decisively, no long-term strategy has been established for long-term recovery .

[320] Ministry of Labour and Employment of the Netherlands, *Slovakia launched platform Circular Economy*, News Report, 11 December 2019, https://www.agroberichtenbuitenland.nl/actueel/nieuws/2019/12/11/slovakia-platform-circular-economy

[321] European Circular Economy Networks, *Circular Slovakia,* https://circulareconomy.europa.eu/platform/en/dialogue/existing-eu-platforms/circular-slovakia

[322] CEDEFOP, Slovakia: Mismatch priority occupations, 10/2016, Skills Panorama, https://skillspanorama.cedefop.europa.eu/en/analytical_highlights/slovakia-mismatch-priority-occupations

[323] European Central Bank, *Level of Unemployment*, Statistical Data Warehousehttp://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=132.STS.M.SK.S.UNEH.RTT000.4.000

Figure 17: Number of foreign workers in Slovakia

Source: OECD (2019) Economic Survey Slovak Republic

A 2017 analysis by CEDEFOP[324] noted how *"there is no coherent set of skills anticipation activities for producing and interpreting skills intelligence in Slovakia."*[325] While documents such as the 2018 National Programme for the Development of Education have been produced, there remains a lack of coherently applied Skills Assessment and Anticipation (SAA) tools. Furthermore, the dissemination of information from SAA tools that exist in Slovakia is fragmented and not always tailored to the needs of different users.[326] The absence of an overarching skills strategy means that, in practice, the role of stakeholder engagement and local/regional dialogue between policymakers, employers and education and training providers has become very important. In this regard Slovakia appears to perform much better in terms of co-operation and co-ordination with stakeholders, as it scored among the highest in the most recent OECD Indicators of Regulatory Policy and Governance (iREG) on stakeholder engagement.[327] The more regulatory practices a country has implemented, the higher its iREG score. The indicators on stakeholder engagement and RIA for primary laws only cover those initiated by the executive – 98% of all primary laws in the Slovak Republic.[328]

The just-published OECD National Skills Strategy project[329] suggests that there is still a lack of overall skills strategy in Slovakia, although the report provides recommendations on how to improve its skills performance. The project was a collaborative initiative that also included Slovak government stakeholders.

The OECD and the previous government of Slovakia identified four priority areas for improving Slovakia's skills performance, as summarised in the table below:

[324] CEDEFOP is the European Centre for the Development of Vocational Training: https://www.cedefop.europa.eu/

[325] CEDEFOP, *Skills anticipation in Slovak Republic*, 2017, Skills Panorama, Analytical highlights series. https://skillspanorama.cedefop.europa.eu/en/analytical_highlights/skills-anticipation-slovak-republic

[326] OECD, OECD Skills Strategy Slovak Republic: Assessment and Recommendations, 2020, OECD Skills Studies, OECD Publishing, Paris, https://doi.org/10.1787/bb688e68-en

[327] OECD, OECD Skills Strategy Slovak Republic: Assessment and Recommendations, 2020, OECD Skills Studies, OECD Publishing, Paris, https://doi.org/10.1787/bb688e68-en p16.

[328] https://www.oecd-ilibrary.org/sites/9789264303072-en/1/2/7/32/index.html?itemId=/content/publication/9789264303072-en&_csp_=46cd5ed37844c9dc6cf21c84716ab307&itemIGO=oecd&itemContentType=book#indicator-d1e26354

[329] OECD, OECD Skills Strategy Slovak Republic: Assessment and Recommendations, 2020, OECD Skills Studies, OECD Publishing, Paris, https://doi.org/10.1787/bb688e68-en

Table 16: OECD and Slovak recommendations for improving skills

Priority	Scope	Mechanisms
Strengthening the skills of youth	Ensuring that youth leave school with strong skills is key to ensuring that Slovakia has the skills it needs to achieve its economic and social ambitions. In Slovakia, the skills of 15-year-olds (measured by PISA) lag behind their peers in other OECD countries in reading and science, and are declining over time. Performance in school is uneven across different groups of youth, especially between Roma and non-Roma students.	• Increase enrolment in pre-primary education, especially among vulnerable groups. • Support schools and teachers in their work with vulnerable students. • Build a strong teaching workforce.
Reducing skills imbalances	Skills imbalances are costly for individuals, firms and the economy as a whole as they lead to lower investment and lower overall productivity. Slovakia experiences shortages both among higher and lower skilled occupations. There are also strong skills mismatches among younger workers and tertiary educated workers. The low responsiveness of the secondary vocational education and training (VET) and tertiary education system have contributed to skills shortages and skills mismatches, whereas emigration and brain drain have been major drivers behind shortages.	• Improve the dissemination of information on labour market and skills needs. • Strengthen the responsiveness of students and their families to labour market needs. • Strengthen the responsiveness of secondary VET and tertiary education institutions to labour market needs. • Move from brain drain to brain gain.
Fostering greater participation in adult learning	Adult learning is particularly important for Slovakia. The Slovak economy is strong and catching up with higher-income countries. Employment and wages are growing and the unemployment rate is historically low. Nonetheless, Slovak production and exports are concentrated in a small number of manufacturing industries and the risk of job automation is particularly high. In this context, adult learning is, and will continue to be, essential for boosting the skills of adults, and can generate a range of personal, economic and social benefits. More effective adult education and training will be needed to maintain or increase the level of skills to keep pace with these rapidly changing conditions.	• Improve the governance of adult learning. • Increase participation among adults out of work. • Support the capacity of employees and firms to engage in adult learning.
Strengthening the use of skills in the workplace	There has recently been growing awareness that how well employers use skills in the workplace may be just as important as the skills their workers possess. The skills of adults are not used to their full potential in Slovakia, and the use of most types of employees' information processing, job-specific and generic skills could be intensified. The use of reading skills at work in Slovakia is below the OECD average, while the average literacy proficiency of adults is above average, and the use of ICT (Information and Communication Technology) skills could be strengthened. Despite the strong link found between the intensive use of skills and the adoption of high performance workplace practices (HPWP), such as flexibility in the workplace or teamwork, Slovak firms are adopting HPWP at a lower rate than their counterparts in most other countries.	• Provide incentives and support to Slovak firms for the adoption of HPWP. • Enhance the governance of policies and strategies that affect skills use.

