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DRAFT  
RESEARCH AND INNOVATION STRATEGY  
FOR SMART SPECIALISATION OF THE  
SLOVAK REPUBLIC  
2021-2027

MINISTRY OF INVESTMENT, REGIONAL DEVELOPMENT AND INFORMATIZATION OF THE SLOVAK REPUBLIC



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## List of abbreviations

<b>5G</b>	The 5th generation mobile network
<b>AI</b>	Artificial Intelligence
<b>AKIS</b>	Agricultural Knowledge and Innovation
<b>BERD</b>	Business Enterprise Research and Development
<b>BS</b>	Business sector
<b>CAP</b>	Common Agricultural Policy
<b>CURI</b>	Catching-up Regions Initiative
<b>EC</b>	European Commission
<b>EDP</b>	Entrepreneurial Discovery Process
<b>EIP-AGRI</b>	The European Innovation Partnership for Agricultural Productivity and Sustainability
<b>EIS</b>	European Innovation Scoreboard
<b>EIT</b>	European Institute of Innovation & Technology
<b>ERA</b>	European Research Area
<b>ES</b>	Electricity system
<b>ESFRI</b>	European Strategy Forum on Research Infrastructures
<b>ESIF</b>	European Structural and Investment Funds
<b>EU</b>	European Union
<b>EU Funds</b>	EU Cohesion Policy Funds for the programming period 2021-2027
<b>EU-13</b>	EU Member States who joined the EU 2004, 2007 and 2013
<b>EU-27</b>	EU Member States after the withdrawal of the UK from the EU
<b>EUSDR</b>	EU Strategy for the Danube Region
<b>FTE</b>	Full-time equivalent
<b>GDP</b>	Gross domestic product
<b>GERD</b>	Gross Domestic Expenditure on Research and Development
<b>GO SR</b>	Government Office of the SR
<b>H2020</b>	Horizon 2020
<b>HE</b>	Horizon Europe
<b>HI SAS</b>	History Institute of the Slovak Academy of Sciences
<b>HPC</b>	High-performance computing
<b>ICT</b>	Information and communication technologies
<b>IoT</b>	Internet of Things
<b>IPO SR</b>	Industrial Property Office of the SR
<b>IPoR</b>	Innovation potential of regions
<b>IPR</b>	Intellectual property rights
<b>ISTC</b>	International scientific and technological cooperation
<b>KEGA</b>	Cultural and Educational Grant Agency
<b>KPI</b>	Key Performance Indicator
<b>MaaS</b>	Mobility as a Service
<b>MARD SR</b>	Ministry of Agriculture and Rural Development
<b>ME SR</b>	Ministry of Economy of the Slovak Republic

<b>MESRS SR</b>	Ministry of Education, Science, Research and Sport of the Slovak Republic
<b>MF SR</b>	Ministry of Finance of the Slovak Republic
<b>MH SR</b>	Ministry of Health of the Slovak Republic
<b>MI SR</b>	Ministry of the Interior of the Slovak Republic
<b>MIRDI SR</b>	Ministry of Investments, Regional Development and Informatization of the Slovak Republic
<b>MLSAF SR</b>	Ministry of Labour, Social Affairs and the Family of the Slovak Republic
<b>MNC</b>	Multinational Corporation
<b>MoD</b>	Mobility on Demand
<b>MSCA</b>	Marie Skłodowska-Curie Actions
<b>NACE</b>	Nomenclature statistique des activités économiques dans la Communauté Européenne
<b>NFC</b>	Non-refundable financial contribution
<b>NGS</b>	Next Generation Sequencing
<b>NUTS 2</b>	Statistical territorial unit – area (Nomenclature of territorial units for statistics)
<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>OP RI</b>	Operational Programme Research and Innovation
<b>OP SK</b>	Operational programme Slovakia
<b>P2P</b>	Peer to peer file sharing programmes
<b>PCS3</b>	Permanent Committee for RIS3 Implementation
<b>PS</b>	Public sector
<b>R&amp;D</b>	Research and development
<b>RDI</b>	Research, development and innovation
<b>RES</b>	Renewable energy sources
<b>RIS3</b>	Research and Innovation Smart Specialisation Strategy
<b>RIS3 2014-2020</b>	Research and Innovation Smart Specialisation Strategy of the Slovak Republic 2014-2020
<b>RIS3 proposal</b>	Supporting the transformation of the Slovak economy by increasing its innovation performance – output of the project developed by an international consortium
<b>RRP</b>	Recovery and Resilience Plan
<b>RWE</b>	Real World Evidence Data Generation
<b>SAA</b>	Skills Assessment and Anticipation
<b>SAS</b>	Slovak Academy of Sciences
<b>SGCSTI</b>	Slovak Government Council for Science, Technology and Innovation
<b>SIEA</b>	Slovak Innovation and Energy Agency
<b>SIH</b>	Slovak Investment Holding, joint-stock company
<b>SK RIS3 2021+</b>	Research and Innovation Smart Specialisation Strategy of the Slovak Republic 2021+
<b>SK VI Roadmap 2021-2030</b>	Roadmap of research structures
<b>SLORD</b>	Slovak Liaison Office for Research and Development)
<b>SMEs</b>	Small and medium-sized enterprises
<b>SR</b>	Slovak Republic
<b>SRDA</b>	Slovak Research and Development Agency

<b>ST services</b>	Scientific and technological services
<b>STEM</b>	Science, Technology, Engineering, and Mathematics
<b>TRC</b>	Technology Research Centre
<b>TRL</b>	Technology Readiness Level
<b>USP</b>	University Science Park
<b>V4</b>	Visegrad Group (Czech Republic, Hungary, Poland and Slovak Republic)
<b>VEGA</b>	Scientific Grant Agency of the MESRS SR and SAS
<b>WDI</b>	World Development Indicators

## Executive Summary

Research and Innovation Strategy for Smart Specialisation of the Slovak Republic 2021-2027 (hereinafter only as "SK RIS3 2021+") is a strategic document defining the objectives, policy system and measures in the field of research, innovation and human resources that will support the structural change of the Slovak economy towards growth based on increasing research and innovation capacity and excellence<sup>1</sup> in the segments with the highest competitive potential. It is the core document setting the baseline for the content of the European Union Cohesion Policy funds for the period 2021-2027 (hereinafter only as "EU Funds") in the area of research, development and innovation (hereinafter only as "RDI") and for the area of skills. The updating and implementation of the Research and Innovation Strategy for Smart Specialisation (hereinafter only as "RIS3") is essential to achieve the criteria of the baseline condition "*Good governance of a national or regional strategy for smart specialisation*". The meeting of the baseline criteria is a prerequisite for the drawdown of funds and the implementation of part of the activities of Policy Objective 1<sup>2</sup> "A more competitive and smarter Europe by promoting innovative and smart economic transformation and regional ICT connectivity" under the Operational Programme Slovakia (hereinafter only as "OP SK") in the programming period 2021-2027.<sup>3</sup>

The SK RIS3 2021+ goal is to support those priority areas that have the greatest potential for transformation towards higher added value actions and activities, while at the same time having sufficient research and innovation capacity.

The implementation of the SK RIS3 2021+ is under the responsibility of the Slovak Government Council for Science, Technology and Innovation (hereinafter only as "SGCSTI"), which has created a special body to coordinate activities related to RIS3 - the SGCSTI Permanent Committee for RIS3 implementation (hereinafter only as "PCS3"). Within the RIS3, a wide range of representatives of central government authorities, associations and unions representing business, the Slovak Academy of Sciences (hereinafter only as "SAS"), research institutions and universities are represented.

The starting point for the preparation of the SK RIS3 2021+ was an extensive analysis of the Slovak RDI support and development system carried out by the international consortium VVA Economics & Policy, BAK Economic Intelligence, KPMG (hereinafter only as "the consortium"), and national stakeholders within the framework of the project of the European Commission (hereinafter only as "EC") "*Supporting the transformation of the Slovak economy by increasing its innovation performance*".<sup>4</sup> The analysis of the

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<sup>1</sup> The meaning of the term **excellence**, if not further specified, varies according to the context of use: in the field of basic research, excellence is understood mainly as the creation of original knowledge reflected e.g. by a high number of citations; in the field of applied research and innovation, it is understood mainly as application in practice, scalability of solutions applied e.g. in the field of research and innovation, e.g. in the field of innovation, e.g. in the field of innovation, e.g. in the field of innovation, e.g. in the field of research and innovation. In the field of education, in particular the development of skills necessary for the labour market and the ability to creatively use the acquired knowledge leading, for example, to good employability of graduates in the field and the establishment of their own businesses.

<sup>2</sup> In the case of Policy Objective 1, as defined in Article 3 (1)(a) of the Regulation 2021/1058, compliance with the SK RIS3 2021+ is an essential condition for operations related to specific objectives in points (i) a (iv) of letter (a) above. Under OP SK, this condition applies on Specific Objective 1.1 (Enhancing research and innovation capacities and the uptake of advanced technologies) and 1.4 (Developing skills for smart specialisation, industrial transition and entrepreneurship).

<sup>3</sup> European Commission (2021): Regulation of the European Parliament and the Council (EU) 2021/1060 of 24 June 2021, laying down common provisions on the European Regional Development Fund, the European Social Fund Plus, the Cohesion Fund, the Just Transition Fund and the European Maritime, Fisheries and Aquaculture Fund and financial rules for those and for the Asylum, Migration and Integration Fund, the Internal Security Fund and the Instrument for Financial Support for Border Management and Visa Policy. Available at: <https://eur-lex.europa.eu/legal-content/SK/TXT/?uri=CELEX%3A32021R1060&qid=1627370407903>

<sup>4</sup> Project was implemented by the Ministry of Investments, Regional Development and Informatization of the SR with the assistance of the Structural Reform Support Service of the European Commission.

Slovak RDI system was prepared on the basis of several workshops, trainings and interviews, and resulted in two evaluation reports (AS-IS<sup>5</sup> report and TO-BE<sup>6</sup> report).

The first report (AS-IS), on which the RIS3 2021+ SK is based, provides an in-depth assessment of the current state of RDI in the Slovak Republic (hereinafter only as "SR"). The second report (TO-BE) offers concrete recommendations for reforming the system and removing or minimising obstacles and problems in implementation.

In the framework of the SK RIS3 2021+, the domains of smart specialisation are further defined by the Entrepreneurial Discovery Process (hereinafter only as "EDP"), implemented on the quadruple helix principle<sup>7</sup> with the support of the aforementioned consortium. Within the EDP, surveys, online discussions and workshops were carried out to better define the priority areas of smart specialisation, the transformation objectives, and the direction of the implementation of the SK RIS3 2021+.

The introductory part of the document presents the background information on the strategy preparation process, lessons learned from the past and a SWOT analysis of the Slovak RDI system. One of the strongest aspects of the current state of RDI in the Slovak Republic is the general consensus of stakeholders on the need to improve, strengthen and update the current RDI system. The biggest weakness of the current state of RDI is related to the long-term insufficient and unsystematic financing of RDI influenced by inconsistent political decisions, brain drain and outflow of experts, including researchers abroad. One of the constraints for smart specialisation is the continued administrative burden in implementing RDI projects funded by the European Structural and Investment Funds (ESIF). The biggest threat for the upcoming programming period 2021-2027 is the failure of all relevant stakeholders to manage the reform processes in the RDI support system, which may result in a failure to exploit the potential provided by the EU Funds as well as the Recovery and Resilience Plan of the Slovak Republic (hereinafter only as "RRP") for the RDI support. In terms of opportunities, these depend mainly on the extent to which effective measures can be defined and implemented to halt the brain drain and support the return of key players in the RDI and education ecosystem, as well as to simultaneously improve the conditions and make the field of RDI more attractive to young people and top professionals in Slovakia.

The SK RIS3 2021+ strategic vision is to ensure and implement by 2027 an economic transformation that will bring economic growth based on research and innovation, the creation of knowledge-intensive products and high value-added jobs. This transformation will build on the strengths of the Slovak RDI ecosystem, exploit opportunities brought about by global trends in business models and technological innovation, with the aim of strengthening the international competitiveness of domestic innovative companies as well as attracting foreign high-tech investment.