Source: OECD (2020) Skills Strategy Slovak Republic: Assessment and Recommendations

Most existing skills anticipation initiatives have been developed under the Ministry of Labour, Social Affairs and Family. The Ministry of Education, Science, Research and Sport is a key ministry with regards to Vocational Education and Training (VET) and Higher Education. At the sub-national level, self-governing regional authorities lead the dialogue with other stakeholders.

There seems to be no budget specifically dedicated to skills anticipation in Slovakia with significant resources sought from the European Social Fund (ESF).[330] The OECD suggests that there is a degree of urgency in addressing the skills gap, since continued skills shortages may deter future investment in the form of FDI.[331] Some forecasting projects have been quite successful – for example, the Slovak Centre of Labour, Social Affairs and Family (COLSAF) launched the ESF-funded project forecasting labour market developments in 2014.[332] However, without sufficient follow-up funding from the national administration, these projects struggle to be sustainable.

With regards to the Slovak education system's ability to support skills development, recent OECD analysis concludes that *"Slovak tertiary education puts too little emphasis on practical experience, contributing to significant labour market mismatch among young tertiary graduates. This reduces productivity and earnings. Qualifications are particularly poorly matched to the needs of businesses involved in robotics and IT solutions"*. [333]

As a response to these challenges, graduate tracking systems, educational counselling, and career guidance (already included in the Slovak government education strategy) need to be institutionalised across the system.

Other measures have been put in place in Slovakia already. For example, the OECD[334] highlights the creation of centralised information outlets for students and their parents, although this is somewhat limited in its functions.

There are ways to further build on the information service. A few years back, Poland launched a national system for tracking graduates' employment by matching employment records from social security with universities data and providing reliable information on graduates' situation in the labour market, including their employment and salaries.[335] A comparable Slovak system was recently launched in April 2020 by the Ministry of Labour, Social Affairs and Family. This initiative was called the 'graduate footprint'[336], although it is still too early to evaluate its impact.

Other types of measures that the Slovak education system could consider introducing include:

- **Support and teaching to develop tacit skills.** The Slovak education system does not cover the development of soft skills, such as the ability to cooperate, share information, and project and people management skills.
- **Provide graduates with management skills** and other support that could encourage the formation of new businesses.[337]

[330] CEDEFOP, *Skills anticipation in Slovak Republic*, 2017, Skills Panorama, Analytical highlights series. https://skillspanorama.cedefop.europa.eu/en/analytical_highlights/skills-anticipation-slovak-republic

[331] OECD, *OECD Economic Surveys Slovak Republic*, 2019.

[332] CEDEFOP, *Skills anticipation in Slovak Republic*, 2017, Skills Panorama, Analytical highlights series. https://skillspanorama.cedefop.europa.eu/en/analytical_highlights/skills-anticipation-slovak-republic

[333] OECD, *OECD Economic Surveys Slovak Republic*, 2019.

[334] OECD, *OECD Economic Surveys Slovak Republic*, 2019.

[335] OECD, *OECD Economic Surveys Slovak Republic*, 2019.

[336] The results of the survey were published for the first time in February 2020 on the information portal www.uplatnenie.sk . Further information is also available at https://www.employment.gov.sk/sk/informacie-media/aktuality/kde-koncia-absolventi-skol.html

[337] OECD (2019) OECD Economic Surveys Slovak Republic

5 AS-IS Conclusions

Chapter 5 presents the AS-IS report conclusions, based on the literature review and stakeholder interviews. This section draws upon the evidence from all previous sections of the report, and as such no new information is included. Where appropriate, reference has been made to the sections of this report where relevant information can be found pertaining to the concluding remarks.

In the TO-BE report, which follows this AS-IS report, the conclusions outlined below are accompanied by recommendations including reference to specific case studies and international comparisons.

5.1.1 The Slovak RTDI system

Slovakia's economy is closely linked to globalisation and the country will be strongly impacted by the technological revolution currently unfolding in the manufacturing sector. In order to respond to current and future changes and to maintain its competitiveness, Slovakia needs to continue to improve its RTDI system. As outlined in section 2, Slovakia's investment in its RTDI system is still below 1% of GDP, investments in infrastructure must produce positive outcomes. In the last programming period (2007-2013) almost EUR 1.4 billion was invested in infrastructure, with little discernible effect on research performance. The private sector is increasing its performance, the conversion rate of patent applications to patent grants was 34% in 2017 and 43% in 2018, this growth must be maintained.[338]

Furthermore, given the potentially severe long-term consequences of the COVID-19 outbreak on current Slovak industries, additional efforts will be needed from the ministries responsible for innovation to coordinate a common response with regards to diversification of industry and support to emerging areas of innovation.

Slovakia has pockets of highly innovative activities in ICT and engineering, biomedicine, bioeconomy, for example, but it suffers from underfunding, fragmentation of actors and activities and the absence of sufficient private sector investment.

Compared to the average European country, RTDI policy is a fairly recent development in Slovakia; the country's economic strategy has previously, and for a long time, been centred on attracting FDI rather than pushing domestic innovation. The root cause for this approach was the view from the Slovak government that FDI would result in knowledge transfer and therefore improve the RTDI system. The legacy of FDI-centred polices contributed to creating a 'dual' industry, dominated by large foreign MNCs and a smaller domestic industrial sector. Although there is some innovation support to the latter, more effective support is required, including for medium-sized enterprises.

Aside from the recent merging of the two Operational Programmes for Structural Funds in December 2019, the governance and structure of the Slovak RTDI system has remained constant over the past five years.

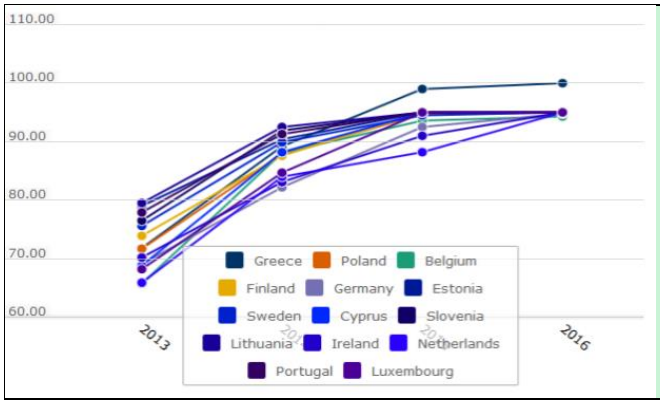
RTDI policy is centralised and led by the Ministries of Education and of Economy. Although there are effective forums for coordination of RTDI at ministry level, the general view is that policy coordination overall is problematic. This is due to the large number of decision-making layers, resulting in a lack of transparency, as well as issues with human resources. For the private sector this means navigating a the large number of different agencies, frequent legislative changes and increased administrative

[338] https://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=SK

costs for start-ups and SMEs that are crucial to ensuring successful knowledge transfer.[339] This weakness persists despite advisory forums such as the Council for Science, Technology and Innovation being considered an effective mechanism for coordination.

The ESIF programme contributes a significant amount of funding for RTDI in Slovakia. Consequently, cooperation to effectively and efficiently make use of ESIF investment is a hugely important element of the Ministries' and Managing Authorities' responsibility. Cooperation to implement the Operational Programmes for RTDI under the 2014-2020 ESIF programme period has not been successful, as shown by the slow disbursal of funds.

Table 17: Early Absorption Member States



These Member States were all classed as 'early absorbers' between 2013 and 2016 and would therefore present good best practices for Slovakia, which may warrant further investigation and targeted comparisons.

Source: https://www.europarl.europa.eu/RegData/etudes/STUD/2018/621785/IPOL_STU(2018)621785_EN.pdf

One important aspect of this is Slovakia's very low level of implementation with regards to its Technical Assistance (TA) allocation during the latest programming period (4% by 2018 – see section 2.4.1 for precise details). While the reasons for this are unclear, the TA budget would appear to be important for Slovakia, considering the aforementioned challenges outlined in the report. A detailed explanation of the TA challenge can be found on page 52.

There is a great willingness to change the current situation, and in particular, to ensure that the upcoming 2021+ programme period is implemented successfully. During the interviews, many stakeholders were reflective and provided concrete recommendations for how to better build consensus, and decisive efficient action around RTDI policy. These are integrated into the TO BE report, and centre around:

- Legislative changes
- Improving coordination of research infrastructures
- Improving collaboration, both at policy level and between research stakeholders
- Strengthening human resources
- Efficient use of RTDI Funding
- Monitoring and evaluation

Despite the drive to improve governance, at the same time stakeholders have not been able to point to the exact point of failure, but rather suggested it was the result of a general lack of cooperation and transparency among those involved. A mid-term evaluation of the OP for innovation also found there was an inability to identify the exact causes of shortcomings.

[339] Paulo Andrez, Hannes Leo, Sigrid Johannisse, Jari Romanainen, *Specific Support to Slovakia Boosting the Slovak startup ecosystem,* 2017, Horizon 2020 Policy Support Facility, https://rio.jrc.ec.europa.eu/sites/default/files/report/KI-AX-17-001-EN-N%20SK.pdf p43

Quick improvement is needed with regards to the management – and crucially – expenditure of ESIF funds. This would include improved transparency and more efficient handling of the calls for proposals and evaluation procedures. The EEA Norway grant programme runs a Good Governance and Cross-border Cooperation programme in Slovakia, which aims to improve efficiency and transparency in public institutions. It is possible funding and support may be sought from this instrument.[340]

There is a lack of know-how and experience of research management. For example, there is limited use of a results-based approach to monitoring and evaluation, which would be more suited to innovation support.

5.1.2 RTDI funding

Slovakia is one of the most dependent countries on European funds in the EU-27. ESIF and the Framework Programme for RTD (Horizon 2020) form the core, while EEA and Norway Grants also provide opportunities for collaborative bottom-up innovation projects, also involving SMEs.

Competitive international funding (Horizon 2020) is centred on the Bratislava and Košice regions, but international competitive funding is lacking in most other regions. As such, there is a heavy reliance on non-competitive ESIF investments.

The delays in implementing ESIF investments have had severe knock-on effects stemming from the lack of distribution of funding for the current programme period. Human resource capacity, brain drain, and a large number of different agencies, ministries and advisory bodies involvement are the key causes of these delays. Another potential knock-on effect is that the calls for proposals are attracting fewer applications, possibly partly due to lack of trust in the processes and 'reputational damage', but also partly due to potential beneficiaries seeking access to funding through other means.

The stakeholder interview findings suggest that several barriers are behind the significant ESIF funds delay. These could be categorised as organisational, administrative and behavioural barriers. One clear incidence of this was the cancelling of announced calls, since they did not conform to the ex-ante conditionalities, which is the responsibility of the DPMO. There was therefore also a need to change and revise the procedures of the calls.

There is a positive trend of increasing private sector investment in Slovakia.

EIB and EIF funding is also playing an increasingly important role in Slovakia. The value of EIB/EIF loans, guarantees and equity increased 93% between 2018 and 2017. The EIB Group has leveraged EUR 14.44 billion in innovation alone in 2019. In total, around 2,300 small businesses benefited from EIB Group operations in 2019.[341] Further research is needed to understand precisely why EIB investment is increasing so much.