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<sup>5</sup> VVA Economics & Policy, BAK Economic Intelligence, KPMG (2020): **AS-IS report** – Supporting the transformation of the Slovak economy by increasing its innovation performance. Available at:

<https://www.mirri.gov.sk/sekcie/investicie/strategia-vyskumu-a-inovacii-pre-inteligentnu-specializaciu-sr/aktualizacia-ris3/>

<sup>6</sup> VVA Economics & Policy, BAK Economic Intelligence, KPMG (2020): **TO-BE report** - Supporting the transformation of the Slovak economy by increasing its innovation performance. Available at:

<https://www.mirri.gov.sk/sekcie/investicie/strategia-vyskumu-a-inovacii-pre-inteligentnu-specializaciu-sr/aktualizacia-ris3/>

<sup>7</sup> **Quadruple Helix** consists of four basic components: **First Helix** - manufacturing and services, primary sectors, financial sector, creative industries, social sector, large companies, SMEs, young entrepreneurs, students with business ideas, clusters and business organisations; **Second Helix** - public and private research institutions and organisations, colleges and universities, science and technology parks for education and training, institutions and organisations for technology transfer; **Third Helix** - all organisational units of the state administration (ministries), regional level (HTUs), advisory state bodies and institutions, public procurement offices, incubators; **Fourth Helix** - NGOs and citizens, initiatives related to societal challenges for which innovative solutions would be useful, consumer associations, and talents.



The SK RIS3 2021+ defines the RDI management system in line with the RRP. The RDI management system can be characterised as efficient in planning and drafting strategies, but inefficient in promoting strategic actions and implementation. Many of the obstacles to the successful development of the RDI ecosystem in the Slovak Republic are the result of interrelated factors, the most prominent of which are the lack of a real long-term strategy for science policy and innovation and its implementation in the form of critically important support at all levels of RDI according to established international criteria, the overall lack of systemic and continuous RDI funding, including targeted support schemes for the young generation of scientists, fragmentation of management in terms of competencies, lack of coordination of the concerned ministries and weak provision of ministerial capacities, loss of motivation of researchers and the private sector due to instability and unpredictability of funding and implementation of RDI support, resulting in lack of trust in the process of policy making in the field of RDI.

**Horizontal challenges** highlight the need to address cross-cutting issues of the Slovak RDI system as a whole. In key areas, the SR needs to achieve a fundamental shift to create the necessary space for the development of RDI. The main horizontal challenges of the RDI system in the SR include systemic and continuous support for the development of human resources and skills, RDI funding, cooperation between state, public and private research institutions and the business sector, as well as targeted development of research infrastructure, a legislative framework defining clear competences and processes in RDI policy-making, enforceability of decisions and defining a set of instruments, internationalisation and industrial transformation. **The proposed actions** respond to horizontal challenges and aim to achieve the strategic objectives and vision.

The support to the SK RIS3 2021+ focuses on priority areas and transformation objectives within the defined domains of smart specialisation, which have the greatest transformation potential in terms of the structure of the current and future economy, and which also have sufficient research and innovation capacity in the form of high-quality research teams, institutions and innovative companies. The domains of smart specialisation 2021-2027 are:

- Domain 1: Innovative Industry for the 21<sup>st</sup> century;
- Domain 2: Mobility for the 21<sup>st</sup> century;
- Domain 3: Digital Transformation of Slovakia;
- Domain 4: Healthy Society;
- Domain 5: Healthy Food and Environment.

An important part of the SK RIS3 2021+ is the monitoring system. Its task will be to capture and monitor the expected changes at the level of each of the defined priority areas, as well as at the level of implementation of the measures defined within the set of policies, through the entities responsible for setting the system of indicators. The basic elements of the governance structure responsible for setting up and revising the monitoring system, as well as for the actual implementation of the monitoring, are the Transition Councils. They are responsible for the implementation of the calls, the SGCSTI Secretariat, the SKS3 and the SGCSTI. Evaluation refers to the assessment of monitoring information at specific intervals as a basis for taking decisions on adjustments to the strategy in relation to the management of implementation and measures for achieving the set objectives, and possibly proposing changes needed to make implementation more efficient.

The SK RIS3 2021+ communication strategy defines communication tools in relation to all affected target groups.<sup>8</sup> A communication platform will act as an information database on current support opportunities from all available sources. Among other things, this platform represents the SK RIS3 2021+ single contact point.

An important complementary document to the SK RIS3 2021+ is also the **EDP Summary Report**<sup>9</sup>, which aims to summarize the progress and outcome of the EDP for each domain at defined time intervals. The content of the summary report includes the rationale for the selection of the domains, a detailed description of the process of defining the priority support areas, a description of the transformation objectives and transformation maps, including the identification of available research capacities and potential users.

For these reasons, the SK RIS3 2021+ currently creates the basic framework for the support to the RDI ecosystem in the Slovak Republic, defines measures and tools to achieve strategic objectives and serves as a starting point for setting up continuous processes that will contribute to the creation of an efficient RDI support system.

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<sup>8</sup> **Target groups** in the context of the communication strategy are all components of quadruple helix (see footnote 7), to which key information on achieving the strategy objectives will be communicated and the flow of information will be linked for faster and efficient implementation of the SK RIS3 2021+ strategy.

<sup>9</sup> Ministry of Investment, Regional Development and Informatization of the SR (2021): *Summary Report of the Entrepreneurial Discovery Process*. Available at: <https://www.mirri.gov.sk/sekcie/investicie/strategia-vyskumu-a-inovacie-pre-inteligentnu-specializaciu-sr/aktualizacia-ris3/>

## Introduction

The SK RIS3 2021+ is a **strategic document** defining the objectives, policy system and measures in the field of research, innovation and human resources that will support the stimulation of the structural change of the Slovak economy towards growth based on increasing research and innovation capacity and excellence in the segments with the highest competitive advantage. It is the core document setting the content focus for the use of EU Funds and the concentration of all resources related to RDI. This document is an update of the "*Knowledge to Prosperity - Research and Innovation Strategy for Smart Specialisation of the Slovak Republic*" strategy (hereinafter only as "RIS3 2014-2020").

The update was carried out within the framework of the project "*Supporting the transformation of the Slovak economy by increasing its innovation performance*" financed by the EC and implemented by an international consortium. The SK RIS3 2021+ considers the two basic conceptual documents developed to identify the needs for supporting RDI in the SR (AS-IS and TO-BE reports), taking into account the need to transform the Slovak economy into a knowledge-oriented economy.

The update and implementation of RIS3 is linked to the fulfilment of the criteria of the basic condition "Good governance of a national or regional strategy for smart specialisation". The fulfilment of the baseline criteria is a prerequisite for the drawdown of funds and the implementation of part of the activities of Policy Objective 1 "A more competitive and smarter Europe through the promotion of innovative and smart economic transformation and regional ICT connectivity" under the OP SK<sup>10</sup> in the programming period 2021-2027.

Continuous EDP among the RDI system stakeholders and reflection of its results in the 2021-2027 programming period is an essential element of the SK RIS3 2021+.

The document is structured in five chapters. The first chapter brings the background information on the process of strategy preparation, lessons learned from the past, and SWOT analysis of the Slovak RDI system. The second chapter defines the vision and strategic objectives, the fulfilment of which will enable the transformation of the Slovak economy. The third chapter defines the RDI management system, including the systemic and legislative measures necessary for the development of the RDI ecosystem, as well as the frameworks of the monitoring, evaluation, and communication system of the SK RIS3 2021+. The fourth chapter defines the horizontal challenges of the RDI system and designs an appropriate set of policies and measures through which the SR will achieve progress in key areas. The fifth chapter defines priority areas and transformation objectives within the defined domains of smart specialisation.

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<sup>10</sup> These are the activities of Specific Objective 1.1 and Specific Objective 1.4.

## 1. Strategy baseline

The SK RIS3 2021+ baseline was the update of the RIS3 2014-2020 approved by Resolution of the Government of the SR No. 665 of 13 November 2013<sup>11</sup>, and the draft update of the Smart Specialisation Strategy of the SR,<sup>12</sup> which was prepared within the project "Supporting the transformation of the SR economy by increasing its innovation performance" (hereinafter only as the "draft RIS3"), which included two basic conceptual documents, namely the "AS-IS" and the "TO-BE" reports. These materials represent an analytical, but also a supporting methodological and information source for the development of the SK RIS3 2021+. The "AS-IS" document represents an analytical report on the state of the RDI system in Slovakia. The document entitled "TO-BE" offers recommendations for improving the state of RDI in Slovakia. The Action Plan for the SK RIS3 2021+ implementation will be the baseline document for the disbursement of funds with a more detailed specification of activities based on the content framework of the SK RIS3 2021+ strategy. The Action Plan will be continuously updated in light of the EDP process.

### 1.1. Background information on the strategy preparation process

The preparation process of the new SK RIS3 2021+ started in 2019. Several consultation activities were held during 2020, including a **workshop aimed at redefining** the five domains of smart specialisation, designing priority areas, setting transformation objectives, and summarising existing capacities. As a next step, surveys were carried out within the public and private sectors in Slovakia under the auspices of the Ministry of Investment, Regional Development and Informatization of the Slovak Republic (hereinafter only as "MIRDI SR") and the domain coordinators, respectively, in order to focus in more detail on areas of the Slovak economy with high transformation potential. The results of the surveys serve as a basis for the continuous EDP.

**In late September 2020**, the EDP held **five workshops** with the aim to define the priority areas more precisely, to explain the methodology of the continuous EDP and the basic pillars of the transformation maps to stakeholders. Due to the COVID-19 pandemic, some workshops were conducted in an online format rather than presential, with additional consultations with stakeholders in each domain. By conducting the workshops, a separate EDP was initiated to identify the transformation maps through which the transformation goals will be achieved.

**A Validation Workshop on the EDP outputs** was held in November 2020 with the participation of the public research sector and universities, the business sector and the concerned ministries. Specifically, the priority areas of each domain were presented with the identification of the transformation goals to be achieved in each domain. The approach taken by each domain to define the priority areas, the underlying data on which they were based, as well as the needs that were identified by each domain were discussed.

Based on the workshop outcomes and the analyses already carried out (AS-IS and TO-BE reports), the consortium prepared a draft RIS3 in English, which was then sent to stakeholders for comments in December 2020.

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<sup>11</sup> Ministry of Economy of the SR (2013): *Knowledge to Prosperity - Research and Innovation Strategy for Smart Specialisation of the Slovak Republic*. Available at: <https://www.mhsr.sk/uploads/files/y8MaYzff.pdf>

<sup>12</sup> VVA Economics & Policy, BAK Economic Intelligence, KPMG (2021): *Draft Smart Specialisation Strategy of the Slovak Republic for the period 2021 – 2027*. Available at: <https://www.mirri.gov.sk/sekcie/investicie/strategia-vyskumu-a-inovacie-pre-inteligentnu-specializaciu-sr/aktualizacia-ris3/>

## 1.2. Basic economic outlook

The small and very open Slovak economy has experienced continuous economic growth over the last decade (except for 2020). Between 2011 and 2020, the average annual growth rate of real gross domestic product (hereinafter only as "GDP") of the EU-27 Member States after the UK's withdrawal (hereinafter only as the "EU-27") was 0.74 %, while in Slovakia it was 1.93 %.<sup>13</sup> Within the Visegrad Four group (hereinafter only as the "V4"), both Poland (3.015 %) and Hungary (2.18 %) achieved higher GDP growth in the reference period, while the Czech Republic recorded GDP growth of 1.63 %, the lowest among the V4 countries. In the World Competitiveness Ranking 2019, the Slovak Republic ranked 53rd out of 63 countries surveyed. In a comparison of 141 countries in terms of competitiveness sub-categories, Slovakia ranked in 2019 as follows: macroeconomic stability (1st place),<sup>14</sup> infrastructure (30th place), information and communication technologies (ICT) (39th place), and energy and energy efficiency (39th place). Rank), innovation capacity (44th)<sup>15</sup>, skills (45th), business dynamism (55th), financial system (56th), health (57th), market size (59th), institutions (61st), labour market (64th), product market (89th).