With regards to national funding, the largest source is awarded through block funding to universities and to a lesser extent to public research institutes. However, block funding is currently not linked to excellence-related criteria and spread across a large number of institutions, making it somewhat ineffective. Changes to funding systems can of course be made, but they need to be well planned and done gradually in order to be effective since sudden changes in financial allocation can lead to further problems and/or resentment among HEIs that fear the they may lose out in planned reforms.

340 https://eeagrants.org/news/programme-agreement-signed-good-governance-and-cross-border-cooperation-programme-slovakia

341 European Investment Bank, *EIB Group support for projects in Slovakia stood at €251m in 2019*, News Item, 7 February 2020, https://www.eib.org/en/press/all/2020-044-eib-group-support-for-projects-in-slovakia-stood-at-eur-251m-in-2019

5.1.3 RTDI infrastructure

Since 2007, Slovakia has taken significant steps in upgrading its RTDI infrastructure with the help of Structural Funds investments (as outlined in section 2.4.2). These investments constitute important foundations for conducting high-quality research and to enhance Slovakia's RTDI profile internationally.

Although significant investments are still being made through the current ESIF period, there is also a need to ensure that new, existing infrastructures are used and maintained effectively. This requires good collaboration between public research performers (which tend to host the research infrastructures) and private sector actors including entrepreneurs (which need access to the research infrastructures and to institutional knowledge in order to innovate). It will also require investments in human resources and the upkeep of RI technology.

Effective management of RTDI infrastructure also appears to be lacking. For example, there is a lack of clarity with regards to state aid rules, and the use of research infrastructure by private companies are unclear and present an ongoing problem, according to policymakers and research performers, in particular those relating to government research facilities. Workshops, such as the one outlined below, should be commonplace in Slovakia until greater understanding has been established.

Figure 18: Example seminar on state aid in RDI, 27 January 2016, Brussels

- 9:15-10:15 State aid rules for Research, Development and Innovation

  Speaker: Paolo Cesarini, Directorate-General for Competition, European Commission

- 9:15-10:15 Current challenges related to application of State aid in the field of RDI

  Speaker: Phedon Nicolaides (State aid expert – Professor at Maastricht University and College of Europe)

- 10:45-12:15 State aid rules for RDI / Key issues identified by practitioners

  Speaker(s): Marek Przeor / Yvonne Simon, Directorate-General for Regional and Urban Policy, European Commission

- 13:15-15:15 Parallel working groups
- 15:45-16:30 Reporting from the working groups
- 16:30-16:45 Conclusions and closure

  Speaker: Pascal Boijmans, Head of Unit, Directorate-General for Regional and Urban Policy, Commission

Source: https://ec.europa.eu/regional_policy/sources/conferences/state-aid/rdi/summary_pres_disc.pdf

5.1.4 Collaboration between RTDI actors

A fragmented system and lack of collaboration among stakeholders is a well-documented challenge in Slovakia. Fundamentally, a lack of a collaborative culture and a tendency to work in silos are still issues, but there are signs that cooperation is improving. Some recommendations on how to ameliorate the situation can be found in the TO BE report along with the case study of the UK Concordat for Researchers that was published in 2019.

Improved cooperation can be identified both through bottom-up initiatives (e.g. younger researchers and younger entrepreneurs are more open to inclusivity) and through top-down policy steering (e.g. insisting on collaborative applications in response to calls for proposals, establishing collaborative instruments such as competence centres). Anecdotal evidence suggests that. once

'forced to' collaborate, public and private research performers tend to see the benefits of partnerships.

The (now discontinued) Science Park programme[342] was considered as a good practice example in terms of design and implementation. The same programme was considered to have been a game changer in terms of fostering collaboration. More information on the science parks can be found in section 3.1.4. Examples of successful collaboration from Eastern Finland can be found in the TO-BE report.

However, collaboration can also be fostered through smaller investments and does not have to entail financing science parks or centres. There is a greater role for seed funding, student placements, mobility funding, innovation vouchers that is not currently emphasised.

Slovak clusters could contribute more to the RTDI system than is currently the case. Clusters are, with a few expectations, driven by industry. Some clusters are very successful and could be used as models for upcoming ones, for example the IT cluster linked to the Technical University in Košice. ESIF support for clusters has been delayed.

5.1.5 Drivers and barriers for innovation

Chapter 3 of this report describes several drivers and barriers affecting the performance of the Slovak RTDI system. The conclusions from these are also described in sections 5.1.1-5.1.4.

Many of the barriers identified can be traced to the fragmented set up and overall governance of RTDI. Although the structure of responsibility and governance in Slovakia is similar to other EU systems, it is more convoluted, less intuitive and has more administrative layers. From this can be traced particular habits and behaviours that are not conducive to trust and collaboration. As is well documented already, a lack of public and private investment (GERD and BERD) into RTDI also constitutes a barrier. In order to improve RTDI investments, there needs to be a political consensus to actively and sustainability support innovation, possibly through a combination of fiscal and monetary policies.

This study can point to a number of drivers that are – and have the potential to become – even more prominent drivers for innovation. These include both new areas of RTDI (e.g. biomedicine, bioeconomy) existing strong holds (e.g. ICT) and new actors – young researchers with new ideas and existing international networks, as well as SMEs and other businesses, especially export-oriented enterprises. Large investments resulting in upgraded research infrastructures are also a contributing driver (provided that access to research infrastructures can be improved).

This report briefly outlines the status quo of three key areas – digitalisation, automation and robotics – which are particularly pertinent to the wider Slovak economy. Where relevant, country comparisons and further information has been provided in section 3.2. Given their importance and links to the wider labour market structure, these areas need special policy attention and investment. Robotics and automation are closely related. Although employment losses are one risk with these trends, Slovakia can also capitalise on its knowhow of robotics.

5.1.6 Current and planned policy measures

RTDI policy is a relatively new policy area for Slovakia and constitutes a significant change in direction from the previous strategy of attracting FDI and 'relying on' imported knowledge from MNCs.