According to Eurostat data from 2019, the SR has the fourth most open economy in the European Union (EU). Total openness accounted for 185 % of GDP, of which exports accounted for 93 % and imports 92 %. As part of its involvement in global supply chains, the SR focuses mainly on assembly and completion of imported semi-products with a low added value of its own. Slovakia's exports are heavily dependent on imports from abroad, which has an impact on the low contribution of Slovakia's value added to exports.<sup>16</sup> One of the biggest challenges in the context of the COVID-19<sup>17</sup> pandemic was the involvement of the SR in global supply chains and its dependence on global economic developments.

The Slovak economy has a dual character. Its backbone consists of branches of multinational corporations (hereinafter only as "MNC"), especially car and consumer electronics manufacturers, who have brought with them dozens of their own suppliers. The second part consisted of domestically owned small and medium-sized enterprises (hereinafter only as "SME"), about 553,506 in 2019 (93 % of all active SMEs).<sup>18</sup> Large enterprises and SMEs are closely linked, with hundreds of SMEs typically linked to a single large enterprise as a subcontractor. It is therefore desirable to focus on promoting cooperation between large enterprises and SMEs with each other and their cooperation with the research and development sector, thereby creating the conditions for further economic growth in the SR. The development of small and medium-sized enterprises is one of the essential prerequisites for the healthy economic development of the country. SMEs in the SR constitute a significant majority<sup>19</sup> of the total number of business entities, providing employment opportunities in the corporate economy for almost three

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<sup>13</sup> Eurostat (2021): *TempoReal GDP Growth rate – volume*. Available at:

<https://ec.europa.eu/eurostat/databrowser/view/tec00115/default/table?lang=en>

<sup>14</sup> A country's position in the Global Competitiveness Index out of 141 countries surveyed represents the level of score achieved on a 0-100 scale, where 100 represents the optimal situation.

<sup>15</sup> National Productivity Board of the Slovak Republic (2019): *Report on productivity and competitiveness of the Slovak Republic 2019*. Available at: [https://ec.europa.eu/info/sites/default/files/economy-finance/7814\\_report-on-productivity-and-competitiveness-of-the-slovak-republic-npb-isa-final2.pdf](https://ec.europa.eu/info/sites/default/files/economy-finance/7814_report-on-productivity-and-competitiveness-of-the-slovak-republic-npb-isa-final2.pdf)

<sup>16</sup> OECD data (2019): *Increasing the benefits of Slovakia's integration in global value chains*. Available at: [https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ECO/WKP\(2019\)21&docLanguage=En](https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ECO/WKP(2019)21&docLanguage=En)

<sup>17</sup> SADOVSKÁ, E. (2020): *The Achilles heel of our economy*. Available at: <https://komentare.hnonline.sk/komentare/2167651-achilova-pata-nasej-ekonomiky>

<sup>18</sup> Slovak Business Agency (2020): *Report on the small and medium-sized enterprises in numbers in 2019*. (p.18) Available at: [http://monitoringmsp.sk/wp-content/uploads/2020/07/MSP\\_v\\_cislach\\_2019.pdf](http://monitoringmsp.sk/wp-content/uploads/2020/07/MSP_v_cislach_2019.pdf)

<sup>19</sup> For reporting statistics on the number of entities falling into the SME category, it is necessary to take into account the statistical bias for entities that are part of the consolidation. The methodology for the categorisation of enterprises for the purpose of statistical reporting of the information referred to in the text is based on Council Regulation (EEC) No 696/93 of 15 March 1993 on the statistical units for the observation and analysis of the production system in the Community. Available at: <https://op.europa.eu/de/publication-detail/-/publication/1ea18a1a-95c2-4922-935c-116d8694cc40/language-sk>

quarters (74 %) of the active workforce 97 % of SMEs are micro-enterprises employing fewer than 10 employees. More than three quarters of SMEs are active in industry, trade and related services and construction. In 2019, SMEs recorded a positive development, but their results have already been affected by the slowdown in the growth rate of the Slovak economy, which reached its lowest growth rate in the last three years. The year 2019 was also the last year of a successful decade for SMEs, which was characterised by an increase in the performance of the SME sector. Therefore, there is an effort to increase the presence of MNC branches in the country by having an increasing number of suppliers from domestic firms. These should gradually provide innovations and in-house research in addition to simple products to MNCs.<sup>20</sup>

One of the biggest challenges for the industrial sector and the labour market in the Slovak Republic in the medium term is the ongoing technological revolution. The competitiveness of countries in the 21st century is built on a highly skilled workforce and innovative performance. Businesses with the highest export capability in the Slovak Republic (e.g. car manufacturers and their suppliers) are almost completely decoupled from the national science and research ecosystem. In the 2020 Digital Economy and Society Index, Slovakia ranked 21st among EU Member States.<sup>21</sup> Such low ranking presents a problem related to the vulnerability of the labour market in relation to significant technological change. Only 16.8 % of enterprises in the Slovak Republic innovate, compared to 28.6 % in the EU-27.<sup>22</sup> Therefore, the Slovak economy is among those countries of the Organisation for Economic Co-operation and Development (hereinafter only as "OECD"), which suffer from a relatively low RDI financing by the private sector. Untapped potential is represented, for example, by the transferring of MNC development centres to Slovakia, the establishment of such centres at large domestic enterprises or support for innovation activities within the SME segment. In the context of assessing the investment performance of enterprises in the conditions of the Slovak Republic, it is also necessary to mention the position of the Slovak Republic in the international context (Figure 1), which is mainly influenced by the low volume of purchased fixed assets, which are often related to the R&D and innovation activity of enterprises. In the Slovak Republic, the share of machinery and equipment in fixed asset investments is extremely high and the share of intellectual assets (referred to as "intellectual property assets" in international databases, which include investments in software, databases, R&D results, etc.) is relatively low.

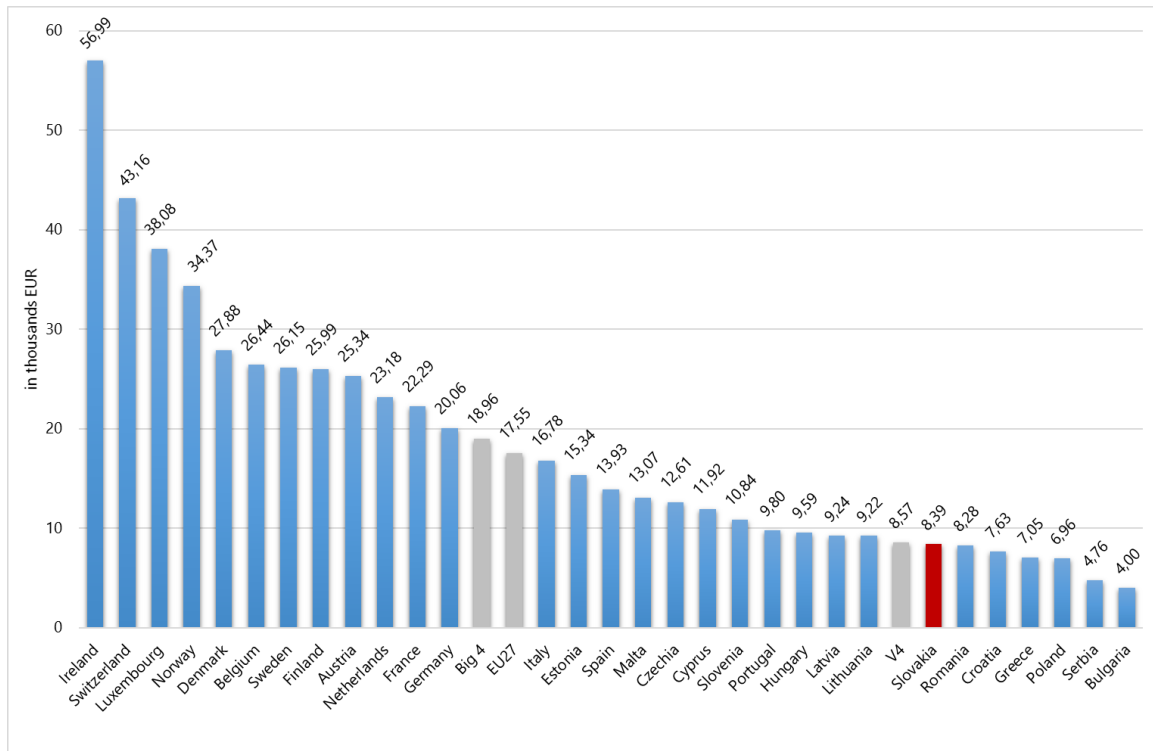
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<sup>20</sup> Slovak Business Agency (2020): *Small and medium enterprises in numbers*. (p. 18). Available at: [http://monitoringmsp.sk/wp-content/uploads/2020/07/MSP\\_v\\_cislach\\_2019.pdf](http://monitoringmsp.sk/wp-content/uploads/2020/07/MSP_v_cislach_2019.pdf)

<sup>21</sup> European Commission (2020): *Digital Economy and Society Index 2020 (DESI)*. Available at: <https://digital-strategy.ec.europa.eu/en/policies/desi>

<sup>22</sup> Slovak Business Agency (2020): *Innovation potential of SMEs in Slovakia*. Available at: <http://monitoringmsp.sk/wp-content/uploads/2020/08/Inova%C4%8Dn%C3%BD-potenci%C3%A11-MSP-na-Slovensku-1.pdf>

**Figure 1: Fixed capital formation per 1 employee in 2020**



Source: Eurostat – internally prepared<sup>23</sup>

Prior to the outbreak of the COVID-19 pandemic, strong real GDP growth was expected at 4.1 % in 2019, before declining to 3.5 %<sup>24</sup> in 2020. Per capita income growth was higher than in many OECD member countries, and with a positive outlook. The positive outlook for economic growth was driven by a combination of rising household demand, growth in household spending, high average wage growth and rising net export growth. The significant increase in net exports was mainly driven by foreign direct investment in the strongly export-oriented manufacturing sector. The manufacturing sector accounts for 85 % of total national output and is mainly made up of MNCs operating in the automotive and electronics industries.<sup>25</sup> Slovakia is one of the EU countries with a high share of industry in GDP (Slovakia (22.6 %); Germany (22.9 %); Hungary (24.2 %); Poland (24.6 %); Slovenia (26.7 %); Czech Republic (28.7 %); Ireland (39.2 %).<sup>26</sup> Infrastructure gaps and weak connectivity between urban and rural areas mean that in 2019, for instance, GDP per capita (in purchasing power parity) ranged between 162 % of the EU average (Bratislava Capital Region) and 50 % of the EU average (Eastern Slovakia Region). These regional differences are less pronounced when comparing net disposable income per capita, which ranges between 153 % of the EU average (Bratislava Capital Region) and 87 % of the EU average (less developed regions of the Slovak Republic).<sup>27</sup>

<sup>23</sup> Note: **The calculation is based on** gross fixed capital formation at current prices and the number of employees in the 15-64 age group, excluding employees in the education, public administration, defence and compulsory social security sectors. Big 4: France, Germany, Italy, Spain.

<sup>24</sup> European Commission (2019): *Country Report Slovakia 2019*. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019SC1024&from=EN>

<sup>25</sup> Trading Economics (2021): *Slovakia Manufacturing Production*. Available at: <https://tradingeconomics.com/slovakia/manufacturing-production>

<sup>26</sup> Eurostat (2021): *Gross value added at current basic prices*. Available at: [https://ec.europa.eu/eurostat/statistics-explained/images/5/54/Gross\\_value\\_added\\_at\\_current\\_basic\\_prices%2C\\_2005\\_and\\_2020\\_%28%25\\_share\\_of\\_total\\_gross\\_value\\_added%29\\_NA2021.png](https://ec.europa.eu/eurostat/statistics-explained/images/5/54/Gross_value_added_at_current_basic_prices%2C_2005_and_2020_%28%25_share_of_total_gross_value_added%29_NA2021.png)

<sup>27</sup> European Commission (2020): *Country Report Slovakia 2020*. Available at:



Economic forecasts from Discover CEE<sup>28</sup> (published in February 2021) projected that the COVID-19 pandemic would cause GDP to decline by 5.9 % in 2020, a slightly sharper decline than that seen during the global financial crisis of 2008–2009, when GDP in the Slovak Republic fell by 5.5 %.<sup>29</sup> The EC forecasts GDP growth to recover to 4.1 % in 2021 and 5.4 % in 2022. The COVID-19 pandemic has left Slovakia in a particularly vulnerable position due to the openness of its economy.

The state of R&D and innovation potential of the SR in terms of selected indicators is presented in a separate section of the document as Annex 1.

### 1.3. Lessons learned and experience from the previous period

Currently, there is no coherent functional innovation ecosystem in the Slovak Republic, consisting of institutions, policies, programmes and instruments creating appropriate conditions for supporting RDI and increasing the international competitiveness of the Slovak Republic.

In 2007, the Government of the Slovak Republic approved the Draft Innovation Strategy of the Slovak Republic for 2007–2013,<sup>30</sup> which aimed to bring a systemic approach among the diverse and non-systemic implicit measures and to ensure the implementation of the innovation policy in the conditions of the Slovak Republic, which was not sufficiently implemented.<sup>31</sup>

Due to the financial and economic crisis in 2007–2013, the SR used financial resources mainly for measures aimed at subsidising jobs and maintaining employment. RDI support was not provided to the extent originally planned and many, even low-cost measures financed from the state budget resources, where the interest of the business sector was assumed (e.g. innovation vouchers), were not implemented. The main measures were implemented from the resources of the operational programmes of the National Strategic Reference Framework (hereinafter only as "NSRF"). Significant steps towards modernising public RDI infrastructure were also taken in this period, with more than €1.4 billion of European funding invested in its construction and modernisation, representing around 10 % of the total allocation.<sup>32</sup> However, once the infrastructure and equipment was upgraded, exploitation soon became the most significant problem due to the lack of adaptation of the system to implement such projects in terms of legislation, financing and sustainability.

RIS3 2014–2020 served as a de facto innovation strategy. Some other initiatives were also implemented in this period, such as the initiative of the Slovak Innovation and Energy Agency (hereinafter only as "SIEA") to support the cluster strategy. The implementation of RIS3 2014–2020 cannot be seen as a success, mainly due to flawed policy decisions, administrative obstacles, lack of continuity of the strategic process, partial failure of the implementation of the Operational Programme Research and Innovation (OP RD), non-implementation of the measures defined in the implementation plan, and inadequate monitoring and evaluation.

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<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020SC0524&from=EN>

<sup>28</sup> VALACHY, J., LORINC, T., DEUBER, G., (2020): *Covid-19 in Slovakia: Active plus effective (new) government – lack of anticyclical tools*. Available at: <http://www.discover-cee.com/covid-19-in-slovakia-active-plus-effective-new-government-lack-of-anticyclical-tools/>

<sup>29</sup> Economic projections for the second wave of the COVID-19 pandemic (autumn and winter 2020) were not available at the time of the drafting phase of this chapter.

<sup>30</sup> Ministry of Economy of the SR (2007): *Draft Innovation Strategy for 2007–2013*. Available at: <https://rokovania.gov.sk/RVL/Material/16489/1>

<sup>31</sup> Slovak Business Agency: *Research on the implementation of the measures of the Innovation Strategy of the Slovak Republic for 2007–2013 from the point of view of small and medium-sized enterprises*. Available at:

<http://www.sbagency.sk/sites/default/files/5-vyskumrealizacieopatreniinovacnejstrategie.pdf>

<sup>32</sup> Slovak liaison office for research and development in Brussels (2015): *Contribution of the Slovak Republic to the ERA. New Research Infrastructure*. Available at: <https://www.slord.sk/aktuality/newresearchinfrastructure/>



It can be concluded that the shortcomings in strategic planning, which were characteristic of the period before 2007, are no longer such a significant problem in the Slovak Republic, however, the implementation of the plans is problematic. In the current period, other problems of the RDI system have come to the fore. The main problems include a lack of coordination in research infrastructure and its inadequate use and maintenance. Insufficient coordination and implementation of strategies related or linked to RIS3 and affecting the RDI ecosystem is also problematic. It is therefore essential that all these strategies are linked in the National Strategy for Research, Development and Innovation 2030.<sup>33</sup>

#### 1.4. Macro-regional comparison and regional specificities

Several macro-regional and regional elements need to be considered in the implementation of the SK RIS3 2021+.

##### 1.4.1. Macro-regional comparison

In 2019, EU Member States spent more than €306 billion on R&D. The average R&D intensity in the EU, i.e., the percentage of R&D expenditure as a share of GDP, was 2.19 % in 2019 compared to 2.18 % in 2018. Ten years ago (2009), R&D intensity was 1.97 %. Eight EU Member States recorded R&D intensity below 1 % of GDP: Romania (0.48 %), Malta (0.61 %), Cyprus (0.63 %), Latvia (0.64 %), Ireland (0.78 %), Slovakia (0.83 %), Bulgaria (0.84 %) and Lithuania (0.99 %).<sup>34</sup>

According to the 2019 European Innovation Scoreboard (hereinafter only as "EIS"), the Slovak Republic ranked 22nd and, together with 13 other EU Member States, was placed in the category of moderate innovators.<sup>35</sup> Overall, Slovakia's innovation performance increased by 7.6 percentage points between 2011 and 2019.<sup>36</sup> The assessment shows that Slovakia scores best in sales and employment, which experienced the strongest innovation growth. In the area of sales, positive results were seen in exports of intermediate and advanced (high-tech) technologies as well as in sales of brand-new innovative products for the market and firms. In contrast, exports of knowledge-based services scored relatively low. In the area of employment, the employment indicator in high-growth companies scored strongly. In contrast, employment in knowledge-intensive sectors scored modestly. The weakest performance of the Slovak Republic is in the areas of finance and support, intellectual property<sup>37</sup> and attractive research system. Overall, the following indicators are ranked the lowest: expenditure of high-risk capital, number of patent applications under the Patent Cooperation Treaty (PCT) filed with the European Patent Office in Munich as a receiving office as well as further training.<sup>38</sup>

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<sup>33</sup> Ministry of Finance of the Slovak Republic (2021): Recovery and resilience plan of the Slovak Republic. Available at: <https://www.mfsr.sk/sk/verejnost/plan-obnovy-odolnosti/> Note. The RRP foresees the adoption of a new cross-cutting document of the State Science and Innovation Policy (National Strategy for Research, Development and Innovation), which should represent an umbrella document over RIS3 and other departmental strategies for the field of RDI.

<sup>34</sup> European Research Area – Slovakia (2020): *R&D expenditures in the EU in 2019*. Available at: <https://eraportal.sk/aktuality/vydavky-na-vyskum-a-vyvoj-v-eu-v-roku-2019/>

<sup>35</sup> The analytical inputs in the national and international comparisons that are part of the SK RIS3 2021+ strategy are linked to the baseline as of 2019 (before the Covid-19 pandemic), that the ambitions of the SR in building and developing the RDI ecosystem and meeting the set strategic objectives and targets are not significantly undersized due to the more recent statistics (2020-2021) in relation to the impact of the pandemic on the bulk of macroeconomic and microeconomic statistics and the position of the SR in international rankings (e.g. the impact of the pandemic is not reflected in the international rankings of the SR). The impact of the pandemic on the position of the SR in the EIS, where there was a drop in the position of the SR from a moderate innovator (2019) to a weak innovator (modest innovator - 2021) in relation to RDI.

<sup>36</sup> European Commission (2021): *European innovation scoreboard 2021*. Available at: [https://ec.europa.eu/growth/industry/policy/innovation/scoreboards\\_en](https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en)

<sup>37</sup> **Intellectual property:** is an intangible 'property' that is the result of creative thought or creative intellectual activity. It is subject to legal protection and its use is therefore subject to the consent of the author or creator (copyright and rights related to copyright, industrial property law).

<sup>38</sup> Slovak liaison office for research and development (SLORD) in Brussels (2019): *European and Regional Scoreboard on Innovation in the EU: 2019 Edition*. Available at: <https://www.slord.sk/odporucame/europsky-a-regionalny-prehľad-výsledkov-inovácií-v-eu-edícia-2019/>

**Table 1: Aggregated Innovation Index in V4 countries in 2019**

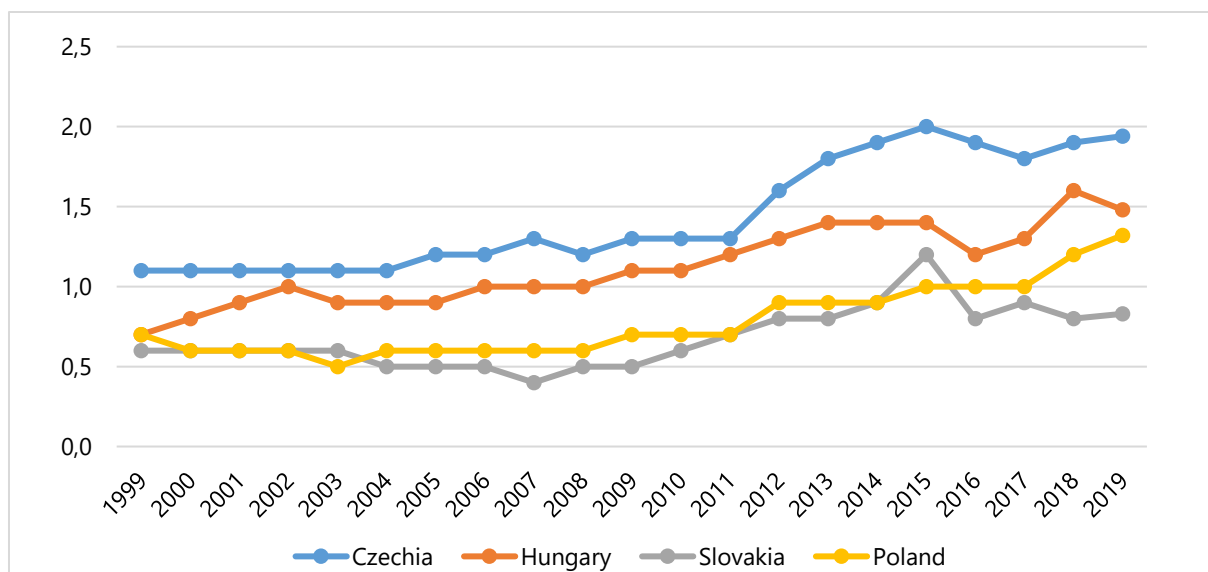
Country V4	Framework conditions			Investments		Innovation activities			Impacts		Summary Innovation Index
	Human resources	Attractive research systems	Innovation-friendly environment	Finance and support	Firm investments	Innovators	Linkages	Intellectual assets	Employment impacts	Sales impacts	
Slovakia	81,9	49,4	50,2	24,5	63,7	41,7	61,2	42,7	130,3	114,8	66,6
Poland	65,4	32,1	121,3	40,5	73,8	16	39,5	70,5	98,4	56	58,9
Hungary	44,7	58,4	83,1	46,2	82,1	34	58,9	47,6	139,2	85,1	66,4
Czechia	73,3	73,3	69,9	57,8	93,7	97	90	55,3	137,9	95,2	84,3

*Source: European Innovation Scoreboard 2019 – internally prepared<sup>39</sup>*

Slovakia's weak position in innovation performance is also reflected in the fact that Slovakia is not represented by a single company among the top 1000 innovative companies in the world in terms of R&D spending, while neighbouring Hungary and the Czech Republic have at least one company each, and similar in size but more developed EU economies (Austria, Switzerland, Denmark, Finland, the Netherlands, Belgium) have several times more (from 5 to 25).<sup>40</sup>

The major structural differences between the Slovak Republic and the EU average are those in which the Slovak Republic is above the EU average, i.e. average annual GDP growth, share of employment in manufacturing and share of value added in foreign-controlled enterprises - and those where the SR is below the EU average, i.e. the share of employment in services and knowledge-intensive sectors, and private spendings on research and innovation.<sup>41</sup> Slovakia's RDI expenditure shown in Figure 2 is the lowest among the V4 countries.