There are encouraging signs of strategies which tackle current and upcoming challenges relating to innovation and which are also related to the wider Slovak economy and governing system, for example the Digital Transformation Strategy 2030, the draft innovation strategy 2007-2013 and

[342] Innovation Map Slovakia, *List of Science and Tech Parks*, https://innovationmapslovakia.sk/en/science-tech-parks

upcoming Cluster Strategy. Generally, these strategies are in line with OECD country trends and EU strategies.

However, there appears to be a disconnect between the setting of a policy direction and in operationalising agreed strategies. The significant delays in ESIF implementation is an example of this, although other reforms and changes foreseen also illustrate this premise. In practice, this has led to little or limited change on the ground, which is a point generally supported by interviewees. Another challenge to overcome is that Slovak strategies tend to rely on ESIF investments with no national budgets earmarked for implementation mechanisms.

With regards to cross-sectional areas, notably skills needs, a coordinated approach that involves both policymakers and employers appears to be lacking, which does not support the link between the skills intelligence gathered and policymaking.

Annex 1 Bibliography

Reports and studies

Baláž, V.; Frank, K.; Ojala, T.; RIO Country Report 2017: Slovak Republic., EUR 29181 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-81482-2, doi:10.2760/427548, JRC111379

Boris Strečanský Center for Philanthropy n.o (2015) Slovakia Country Report EUFORI Study

Digital Economy and Society Index (DESI) 2019

Draft Innovation Strategy of the Slovak Republic for 2007 to 2013

EBRD (2017) Slovak Republic Country Strategy

European Commission (2018) Digital Transformation Monitor Slovakia: Smart Industry

European Commission (2019) European Innovation Scoreboard 2019

European Commission, Innovation kitchen: HORIZON 2020 SME Instrument Impact Report, 2018,. Accessed via: https://ec.europa.eu/easme/sites/easme-site/files/smei_2018_impact_report_final_may_2018.pdf

European University Association (2020) Public Funding Observatory

Forthcoming Baláž, V., Frank, K., Ojala, T. (2020) Innovation Country Report 2019: High growth enterprises, innovation and productivity challenges, Slovak Republic

Implementation plan: Research and Innovation Strategy for Smart Specialisation of the Slovak Republic

Izsák et al (2013) Lessons from a Decade of Innovation Policy What can be learnt from the INNO Policy TrendChart and The Innovation Union Scoreboard. Final Report

OECD (2019) OECD Economic Surveys Slovak Republic

OECD (2020), General government debt (indicator). doi: 10.1787/a0528cc2-en (Accessed on 25 March 2020) and OECD (2020), Household debt (indicator). doi: 10.1787/f03b6469-en (Accessed on 25 March 2020)

OECD (2020), OECD Skills Strategy Slovak Republic: Assessment and Recommendations, OECD Skills Studies, OECD Publishing, Paris, https://doi.org/10.1787/bb688e68-en.

Rampton and Bosch Chen (2019) New Technologies supported by the EEA and Norway Grants 2009-2014 (Rapid Assessment)

Shearman and Zendulková (2018) Use of National and International Research Infrastructures in Evaluation of International Project Award Potential of Slovak Research Institutions Centrum vedecko-technických informácií Slovenskej republiky/Slovak Centre of Scientific and Technical Information Lamačská cesta 8/A, 811 04 Bratislava, Slovak Republik

Skills Panorama (2017), Skills anticipation in Slovak Republic. Analytical highlights series. Available at /en/analytical_highlights/skills-anticipation-slovak-republic

SWD(2019) 1024 final

SWD(2020) 524 final

Swedish Agency For Growth Policy Analysis (2017) Loan Guarantee Schemes as a policy instrument for financing entrepreneurial businesses

The Office of the Deputy Prime Minister of the Slovak Republic (2019) The Strategy of the Digital Transformation of Slovakia 2030. See https://www.vicepremier.gov.sk/wp-content/uploads/2019/11/Brochure-SMALL.pdf

The State of R&D in Slovakia, 2012.

Through knowledge towards prosperity: Research and Innovation Strategy for Smart Specialisation of the Slovak Republic, 2013, P31

VVA and WIK (2019) MONITORING PROGRESS IN NATIONAL INITIATIVES ON DIGITISING INDUSTRY Country report Slovakia

UK Science & Innovation Network Country Snapshot: Slovak Republic Slovak Republic's Science and Innovation Landscape

Websites

https://tradingeconomics.com/slovakia/manufacturing-production

https://www.theglobaleconomy.com/Slovakia/Share_of_manufacturing/

https://data.oecd.org/slovak-republic.htm

http://www.oecd.org/economy/slovak-republic-economic-snapshot/ p7.

https://rio.jrc.ec.europa.eu/country-analysis/organisations/slovak-government-council-science-technology-and-innovation

https://www.apvv.sk/buxus/docs/agentura/ine-dokumenty/statute-srda.pd

Peter Kapitán, Education Ministry vs. Academy of Sciences: What is the dispute actually about?, Slovak Spectator, 2018. Available at https://spectator.sme.sk/c/20912777/ministry-of-education-and-slovak-academy-of-sciences-continue-to-clash.html

Times Higher Education, The World University Rankings, 2018. Available at https://www.timeshighereducation.com/world-university-rankings/2018