**Figure 2: RDI expenditure as a percentage of GDP - SR and V4 countries**



*Source: World Bank (World Development Indicators (WDI)) – own data processing<sup>42</sup>*

<sup>39</sup> European Commission (2021): *European innovation scoreboard 2019*. Available at:

<https://op.europa.eu/en/publication-detail/-/publication/d156a01b-9307-11e9-9369-01aa75ed71a1/language-en/format-PDF/source-136061387>

<sup>40</sup> Strategy& (2018): *The 2018 Global Innovation 1000 study*. Available at: <https://www.strategyand.pwc.com/gx/en/insights/innovation1000.html>

<sup>41</sup> Slovak liaison office for research and development (SLORD) in Brussels (2019): *European and regional overview of results in innovation in the EU. Edition 2019*. Available at: <https://www.slord.sk/odporucame/europsky-a-regionalny-prehľad-vysledkov-inovaciei-v-eu-edicia-2019/>

<sup>42</sup> World Bank: *World development indicators*. Available at: <https://databank.worldbank.org/reports.aspx?source=world-development-indicators>

The expenditure trajectory shown in Figure 2 also highlights the fact that in Slovakia, the ESIF accounted for a higher percentage of total RDI funding than in any other V4 country. The cyclical nature of these funds and the difficulties Slovakia faced in implementing and spending them in 2014-2020 led to a more pronounced decrease in RDI expenditure compared to other countries.<sup>43</sup>

For example, the decline in the investment cycle following the ESIF in 2015/2016 resulted in a 13 % fall in total gross domestic expenditure on research and development (hereinafter only as "GERD") in the Czech Republic, a 12 % fall in Hungary, a 4 % fall in Poland, while the Slovak Republic recorded the largest deficit of up to 32 %.<sup>44</sup> Stakeholders in the RDI ecosystem in the Slovak Republic have long faced problems with the RDI funding continuity and the high dependence of RDI funding on external EU funding compared to other V4 countries. Gross Domestic Expenditure on Research and Development by sector of performance (GERD) is also lower compared to other V4 countries and the EU-27 but is gradually increasing. Table 2 shows GERD in euro per capita.

**Table 2: Gross domestic expenditure on R&D by private sector in 2015-2019 in euro per capita**

Country/Year	2015	2016	2017	2018	2019
EU 27 (since 2020)	377.2	391.4	419.1	438.8	456.7
Czech Republic	167.5	171.7	204	233.9	251.7
Hungary	112.6	103.4	124.8	158.6	165.9
Poland	52.9	71.1	82.1	104.7	116.6
Slovakia	47.8	59.5	74.6	74.6	78.1

Source: Eurostat – internally prepared<sup>45</sup>

In this respect, the private sector in the Slovak Republic has a relatively good track record in certain areas. For example, in Horizon 2020 (hereinafter only as "H2020"), there was a relatively high level of participation by business sector (more than 45 % of the Slovak participation of €103 million in H2020 was by business sector actors). By comparison, the Czech participation (in net EU contributions) totals €377.5 million, with the largest single group - higher education institutions - receiving 45.2 % (although the share in terms of the number of actors is lower). For example, around 229 (SMEs) participated in the H2020 programme by November 2020, compared to 533,<sup>46</sup> in the Czech Republic, which in relative terms represents a participation gap of approx. 5 % against the Slovak Republic.

#### 1.4.2. RDI regional dimension

The RDI policy, higher education and the management of RDI institutions are the responsibility of central government authorities. They are also responsible for most of the resources to support the RDI ecosystem. Self-governing regions have certain competences in the field of secondary and vocational education and regional innovation. The socio-economic and infrastructural disparities between the regions of the Slovak Republic pose a problem. Insufficient infrastructure and weak connectivity between urban and rural areas mean that in 2019, for example, GDP per capita (in purchasing power parity) ranged between 162 % of the EU average (Bratislava Capital Region) and 50 % of the EU average (Eastern Slovakia Region). These regional differences are less visible when comparing net disposable income per

<sup>43</sup> European Commission (2019): *Country Report Slovakia 2019*. Available at:

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019SC1024&from=EN>

<sup>44</sup> World Bank: *World development indicators*. Available at: <https://databank.worldbank.org/reports.aspx?source=world-development-indicators>

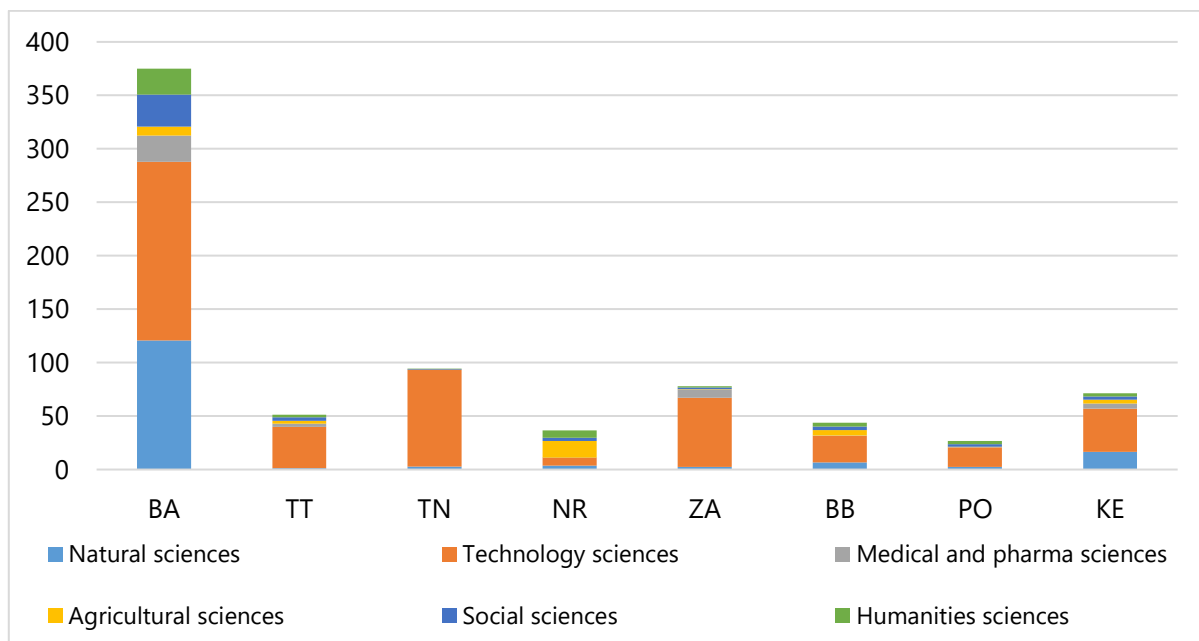
<sup>45</sup> European Commission: *Eurostat-GERD (Gross Domestic Expenditure on Research and Development by sector of performance)*. Available at: [https://ec.europa.eu/eurostat/databrowser/view/rd\\_e.gerd.tot/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/rd_e.gerd.tot/default/table?lang=en)

<sup>46</sup> European Commission (2021): *Slovakia Horizon 2020 country profile*. Available at: <https://webgate.ec.europa.eu/dashboard/extensions/CountryProfile/CountryProfile.html?Country=Slovakia>

capita, which ranges between 153 % of the EU average (Bratislava Capital Region) and 87 % of the EU average (less developed regions of the Slovak Republic).

Stakeholders perceive the preparation of regional RIS3s as necessary, while working on them signals improved cooperation and concrete activities use a bottom-up approach at local and regional level. R&I initiatives at the regional level need to be coordinated with central government processes. The continuous EDP should therefore take into account regional initiatives as a form of capacity building, and ensure that they are more closely linked to national activities. One form of linking the SK RIS3 2021+ activities with regional objectives is seen in integrated spatial strategies developed for the purpose of targeted development of individual regions. Central government authorities need to provide a central coordination framework for RDI policy, support and funding for the RDI ecosystem, while regions have a role to play in the direction and development of RDI.

**Figure 3: R&D expenditure by regions and scientific areas in 2019 (million EUR)**

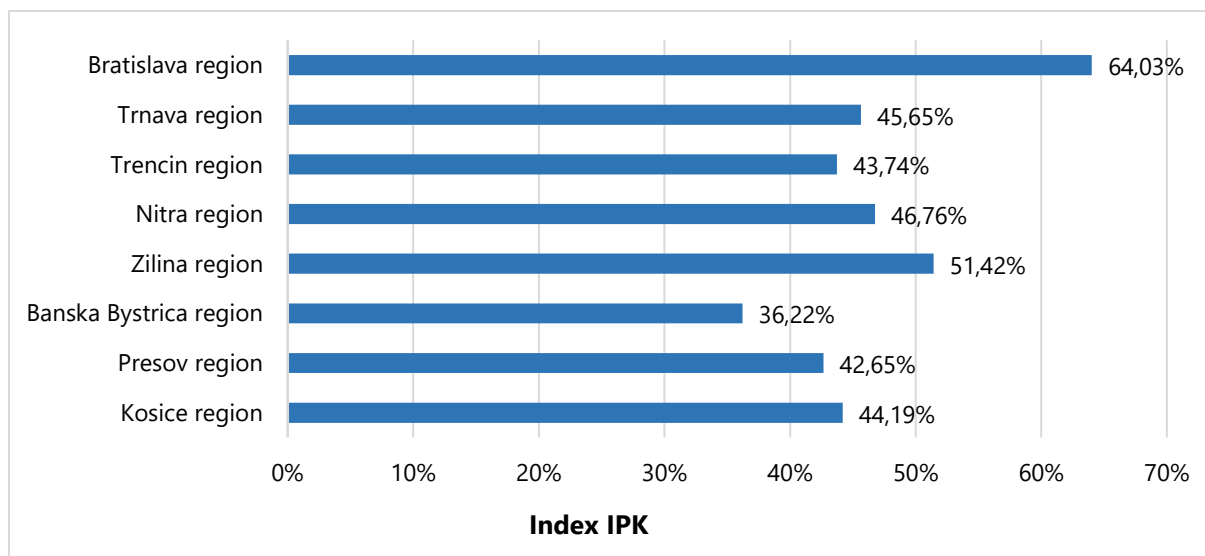


Source: Statistical Office SR – internally prepared<sup>47</sup>

Based on the Innovation Potential Index (hereinafter only as "IPK"), which assesses 5 key areas (People and Cooperation, Policy and Financing, Infrastructure, Culture and Conventions, Economic Performance), the Bratislava region is expected to have the highest innovation potential, with a strong position especially in the areas of Economic Performance, Infrastructure and Culture and Conventions. In contrast, Banska Bystrica Region lags significantly behind the other regions in Infrastructure and Economic Performance (in the area of Economic Performance the results are comparable only with Presov Region).

<sup>47</sup> Statistical Office SR (2021): *DATAcube*. Available at: <http://datacube.statistics.sk/>

**Figure 4: Innovation potential of the regions of the SR**



Source: ERA portal Slovakia – internally prepared<sup>48</sup>

### Regional innovation systems

EC Regional Innovation Scoreboard<sup>49</sup> assesses strengths and weaknesses of Slovak regions (NUTS 2):

- Bratislava region has the most advanced innovation system in Slovakia. Strengths include a high share of the population with higher education, a high share of employment in mid- and high-tech industries, high public sector spending on R&D, and an above-average number of joint public-private sector publications. Weaknesses include a low number of patents or high-quality scientific publications.
- The region of Western Slovakia has a high share of employment in mid- and high-tech industries as a strength. Low public and private R&D expenditure and low volume of commercial outputs of research and innovation (patents, trademarks) are among its particular weaknesses.
- The strengths of the Central Slovakia region are the intensity of non-research innovation expenditure and the relatively high share of employment in the mid- and high-tech industries. Weaknesses are mainly low public and private sector R&D expenditure, as well as very low volume of commercial outputs of research and innovation (patents, trademarks).
- The Eastern Slovakia region has as a strength the intensity of non-research innovation expenditure. Weaknesses are mainly low public and private sector R&D expenditure as well as low volume of commercial R&D outputs (patents, trademarks).

Currently, several regions have their regional innovation strategies (Nitra and Košice self-governing regions), some are updating them (Bratislava self-governing region) or preparing a new one (Banská Bystrica self-governing region). In general, however, there are no comprehensive innovation strategies in the regions and the dynamics of development as well as the innovation potential within these regions

<sup>48</sup> ERA Portal Slovakia: R&D performance indicators in the SR. Available at:

<https://eraportal.sk/wp-content/uploads/2020/12/Ukazovatele-vykonnosti-vyskumu-a-inovacii-v-SR.pdf>

<sup>49</sup> European Commission (2021): *Regional Innovation Scoreboard*. Available at: [https://ec.europa.eu/growth/industry/policy/innovation/regional\\_en](https://ec.europa.eu/growth/industry/policy/innovation/regional_en)

is also different and not analysed in detail, while support is not targeted to selected areas with the greatest potential.

For functional support of innovation activities in the regions, it is key to link the regional innovation strategies with the national SK RIS3 2021+ and to map the current potential and identify innovation capacities through an in-depth analysis of the regional RDI potential,<sup>50</sup> on the basis of which also the implementation of activities under the Action Plan will be adapted to the regional capabilities and specific characteristics of the regional RDI ecosystem. An important factor in supporting innovation activities in the regions will also be their linkage to Integrated Territorial Strategies (hereinafter only as "ITS"), comprehensive development strategies of the territory defining a system of priorities, objectives, and related operations (activities, projects, investments). These operations are spatially, materially and time coordinated within integrated project packages and financed from various sources - EU Funds, the state budget, funds from higher territorial units, cities and municipalities and private investors.

### 1.5. SWOT analysis

Overall, it can be concluded that one of the strengths of the Slovak RDI system lies in the existence of a consensus among stakeholders on the need for change and continuous improvement. In the coming period, this consensus needs to be translated into an agreement on the exact form of this change through instruments such as the continuous EDP.

The biggest weakness of the current system is related to the fragmentation of support across multiple ministries, the lack of coordination between these actors and the absence of a decision-making authority that could ensure the implementation of agreed policies and individual measures by all the ministries concerned. This is followed up by the poor performance of the support system, the impossibility of strategic planning, and the resulting unpredictability of support. The RDI system is further affected by brain drain and an outflow of researchers abroad. It should be noted that a number of factors are interrelated. For example, brain drain<sup>51</sup> can be seen as a symptom of a broader set of problems, including fragmented access to RDI, a low level of national funding, the failure to create employment conditions prospects in the RDI sector for the young generation and a lack of dialogue between the stakeholders towards a real solution to this problem, a solution which has long been in declarative form only.

The biggest challenge specific to smart specialisation and to the upcoming programming period is to streamline and simplify the administration of the project implementation processes and the efficiency of the RDI support system. In the previous period, calls for projects were delayed and cancelled in some cases. This was mainly due to their long preparation, poor formulation, disproportionately long administrative processing of submitted projects and the process of their evaluation. Stakeholders also questioned the quality, transparency and focus of some calls. This poses the greatest immediate threat for the upcoming period. More broadly, the continued economic impact of the COVID-19 pandemic will affect the implementation of future calls as it makes it difficult to incentivise private sector investment.

Developments in the opportunity category depend mainly on the extent to which a package of measures can be put forward to address the gaps in the intervention logic of the strategic management of RDI, stemming the brain drain and encouraging the return of the Slovak experts working abroad, and mobilising domestic top professionals from both the public and private sectors to engage more actively in RDI. In addition, synergies between EU funding and national funding need to be strengthened, which

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<sup>50</sup> See p. 44 in Chapter 3.4. Systemic and legislative measures

<sup>51</sup> **The brain drain** is also seen in a broader context in relation to the outflow of pupils to foreign secondary schools, not only in relation to universities.

will boost the quality of research and an overall improvement of the RDI system. This includes encouraging domestic businesses to invest more in innovation and to enter global markets.

**Table 3: SWOT analysis**

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>▪ Stakeholder consensus on the need to reform the RDI system</li> <li>▪ Key industries represented in global MNC supply chains in industries with high investment in innovation activities</li> <li>▪ Competitive technological and product standards of export</li> <li>▪ Growing interest from the business sector in the re-establishment of corporate RDI structures (entities)</li> <li>▪ Growing willingness to invest in technological development and innovation</li> <li>▪ Growing share of ICT service exports</li> <li>▪ Good results in selected science and technology disciplines and in the concentration of research teams and workplaces</li> <li>▪ Quality human resources in competitive traditional manufacturing sectors</li> </ul>	<ul style="list-style-type: none"> <li>▪ Gaps in the implementation of strategic documents and the absence of a systemic and continuous support for RDI</li> <li>▪ Rising brain drain (high school and university graduates)</li> <li>▪ Insufficient share of domestic RDI activities in export sectors</li> <li>▪ Low intensity of corporate industrial development</li> <li>▪ Lack of MNC activity in the field of RDI in Slovakia</li> <li>▪ Lack of engagement of domestic businesses in MNC subcontracting chains</li> <li>▪ Underfunding of businesses linked to low innovation performance, especially of SMEs</li> <li>▪ Low own value added of the output of domestic businesses</li> <li>▪ The absence of a comprehensive RDI strategy and its implementation, the absence of a national science policy</li> <li>▪ Under-utilisation and sharing of research infrastructure</li> <li>▪ Insufficient funding for the development and optimisation of research infrastructure</li> <li>▪ Barriers to the business sector access to the research infrastructure of public RDI institutions</li> <li>▪ Administrative barriers to the implementation of projects financed by the EU Structural Funds</li> <li>▪ Low level of cooperation between private and public sectors in RDI</li> <li>▪ Low share of national RDI funding</li> <li>▪ Poor involvement of Slovak entities in Horizon 2020</li> <li>▪ Insufficient competitiveness of Slovak RDI institutions within the EU</li> <li>▪ Lack of legislation stimulating the procurement of innovative products</li> <li>▪ Insufficient link between research and the needs of practice <sup>52</sup></li> <li>▪ Shortage of skilled labour and a weak link between the education system and labour market needs</li> <li>▪ High concentration of skilled labour in a few sectors and regions</li> <li>▪ Unsatisfactory (average) results of pupils in international assessments (e.g. PISA)</li> <li>▪ Lack of support for business training and inefficient system of continuing education <sup>53</sup></li> </ul>

<sup>52</sup> Linking education and research systems and the needs of practice relates in particular to the ISCED classification of education in grades 6-8 and to the relevant level according to the National Classification of Education.

<sup>53</sup> Continuing education is understood as programmes and activities that enable people to supplement, extend and deepen their education, to attain qualifications in line with the labour market needs, to satisfy their interests or to prepare for a degree. Education is carried out in educational and extracurricular educational institutions (mostly for a fee) and may be carried out in short-term or long-term organisational forms of study (Act No. 568/2009 Coll. on Lifelong Learning and on amendments to certain acts, as amended).



	<ul style="list-style-type: none"> <li>▪ flexible linking between the current funding system for secondary schools, universities and education and labour market needs</li> <li>▪ Limited number of RDI workers oriented towards practical application of RDI results</li> <li>▪ Low share of foreign RDI workers</li> <li>▪ Insufficient instruments to promote participation in EU and international programmes aimed at scientific excellence</li> <li>▪ Barriers to the use of IPR protection and insufficient support for their development</li> <li>▪ Insufficient AKIS system building at national and international levels, absence of EIP</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>▪ Keener involvement of domestic subcontractors in global MNC supply chains</li> <li>▪ Improving cooperation between private and private sectors in RDI and tapping into the networking potential</li> <li>▪ A more innovative use of land and strategic natural resources and the introduction of innovative solutions in agriculture and water management</li> <li>▪ Promoting the transition to a green economy and adopting legislative changes to support the green transition</li> <li>▪ A more efficient uptake of synergies, in particular between Horizon Europe (HE), the European Strategy Forum on Research Infrastructures (ESFRI) system of programmes and projects and other directly managed EU programmes</li> <li>▪ Involvement of national technology platforms in European platforms</li> <li>▪ A more extensive use and application of SR expertise in carbon-free energy</li> <li>▪ Developing social innovation and creative industries</li> <li>▪ Using the innovation voucher scheme</li> <li>▪ Expansion of national innovative firms in global markets</li> <li>▪ Supporting the setting up and development of innovative spin-offs and start-ups</li> <li>▪ Motivating enterprises to promote innovation and technology transfers</li> <li>▪ Stronger support for dual education and the introduction of the new forms of linking education and the labour market</li> </ul>	<ul style="list-style-type: none"> <li>▪ Failure to address shortcomings in the implementation of strategic documents and the persistent absence of systemic and continuous financial support for RDI</li> <li>▪ Transfer of multinational investors to countries with comparative advantages other than those of the Slovak Republic (EU)</li> <li>▪ Continued lack of investment in advanced products and technologies due to MNC not being connected to the local RDI infrastructure</li> <li>▪ Rising share of the population with insufficient quality of education and a low level of working skills</li> <li>▪ Mismatch between the education system and the structure of study programmes and the fields of study and training and the needs of the labour market<sup>55</sup></li> <li>▪ Persisting poor quality of the educational process in international comparison<sup>56</sup></li> <li>▪ Demand for graduates in education and training fields and study programmes relevant to the domains of smart specialisation to reflect the needs of the business environment<sup>57</sup></li> <li>▪ Poor quality of governance and a poorly set governance model for research institutions</li> <li>▪ Lack of international cooperation and slow response to changing global trends in RDI</li> <li>▪ Absence or insufficient processing of AKIS in CAP, insufficient building of national AKIS, absence of EIP-AGRI and its subsequent synergies with other programmes</li> </ul>

<sup>55</sup> The need to align the education system with the labour market for the current and upcoming periods is necessary at the level of study and training fields of secondary schools (vocational education and training) according to the system of the fields of education within the meaning of Decree No. 251/2018 Coll. and also for study programmes of universities within the relevant field of study within the meaning of Decree No. 244/2019 Coll.

<sup>56</sup> As part of improving the quality of the educational process, it is necessary to focus on all ISCED education levels (0-8), to create an internationally competitive education system.

<sup>57</sup> These are primarily graduates with a university education ISCED 6-8 and the relevant level according to the National Classification of Education.



<ul style="list-style-type: none"> <li>▪ Strengthening vocational and technical education and training in the fields of education and training and in study programmes <sup>54</sup></li> <li>▪ Creating conditions for the return of the Slovak experts working abroad</li> <li>▪ Supporting the arrival, integration and retention of foreign RDI workers and students in Slovakia</li> <li>▪ Involvement of RDI workers in solving business sector problems</li> <li>▪ Dynamic growth in the use of ICT across all business processes</li> <li>▪ Stronger synergies with the Recovery and Resilience Plan (RRP) and the Common Agricultural Policy (hereinafter the “CAP,” Common Agriculture Policy 2023-2027)</li> <li>▪ Increasing the median wage in RDI</li> <li>▪ Systemic support for research, innovative products and technologies in the field of healthcare and enhancing their implementation in clinical practice and in the context of pandemic and crisis situations</li> </ul>	<ul style="list-style-type: none"> <li>▪ Negative impact of ad hoc policy decisions on the implementation of RDI programmes</li> <li>▪ Isolation (imbalance) of the EDP process without adequate involvement of all actors in the quadruple helix model</li> </ul>
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*Source: internally prepared*

It is important to note that several of these elements can be considered interrelated and dynamic, as outlined in the SWOT analysis. For example, a weakness of the current system is the under-utilisation of the existing research infrastructure, in particular the impossibility of its use by the private sector. Existing legislation<sup>58</sup> for the academic sector, the Slovak Academy of Sciences and research institutions under the founding competence of ministries does not create favourable conditions for an active use of research infrastructure and an efficient cooperation between public and private actors. However, if the SR could improve the use of this infrastructure, it could become an opportunity thanks to significant investment in these institutions.

The RDI &I system has benefitted from MNC investment flows during the last two programming periods. There has now been a reduction in this investment and the SR needs to focus on making the best use of investment from industry and on increasing the level of business involvement in research and development. Otherwise, the threat could become a weakness in the coming period.<sup>59</sup>

The innovation voucher scheme has also been successful in some areas of innovation; however, this instrument requires a higher allocation of funds and can therefore be seen as an opportunity for the future.

The participation of the Slovak Investment Holding (“SIH”) in key projects is widely regarded as a success,<sup>60</sup> however, there is a systemic problem with financial instruments of this type. RDI stakeholders believe that the functioning of these financial instruments is not clearly explained to a sufficiently wide

<sup>54</sup> The fields of study and programmes relevant to the smart specialisation domains and their priority areas will be laid down on the basis of the EDP process and their support will be specified through specific activities listed in the Action Plan for the defined period of its validity as a result of the update related to the EDP process.