European Innovation Scoreboard 2019. Accessed via https://ec.europa.eu/docsroom/documents/35910

https://accace.com/amendment-to-the-commercial-code-in-slovakia-effective-as-of-january-1-2018-news-flash

https://www.vuje.sk/

https://www.evpu.sk/

https://www.makers.sk/

https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2014/292/20180501

https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2018/57/20180401

https://www.mhsr.sk/uploads/files/WNtoePVQ.pdf

https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2009/185/vyhlasene_znenie.html

https://rokovania.gov.sk/RVL/Resolution/17589/1

https://rokovania.gov.sk/RVL/Material/23740/1

https://www.indprop.gov.sk/?legislation-in-force

https://internationalpropertyrightsindex.org/compare/country?id=23,20,12,5

https://internationalpropertyrightsindex.org/compare/country?id=23,20,12,5

https://www.zakonypreludi.sk/zz/2002-133

https://spectator.sme.sk/c/20541494/the-academy-of-sciences-is-closer-to-transformation.html

https://spectator.sme.sk/c/20912777/ministry-of-education-and-slovak-academy-of-sciences-continue-to-clash.html

https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2018/269/vyhlasene_znenie.html

https://saavs.sk/o-agenture/

https://eacea.ec.europa.eu/national-policies/eurydice/content/quality-assurance-higher-education-63_en

https://eacea.ec.europa.eu/national-policies/eurydice/content/quality-assurance-higher-education-63_en

Data obtained in March 2020 via https://webgate.ec.europa.eu/dashboard/extensions/CountryProfile/CountryProfile.html?

https://www.multiplexdx.com/post/multiplexdx-became-a-proud-holder-of-the-eic-accelerator

https://cohesiondata.ec.europa.eu/countries/SK

https://www.universityworldnews.com/post.php?story=20180217050748749

https://emerging-europe.com/news/eib-support-for-slovakia-doubles-in-2018/

https://eeagrants.org/news/programme-agreement-signed-business-development-innovation-and-smes-programme-slovakia

cost.eu/wp-content/uploads/2019/09/COST_CountryFactSheets_3_HR_Slovakia.pdf

https://www.eif.org/what_we_do/guarantees/news/2016/efsi_innovfin_cosme_csob.htm

ttps://slord.sk/sk/newresearchinfrastructure.html?page_id=2211

https://fmph.uniba.sk/en/news-detail/back_to_page/fakulta-matematiky-fyziky-a-informatiky-uk/article/historicky-najvaecsia-investicia-do-slovenskej-vedy-a-vyskumu-slovenska-technicka-univerzita/

https://www.esfri.eu/national-roadmaps

The World Bank, Researchers in R&D per Million People, (2005-2017). Available at https://data.worldbank.org/indicator/SP.POP.SCIE.RD.P6?end=2017&locations=SK-CZ-PL-HU-SI&name_desc=false&start=2005&view=chart

Ľuboš Pilc, Two SAS institutes are among Europe's top, five are among the worst, Pravda, 2017. Available at https://spravy.pravda.sk/domace/clanok/420945-sav-dva-ustavy-akademie-patria-k-europskej-spicke/

Poll: Slovak scientists abroad are not keen on returning to Slovakia, Slovak Spectator, 2018, Available at https://spectator.sme.sk/c/20883997/poll-slovak-scientists-abroad-are-not-keen-on-returning-to-slovakia.html

SLOVAKIA: FOREIGN INVESTMENT, Santander Markets, 2020. Accessed via https://santandertrade.com/en/portal/establish-

overseas/slovakia/investing?&actualiser_id_banque=oui&id_banque=17&memoriser_choix=memoriser

http://www.discover-cee.com/digital-slovakia-selectively-at-the-top-but-not-enough-for-an-overall-top-spot-yet/

https://roboticsbiz.com/top-robotics-research-institutions-and-labs-in-slovakia/

https://ec.europa.eu/environment/ecoap/slovakia_en

Annex 2 List of consulted stakeholders

Type	Organisation	First name	Surname
Business association	Association of Industrial Unions (APZ)	Martin	Jančo
Business association	Federation of Employers' Associations of the Slovak Republic (AZZZ)	Roman	Karlubík
Business association	Slovak Chamber of Commerce and Industry (SOPK)	Peter	Klamo
Business association	Klub 500	Tibor	Gregor
Cluster	Union of Slovak Clusters	Daniel	Ács
Company	Business and Innovation Centre Bratislava	Štefan	Vrátny
Company	Business and Innovation Centre Bratislava	Ivan	Filus
Company	VIPO – Electronic complaint management system	Peter	Duchovič
National ministry	Ministry of Agriculture	Monika	Deneva
National ministry	Ministry of Economy	Edmund	Škorvaga
National ministry	Ministry of Environment	Milan	Chrenko
National ministry	Ministry of Health	Martina	Antošová
National ministry	Ministry of Health	Ivica	Kvietiková
National ministry	Ministry of Health	Martina	Lutterová
National ministry	Ministry of Education	Rastislav	Igliar
Agency	Slovak Research Agency	Andrea	Uhrínová
R&D industrial organisation	Association of Research and Development Industrial Organisations (ZPVVO)	Štefan	Boháček

Type	Organisation	First name	Surname
R&D industrial organisation	Association of Research and Development Industrial Organisations (ZPVVO)	Branislav	Hatala
R&D industrial organisation	Association of Research and Development Industrial Organisations (ZPVVO)	Martin	Hraško
Research association	National Agricultural and Food Centre	Dana	Peškovičová
Research association	National Agricultural and Food Centre	Zuzana	Nouzovská
Research association	Slovak Academy of Sciences	Karol	Fröhlich
University	Slovak University of Technology (STU)	Oliver	Moravčík
University	Technical University of Košice (TUKE)	Stanislav	Kmeť
University	Comenius University, Institute of Molecular Biomedicine	Peter	Celec
University	Comenius University	Tomas	Vinar

Annex 3 April Workshop Report

Supporting the transformation of the Slovak economy by increasing its innovation performance

Report of the validation workshop, 23 April 2020

Contract SRSS/SC2019/122 implementing framework contract No SRSS/2018/0l/FWC/002-06

Funded by the Structural Reform Support Programme of the European Union

Overview

Title of the workshop: The RTDI system in Slovakia: Workshop to discuss recommendations for Slovakia's future research and innovation strategy