<sup>58</sup> Act No. 131/2002 Coll. on higher education and on amendments to certain acts, as amended, Act of the National Council of the Slovak Republic No. 278/1993 Coll. on the administration of state property, as amended, and other legislation governing institutions of higher education, SAS and other research institutions

<sup>59</sup> OECD (2019): *International Direct Investment Statistics 2019 – Slovak Republic*. Available at: [https://read.oecd-ilibrary.org/finance-and-investment/oecd-international-direct-investment-statistics-2019\\_f1b43d6b-en#page6](https://read.oecd-ilibrary.org/finance-and-investment/oecd-international-direct-investment-statistics-2019_f1b43d6b-en#page6)

<sup>60</sup> Slovak Investment Holding (2019): *Annual report / 2019*. Available at: [https://www.sih.sk/data/files/vs\\_sih\\_2019\\_sk\\_final-351-351.pdf](https://www.sih.sk/data/files/vs_sih_2019_sk_final-351-351.pdf)

range of potential actors, which leads to their limited use. If this instrument is to remain successful, the situation needs to be monitored in the coming period and overall communication on its use needs to be improved.

One of the key opportunities is the ability of the Slovak Republic to create an attractive environment for the return and retention of Slovak scientists from abroad. Currently, migration of highly qualified people to Slovakia is weak and usually limited to return for personal reasons. In addition to the return of Slovak researchers from abroad, measures must be taken to address the outflow of university students to neighbouring countries and to actively seek to attract talented professionals from abroad. At the same time, more active use should be made of schemes under EU programmes, e.g. Marie Skłodowska-Curie Actions (MSCA COFUND).

Although some schemes have already been proposed and implemented by the SAS (Slovak Academy of Sciences) and by some universities, the scope of such support is limited and a positive environment for potential returnees from abroad is not created systematically and for a period after the project is completed, which is completely non-existent. Analogous schemes need to be developed from national resources and implemented based on continuing requirements of the system and experience from abroad. The schemes must be open to talented researchers from all over the world.

The Slovak Republic will become attractive for the return of experts/researchers working abroad only if conditions comparable to those of the neighbouring countries are created for the support of RDI. Research support must be predictable and have rules for a long-term development and a structure that corresponds to the support that is also common in neighbouring countries for both competitive and institutional funding.

A targeted campaign aimed at the return of Slovak experts, including researchers with their skills and experience from abroad, and their involvement in the national RDI system, built on effective measures (financial and systemic) aimed at improving framework conditions (including family background), will be a positive contribution to the achievement of the objectives of this strategy in all areas.

The forthcoming Internalisation Strategy for Higher Education 2030, as well as measures under Component 9 “*A more efficient management and strengthening of funding for research, development and innovation*” will be a contribution in this area<sup>61</sup> and along with Component 10 “*Attracting and retaining talent*”<sup>62</sup> from RRP.

## **2. Strategy vision and objectives**

### **2.1. Strategy vision**

By introducing an optimised system of policies and measures in the field of research, innovation and human resources to foster the stimulation of the structural change of the Slovak economy towards growth based on increasing research and innovation capacity and excellence in the segments with the greatest competitive advantage in order to promote sustainable growth in employment, income and quality of life.

By 2027, the Slovak Republic will undergo a substantial part of economic transformation, which will bring economic growth based on research and innovation, on the creation of knowledge-intensive products

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<sup>61</sup> Ministry of Finance (2021): The Recovery and Resilience Plan for the Slovak Republic - Component 9: *A more efficient management and strengthening of funding for research, development and innovation*. Available at: <https://www.mfsr.sk/sk/verejnost/plan-obnovy-odolnosti/>

<sup>62</sup> Ministry of Finance (2021): *Recovery and Resilience Plan - Component 10: Attracting and retaining talent*. Available at: <https://www.mfsr.sk/sk/verejnost/plan-obnovy-odolnosti/>

and jobs with high added value. This transformation will build on the strengths of the Slovak RDI ecosystem, using opportunities presented by global trends in business models and technological innovation, with an aim to strengthen international competitiveness of domestic innovative companies as well as to attract foreign high-tech investment.

Systematic support and efficient management of RDI by the State will stimulate cooperation between research and business actors and the creation of inter-sectoral links, while bringing the education system closer to the needs of the economy and emphasising the applicability of R&D outputs. Developing human resources, adjusting the legislative environment, ensuring predictability and stability of funding, using research infrastructures and the efficiency of funds spent will also be key to the development of the RDI ecosystem. At the same time, this transformation will be sensitive to social issues and will also proactively address environmental challenges through sustainable and green technologies.

SK RIS3 2021+ builds on the previous SK RIS3 2014-2020, which failed to achieve the transformation of the economy by failing to implement it, and therefore places particular emphasis on the aspect of implementation in the period 2021-2027. The role of the different components of governance is to ensure implementation and the elimination of shortcomings as well as competence responsibility.

SK RIS3 2021+ is built on two main pillars:

- Domains of smart specialisation as outputs of the entrepreneurial discovery process to be developed through specific projects aimed at developing technologies, products, developing infrastructures or building collaborative platforms;
- Strategic objectives that will be pursued through systemic measures and public policies while responding to the main challenges of the RDI ecosystem.

Fulfilling this vision will contribute to the transformation of the Slovak economy into a knowledge-based economy.<sup>63</sup> Key economic sectors are being restructured to deliver higher added value. Cooperation with MNCs and new strategic segments will be improved, enabling Slovakia to reshape value chains and tap into new market opportunities.

SK RIS3 2021+ focuses on the transformation of the economy in the areas of industry, mobility, digitalisation, health, food, natural resource processing and the environment.

The aim is to achieve a higher share of original Slovak innovations, research and development activities and thus significantly increase the added value of production and related services. The result will be a transformed economy oriented towards innovation and the creation of long-term jobs focused on the use of intellectual and creative skills, which will also reduce the outflow of highly qualified young people abroad.

It is essential that SK RIS3 2021+ SK considers global megatrends and the activities of world leaders from which it would benefit. It is also important to consider various social changes and considers, including the growth of urbanisation, the health and safety of travellers and the growth of teleworking (working from home). This process has been accelerated by the COVID-19 pandemic. SK RIS3 2021+ will also address cross-sectoral linkages.

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<sup>63</sup> The knowledge-based economy is a label for the current modern economic systems of developed countries, which are based on the use of knowledge or products with advanced technologies for the creation of value – of products or services. The knowledge economy is driven by ideas and innovation. The knowledge economy increases labour productivity, creates new industries, innovates services, products, technologies and working methods.

In industry, SK RIS3 2021+ focuses on increasing own innovation capacity to increase the added value of products and services to improve the competitiveness of domestic producers in global supply chains. It is also important to seek solutions that reduce the negative environmental impacts of industry and increase energy efficiency. At the heart of this vision is the idea that research and innovation activities will focus on automated, robotic, reconfigurable and smart systems for manufacturing and logistics tools, and on the introduction of IoT technologies into industry.

The strategy approaches mobility as a comprehensive value chain linking different actors (vehicle manufacturers, transport service providers, technology suppliers, cities and customers) whose smart solutions have the potential to respond to interlinked social, economic, environmental and urban challenges. An important concept in the new mobility is multimodality, i.e., smart interconnection between different modes of transport using innovative business models and advanced digital technologies. In the Slovak Republic, emphasis is also placed on improving legal norms, transport infrastructure, standards and the management of this agenda by the State. The sectoral linkages between mobility/transport, digitalisation and energy are growing at the global level. For example, the use of artificial intelligence, Mobility as a Service (MaaS) and Mobility on Demand (MoD), the personalisation of car manufacturers' product portfolios, smart industry and advanced manufacturing, or the penetration of the Internet of Things (IoT) in mobility, logistics, growing urbanisation and the development of new modes of transport and work are factors that will also have an impact on the development of mobility and logistics in the Slovak Republic.

Health and its aspects are important in their own right, but also for the development of other sectors of social life that reflect other domains. On the other hand, the promotion of certain specific areas in particular sectors can directly or indirectly affect population's health. In the health domain, there is a need to innovate and introduce new processes and technologies at all stages of healthcare delivery, from prevention, through diagnosis and treatment to aftercare. The domain also reflects new trends in demography, mobility and population behaviour.

SK RIS3 2021+ also recognises the importance of production from and on land for the economic development of the Slovak Republic. Biomass and raw materials from and on land account for approximately one third of all materials extracted or produced in the SR. Agricultural land, forests and water cover more than 80 % of the territory of the Slovak Republic. These natural resources are crucial for healthy ecosystems and essential for the health and quality of life of the people living in the SR. SK RIS3 2021+ also foresees the strengthening of cooperation between research and development organisations in agriculture and the environment in order to foster enterprises to introduce innovative solutions, to advance finalisation of agri-food production, to increase quality, safety and self-sufficiency in the production of quality, nutritious, safe and healthy food, to create innovative and healthy food and non-food products, to use waste from production in a circular way and as a raw material for further processing, etc. Biomass in the context of the domain is understood as a biological source of production from and on land, it is not a simplistic linear concept of biomass as a resource for energy use, which was used in the past and disregarded circular solutions and a cascading use of biomass.

Digital technologies are a cross-cutting area, present across all domains, as innovation and the creation of higher value-added products are often achieved precisely through digitalisation and breakthrough technologies such as Artificial Intelligence (AI), 5G or distributed ledger technologies (DLT). Also important for the economic development is understanding data as an asset that is economically exploitable. This also applies to ecosystem accounting, which should also gradually become part of databases relating to data that are economically exploitable; in fact, they should become their basis.

The education system will be aligned to ensure that VET and, in particular, tertiary education are responsive to the needs of the economy and produce a larger workforce with the skills needed to address scientific and economic challenges. Promoting study programmes and fields of study and training in the areas indicated by the EDP process will be substantially enhanced and curricula will be developed increasingly in cooperation with the private sector. Adequate quality education and training provision will be developed in vocational secondary and higher education as well as in continuing education for the acquisition and development of the skills needed. The quality of higher education institutions through performance-based funding and with an emphasis on the acquisition of practical skills and employability at the level of their qualification framework will be improved. The envisaged merging and cooperation of the most reputable universities in Bratislava and Kosice will create synergies enabling the emergence of new, multidisciplinary and promising study programmes within respective fields of study.<sup>64</sup>

A “culture of quality” is being established in the RDI ecosystem, which will make funding focus not only on quantity, but mainly on quality, competitiveness of outputs and their impact. At the same time, ex-ante and ex-post evaluation will use internationally recognised principles of quality, objectivity and transparency and international teams of experts where relevant. Increasing the quality of scientific outputs will also increase the chances of Slovak researchers participating in larger European projects or programmes such as HE. The almost exclusive reliance on EU funds to finance research and innovation projects will be complemented by long-term and stable national research and innovation development programmes, based on the new, integrated National Strategy for Research, Development and Innovation 2030,<sup>65</sup> which will form a unified policy framework for RDI in the future and integrate RIS3. Predictable long-term public funding of RDI will be ensured, thereby strengthening the co-financing of research and innovation activities by the private sector.

The quality, growth and development of human resources is a central theme for the development of RDI. It is therefore proposed to adopt a specific set of measures focusing on human resources across the whole RDI ecosystem. In addition to the return of and retention of Slovak scientists and experts from abroad, the Slovak Republic will take measures to reduce the outflow of university students and secondary school pupils to neighbouring countries and, conversely, to attract talented young professionals from abroad. At the same time, it will set appropriate incentives for the involvement of professionals with advanced knowledge in RDI working in the Slovak Republic. It will also strengthen international mobility and increase the participation of Slovak researchers in international programmes. In order to deepen cooperation between the private and public sectors in RDI, both public and private research institutions need to be equipped with state-of-the-art technologies that will be used to the maximum extent possible. This will contribute to the development of top-level research activities and will also help to attract scientific and technological excellence to Slovakia. Changes in the support of human resources must also be initiated in the academic environment in order to support the education of young researchers. These measures will aim to improve the conditions for their professional and career development and to involve existing scientific capacities in this process. It will also include the training of experts and senior managers from industrial practice to promote their expertise and motivation to initiate the development of RDI activities within enterprises and their parent groups, as well as intensive cooperation with the sources of open innovation, with the aim of increasing the competitiveness of

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<sup>64</sup> Fields of study are based on a system of the fields of study on the basis of Decree No. 251/2018 Coll. on the system of the fields of study for secondary schools and on the material scope of the fields of study. Available at: <https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2018/251/20180913>

<sup>65</sup> Ministry of Finance (2021): The Recovery and Resilience Plan for the Slovak Republic - Component 9 A more efficient management and strengthening of funding for research, development and innovation. Available at: <https://www.mfsr.sk/sk/verejnost/plan-obnovy-odolnosti/>

enterprises by creating unique know-how, products, services and solutions. The overall structure of human resources in R&D institutions must be brought closer to that of quality institutions abroad. The quality of human resources must be improved in both the state and public administrations, thereby enhancing the ability to develop and enforce appropriate RDI policies.