Date: 23 April 2020, 10.00-13.00

Place: online webinar

Number of attendees: 33

Agenda

1. **Welcome and introductions (VVA) (guide times: 10.00 - 10.15)**
2. **Outline of findings and draft recommendations (VVA) (guide times: 10.15 - 10.30)**
3. **Ranking of recommendations from research (all participants) (guide times: 10.30 – 10.45)**
4. **General Discussion of recommendations (all participants) (guide times: 10.45 – 12.00, including break)**
5. **Updated methodology for the RIS3 – From S3 Domains to Transformative Activities (BAK) (guide times: 12.00 – 12.30)**
6. **Outcome of COVID-19 survey (VVA) (guide times: 12.30 – 12.45)**
7. **Conclusions and next steps (guide times: 12.45 - 13.00)**

Summary

Welcome and introductions

VVA briefly recapped the project aims, partners, timelines and outputs:

- The main webinar functions and discussion rules were presented:
    - Everyone is on mute and needs to use the raise your hand function to speak.
    - Questions can be asked via the questions function.
    - Troubleshooting is available online.
- The agenda was presented to the attendees.
- An overview of the project context, objectives and steps taken so far was given.

Outline of findings and draft recommendations

VVA briefly presented the main findings from the research and provided further details on the draft recommendations for the next research and innovation strategy.

- The following seven areas of recommendations (each grouping several individual recommendations) were presented:
    - Area 1: Legislative framework
    - Area 2: Governance

- Area 3: Funding
- Area 4: Human resources
- Area 5: Infrastructure
- Area 6: Collaboration
- Area 7: Monitoring and evaluation

Ranking of recommendations from research

During this phase of the workshop, attendees were asked to use a live poll system to highlight their most relevant recommendations for further discussion. The ranking process was based on how urgently the issues should be addressed.

- The attendees ranked the seven areas of recommendations in the following order:
    1. Funding
    2. Governance
    3. Collaboration
    4. Human resources
    5. Monitoring
    6. Infrastructure
    7. Legislative framework

General Discussion of recommendations

Following the order determined by the attendees in the poll, there was a group discussion of the different recommendations, looking at the feasibility, implementation and ownership of potential solutions. The following points were discussed:

- **Area 3: Funding**
    - Current funding models are not competitive and need revisiting.
    - There is a need for matching national and EU funding.
    - Speed of funding calls needs to be increased, e.g. by issuing a series of generic calls.
    - Tools like the Seal of Excellence should be used more effectively to improve participation in H2020.
    - A key problem is that the national funding is very low and should be at least doubled.
    - Due to COVID-19 crisis, the funding of Seal of Excellence is supposed to be halted, which is a mistake. RTDI is important to increase competitiveness of Slovak companies, particularly SMEs.
    - Transferability of grants between beneficiaries should be assessed. An issue with the Seal of Excellence is to answer the question whether the Seal of Excellence should also be given to H2020 mobility activities.

- Slovakia invests less than 1% in RTDI (only one quarter of what was invested in the 70s and 80s. Increasing these investments (at least to 1.5% or 2%) is strongly recommended to the government. It will be needed to increase the added value generated by Slovak enterprises.
- Upcoming Horizon Europe puts strong emphasis on co-funding, which means that Slovak researchers will need more national funding. Not only seals of excellence, but also smaller schemes are needed.
- Funding management is bad – for example, an application for support for three H2020 projects has not received any results from the responsible agency.
- There is a lot of competition and overall low success rate – the bureaucracy requires a lot of time for preparation. There could maybe two phases: first a simpler proposal phase to assess quality, followed by a second phase for admin documents only for shortlisted proposals.

- **Area 2: Governance**
  - RTDI is more and more becoming a horizontal policy area, so the need for cooperation and coordination increases.
  - Although coordination has improved, there is no clear ownership of RTDI policy in Slovakia and there are many inefficiencies.
  - One prominent example is the delayed implementation of ESIF in the 2014-2020 period.
  - The governance system in Slovakia is very bad, in particular compared to UK or DE. Government action takes a very long time (e.g. issuing calls 6 years after EU funds have been approved, and even these calls are very bad) – although this works slightly better for fundamental research. The system is very bureaucratic and Slovakia ranks quite low in all related EU, OECD and other indexes. A fundamental change is needed.
  - The previous Ministry of Education preferred the funding with the scattergun approach but this does not favour excellence.
  - The management of projects is too complicated. When implementing EU money at national level, the administrative burden is very high compared to directly funded project, e.g. H2020 – those are clearly results-based, the budget is very flexible and you do not have to report the budget for buying a pen for example. In H2020 it is sufficient to have a certified external audit, no additional state control is needed. The administration must go away from the current approach and move towards something that is similar to H2020 to have an effective funds management.
- **Area 6: Collaboration**
  - Collaboration is understood in the wider sense according to the triple helix model, but in particular between research performers in the public and in the private sphere.
  - There should be more institutional incentives for universities to collaborate with industry.
  - There is room to improve support for collaborative mechanisms like clusters.
  - Support is needed to improve RTDI management skills to train people to manage large research projects.

- Collaboration between industry and universities needs improvement. Slovak universities are mainly teaching institutions with less focus on research. There seems to be sometimes some antagonism between science and applied research – science people think that commercial research should not be funded because companies should earn their own money. But companies should also be funded because they create opportunities for universities to be active in the 'real world'. An example of collaboration work: private company collaborating with STU (faculty technical engineering) under the Stimuli scheme, many PhD students did their thesis working on the company's products. But unfortunately the Stimuli scheme had a very bad reputation in SK because companies were funded.
- An application for a cooperation between 4 universities, SAS and 4-5 companies did not go through – not because of formal shortcomings but because the criteria of the Ministry were not in favour of applied research (what would you like to produce, is it competitive etc.). The focus was rather on number of people involved, number of publications and so on. Universities are interested in cooperation with private sector but the Ministry's criteria often do not really allow it.
- The Dutch way of funding implementation is a good example to reduce useless administration and bureaucracy.
- More money is not the point always the main problem, what is also needed is value. There is a lot of corruption and money is used without sustainability (e.g. technology parks that are not used). The industry wants to do collaboration, but programmes for immediate value creation are needed.

- **Area 4: Human resources**
  - This area is broad and includes skills matching between university programmes and industry needs, the research capacities of research institutions or research management skills.
  - Brain drain is a serious issue in Slovakia and reduces the pool of researchers, so concrete incentives should be put in place.
  - This is not only about keeping Slovak researchers but also about attracting international researchers to come to Slovakia to improve internationalisation of Slovak RTDI – tools for this were already described in the current RIS3.
  - Support for career development for young researchers, starting at PhD or even Master level is needed. There is talk about doctoral schools that also train professional skills. Careers outside academia should also be considered. It is also necessary to create support staff positions that are dealing with international research context and international researchers in Slovakia. Feedback from scholarship holders shows that they feel a lack of social contacts and being taken care of. Bad experiences with the Learning Makes Sense project – results clearly show that institutions in Slovakia are very closed towards international cooperation.
  - Attention should be put on (young) national researchers, perhaps via co-funding between companies and universities.
  - The education system is of vital importance, but it is very fragmented (too many universities and faculties). Higher efficiency within the national education system needed.
  - Brain drain needs to be stopped – each institution needs to support its own excellence. Legislation has improved a lot in recent years but there are still things to

be done. E.g. PhD students have to be on a work contract with social security and it takes a lot of time and administration to set up these contracts.

- **Area 7: Monitoring and evaluation**
    - Data is collected to some extent, but there is lack of transparency about how it is used – this makes analysis of funding mechanisms challenging and prevents proper planning and evaluation.
    - More frequent use of data and systematic evidence-based monitoring is recommended.
- **Area 5: Infrastructure**
    - Large investments have been made but funding for continuous maintenance needs to be available.
    - There is need for better use and coordination of research infrastructure.
    - Access of companies to research infrastructure in HEI should be improved.
    - The emphasis should be even higher. A lot of infrastructure was created but without any sustainability. There have been no calls to maintain infrastructure, and if these will not come the infrastructure investments will be lost.
- **Area 1: Legislative framework**
    - The framework appears to be relatively well-functioning.
    - Some areas could be further strengthened for universities and the SAS, for example the transformation of the SAS or the fact that English-speaking study programmes require a tuition fee.
    - The number of HEIs is too high and reducing the number should be considered
    - The research environment is wide and includes also private research institutes managed by Ministries (e.g. the Ministry of agriculture) – they would all benefit from reform.
    - Laws stimulating private investments (e.g. taxation benefits) should be assessed and compared with other countries to see how well SK is doing.

Updated methodology for the RIS3 – From S3 Domains to Transformative Activities

BAK presented the findings of the research (RIS3 SK and RIS3 methods since 2013) and provided details on the recommended method to update the S3 domains for the next strategy, followed by Q&A. The presentation covered the following items:

- Basic principles of RIS3:
    - Build the strategy on regional specific strengths, potentials and opportunities
    - Concentrate on certain priorities
    - Concentrate not on structures but on the transformation of these structures
    - Encourage a logic of entrepreneurial discovery
- Achievements in defining the domains and designing the EDP

- Improvement that have been made
- The objectives, structure and participants of the domain refinement workshop
- The upcoming EDP process
- One attendee commented that that the current domains were chosen well and that there is no urgency to change them. Instead, focus should be put on refining them – exactly what the EDP process aims to do.

Outcome of COVID-19 survey

The results of the survey, sent out ahead of the webinar, were supposed to be outlined. Due to time constraints, this item was skipped.

Conclusions and next steps

The next steps of the study were outlined to the participants, coupled with an invitation to further participate in the next steps:

- Finalisation of the recommendations (May-July 2020)
- Refinement of the RIS3 domains (May-July 2020)
- Entrepreneurial Discovery Process (EDP) (Summer 2020)
- Strategy validation workshop (Autumn 2020)
- Draft Smart Specialisation Strategy(December 2020)

Invitation to the workshop

Valdani Vicari & Associati
ECONOMICS & POLICY

BAK economic intelligence

KPMG

The RTDI system in Slovakia: Workshop to discuss recommendations for Slovakia's future research and innovation strategy

23 April 2020 – 10:00-13:00

Register and access via:
https://attendee.gotowebinar.com/register/6774676485152835084

AGENDA

1. **Welcome and introductions (VVA)**

VVA will briefly recap the project aims, partners, timelines and outputs.

(guide times: 10.00 - 10.15)

2. **Outline of findings and draft recommendations (VVA)**

VVA will go through the findings from the research and provide further details on the draft recommendations for the next research and innovation strategy.

(guide times: 10.15 - 10.30)

3. **Ranking of recommendations from research (all participants)**

During this phase of the workshop, participants are asked to use a live poll system to highlight their most relevant recommendations for further discussion. The ranking process will be based on how urgently the issues should be addressed.

(guide times: 10.30 – 10.45)

4. **General Discussion of recommendations (all participants)**

VVA will use the results of this live poll to structure a group discussion of the recommendations, looking at the feasibility, implementation and ownership of potential solutions.

(guide times: 10.45 – 12.00, including break)

5. **Updated methodology for the RIS3 – From S3 Domains to Transformative Activities (BAK)**

BAK will present findings of the research (RIS3 SK and RIS3 methods since 2013) and provide details on the recommended method to update the S3 domains for the next strategy, followed by Q&A.

(guide times: 12.00 – 12.30)

6. **Outcome of COVID-19 survey (VVA)**

The results of the survey, sent out ahead of the webinar, will be outlined. Participants will have an opportunity to add any further details.

(guide times: 12.30 – 12.45)

7. **Conclusions and next steps**

(guide times: 12.45 - 13.00)

Funded by the Structural Reform Support Programme of the European Union

OFFICE OF THE DEPUTY PRIME MINISTER OF THE SLOVAK REPUBLIC FOR INVESTMENTS AND INFORMATIZATION