The RDI management system will undergo a sweeping reform, which will boost the executive and decision-making competences of the Government Council for Science, Technology and Innovation (GCSTI). Furthermore, consolidating the agencies covering calls and grant schemes is envisaged, to increase the efficiency of processes and the quality of management and to remove unnecessary administrative barriers limiting the use of funds from different support schemes. The proposed changes will ensure more efficient and effective funding of research and innovation activities through national programmes, EU funds and the RRP. In general, the principles of good governance and efficiency will be rigorously applied to interventions and investments and the quality of outputs will be emphasised in implementation. Measures will be put in place to increase the expertise and availability of administrative capacities where they are insufficient. The whole system of public support for RDI activities needs to regain confidence so that it is widely known, accessible and easy to use by a diverse range of actors. The design, approval and publication of calls will be fast, efficient and transparent, and stakeholder participation will be emphasised in the development of plans, in line with the EDP process.

For innovation, it is important to motivate and develop the cooperation of stakeholders, to support the establishment and modernisation of corporate research and development centres, which, among other things, will significantly contribute to the anchoring of key economic sectors.

Financial incentives must cover all research areas with links to the smart specialisation domains and their priority areas to enable research institutions to establish links with the business sector. Support for clusters, which are a concept for innovation creation, will also be of great importance. The existing funding gap at national level at certain stages of the innovation cycle will be addressed through specific measures.

The innovation voucher system will be adapted to better cover the needs of its actors, with the assumption that it will be more widely used by domain actors. The conditions for grant schemes will be adjusted so as not to discriminate against new actors.

Among the decisive elements of a systematic support for RDI is also the creation of conditions for the use of research infrastructure (research and development centres, science parks, centres of excellence, etc.) by relevant actors from the Slovak Republic and abroad as well as its networking and interconnection. This will help to contribute to a greater interest in the use of infrastructure as a comprehensive service with technical and personnel support and also to increase the demand of the next generation for products, technologies, materials and services. Based on the Government-approved Research Infrastructure Roadmap 2020-2030 (hereinafter SK RI Roadmap 2020-2030), the First Action Plan for the implementation of the Research Infrastructure Roadmap for the period 2021-2025 and the Second Action Plan for the implementation of the Research Infrastructure Roadmap for the period 2026-2030 will be developed. Within the framework of the action plans, targeted funding instruments and mechanisms will be put in place to sustain the infrastructure not only financially but also in terms of practical use, which requires the establishment of a framework for long-term sustainability and the capacity for professional staffing. The conditions for the use of this infrastructure will be set in accordance with state aid rules with a view to exploiting research infrastructure in cooperation with



enterprises. To this end, arrangements will be made for the application of the state aid rules by the stakeholders involved.

Strengthening the regulatory framework is part of creating the favourable conditions for the development of research in the business sector. This will raise awareness of the opportunities for IP protection and improve overall patent literacy. Legislative barriers to RDI development will also be identified and removed. An important part of the legislative changes is also completion of the transformation of the Slovak Academy of Sciences (SAS) so that it can enter commercial partnerships to a greater extent and participate in innovative solutions and knowledge transfer. At the same time, the legislative arrangements for the transformation of the SAS will also allow for the streamlining of private-public partnerships for research organisations under the responsibility of the ministries. An international audit of the whole RDI system will be carried out to identify its weaknesses and strengths. At the same time, the mandatory disclosure components of support applications will be identified and revised to ensure that they do not contain economically sensitive information.

In publicly funded support, Open Science principles will be promoted as much as possible, with special consideration given to situations in clearly justified and regularly monitored cases where there is a clear risk of economic loss and a loss of competitive advantage.

All of the above priorities need to be implemented with due regard for the necessary environmental protection and sustainability. Activities should therefore be carried out in full compliance with the green transition.

## 2.2 Strategy goals

Goals of this strategy are divided in two categories:

- **Strategic goals**, which are horizontal, further elaborated in partial targets and implemented by means of measures referred to in chapter Set of policies and measures
- **Domain-specific goals** at the level of individual domains, whereby they are met by means of more specified transformation goals at the level of priority areas that will be implemented by means of transformation maps

### Strategic goals:

Strategic goal	Partial targets
<b>1. Increase the quality and availability of human resources in RDI</b>	1.1 Increase cooperation among companies and secondary vocational schools and universities in the education process
	1.2 Increase the number of graduates of science and technical study programmes at university graduate and doctoral levels
	1.3 Increase salary expenditure per researcher by 50 % (without inflation) until 2027 <sup>66</sup>

<sup>66</sup> As provided in the "AS IS" report on the current situation (prepared as part of this project and included in the bibliography), the total expenditure per researcher (expressed in the full time equivalent; FTE) is at one-half of the level in Czechia, while in Austria and Scandinavian countries, the expenditure per one researcher is three to five times higher than in the Slovak Republic. Therefore, increasing expenditure by 50 % is deemed necessary minimum that needs to be achieved until 2027. Increasing salary expenditure per researcher applies to researchers in public and private sector and the starting point for monitoring of the increase of expenditure will be the statistical data about the number of research employees in the respective year in the proportion to total salary expenditure. The calculation of expenditure per researcher is based on methodologies of the Slovak Academy of Sciences. Slovak Academy of Sciences (2019): *Analysis of funding and scientific output of SAS*. Available at: [https://www.sav.sk/uploads/dokumentySAV/4\\_SAS-2021\\_analysis.pdf](https://www.sav.sk/uploads/dokumentySAV/4_SAS-2021_analysis.pdf)

	1.4 Increase the number of doctoral and postdoctoral fellows at domestic universities and research institutions
	1.5 Increase the number of graduates of foreign universities who will get employed in the Slovak Republic
	1.6 Increase the level of qualification and availability of human resources in state administration in the field of R&D policies and management
	1.7 Increase the attractiveness of secondary vocational schools in order to reduce the number of students leaving abroad
	1.8 Increase the quality of the education process in study programmes and vocational study programmes relevant for priority areas <sup>67</sup>
	1.9 Increase the accessibility and relevance of further education
<b>2. Improve the innovation performance and position of the SR in international comparison</b>	2.1 Increase, until 2027, the overall productivity of factors (Total-Factor Productivity) to the EU average <sup>68</sup>
	2.2 Increase the level of cooperation between the private sector and academia in research and innovation projects
	2.3 Increase expenditure from businesses to universities and state sector
	2.4 Improve the position of Slovakia in the European innovation scoreboard <sup>69</sup>
	2.5 Increase the financial volume of contractual cooperation for the use of research infrastructures by the private sector
<b>3. Increase the contribution of the research to the economic growth by means of development of the quality of the RDI</b>	3.1 Increase the share of overall expenditure on R&D to at least 1.20 % of the GDP until 2024, with the goal to reach the share of expenditure of 1.64 % of the GDP in 2030. As part of the increase, the proportion of expenditure between the private and the public fundings must reach 3:2 in line with the EU average <sup>70</sup>
	3.2 Increase the share of articles published in magazine in the 1 <sup>st</sup> quartile in indexed international databases <sup>71</sup>
	3.3 Increase the overall expenditure on R&D in the private sector by means of a systemic support to its activities <sup>72</sup>
	3.4 Increase the volume of acquired funds and the number of Slovak entities' participations in the HE Programme <sup>73</sup>

Three basic indicators have been selected in order to ensure monitoring of the impact of implementation of the SK RIS3 2021+ Strategy at the level of strategic goals, whose purpose is to evaluate, in a broader

<sup>67</sup> The ambition of SK RIS3 2021+ for this specific objective is to support the increase of the quality of education process in science and technology at the level of primary schools, secondary schools and universities with a specific focus on increasing the rating in PISA, TIMSS/PIRLS, T9, Multibank, Shanghai Ranking.

<sup>68</sup> In the period of 2013-2014, the Slovak Republic was at the EU average in the indicator for the total productivity of factors. In the 2015-2019 period, the difference in the TFP index between the EU level and the SR was growing negatively, which represents slightly slower growth of the TFP index for the SR compared to other EU Member States after 2015. Therefore, the goal for the SR in the following Programming Period (2021-2027) is to turn over the negative trajectory of the TFP index growth and reach the EU average again until 2027. Available at: <https://db.nomics.world/AMECO/ZVGDF?dimensions=%7B%22geo%22%3A%5B%22svk%22%5D%7D>

<sup>69</sup> In the preceding Programming Period 2013-2019, the SR increased its innovation performance according to EIS Index by 7.6 in relative comparison to the EU. The ambition for the following programming period is to get to the value of 81.8 (in 2024) and 91.2 (in 2027) and reach the index value at the EU average in 2030. Available at: <https://eraportal.sk/wp-content/uploads/2020/12/Ukazovatele-vykonnosti-vyskumu-a-inovaciei-v-SR.pdf>

<sup>70</sup> The share of expenditure on RDI in the GDP for 2019 amounted to 0.83 %. The target value of the mid-term milestone (2024) and long-term milestone (2027) is recalculated by the growth rate in relation to the ambition to reach the increase the share of investments to R&D in the GDP to the EU average that reported the most intensive growth of funds invested to R&D in the past 10 years (Belgium-0.89 % increase, Poland-0.66 % increase, Czechia-0.65 % increase, Greece-0.64 % increase). Available at: <https://eraportal.sk/aktuality/vydavky-na-vyskum-a-vyvoj-v-eu-v-roku-2019/>

<sup>71</sup> The share of articles in quartile Q1 in 2019 was 24.7 % of all articles in magazines listed in Journal Citation Reports™ including the Emerging Sources Citation Index. For the mid-term and long-term milestones, the methodology of 2 indicators for partial target 3.2 was set in cooperation with the Centre of Scientific-Technical Information of the Slovak Republic.

<sup>72</sup> The percentage share of expenditure of the private sector in the GDP will amount to 0.86 % of the GDP until 2027, while respecting compliance with goal 3.1, which defines the share of expenditure between the private and public sector in the 3:2 proportion.

<sup>73</sup> The percentage share of the funds received from the H2020 programme for Programming Period 2014-2020 amounted to 0.12 % of the GDP with 521 Slovak participating entities. The ambition of the SR in the HE Programme for Programming Period 2021-2027 is to double the amount spent and the number of Slovak participating entities, which will correspond the level of the Czech Republic.



context, the impact of implemented activities, measures and calls to the RDI ecosystem. Indicators for all partial targets that are bound to specified strategic goals as well as the methodology guidelines for their monitoring will form a part of the Action Plan for Implementation of SK RIS3 2021+.

Strategic goal	Indicator name	Monitored unit	Current value	Target value
Increase the quality and availability of human resources in RDI <sup>74</sup>	Number of persons employed in R&D in FTE	Number of researchers	21,195.9 (2019)	24,000 (2027)
Improve the innovation performance and position of Slovakia in international comparison <sup>75</sup>	Position of Slovakia in the Global Innovation Index	GII value	42.05 (2019)	45 (2027)
Increase the contribution of the research to the economic growth by developing the quality of RDI <sup>76</sup>	Percentage share of expenditure on R&D from the private sector in the GDP	% of the GDP	0.40 % (2019)	0.86 % (2027)

### Domain-specific goals:

#### Domain 1: Innovative industry for the 21<sup>st</sup> century

The goal is to support innovations for transformation of industrial production in Slovakia to a higher level so that they could lead to a significant reduction of negative effects on the environment, increase of energy efficiency, increase of the competitiveness connected to the growth of exports.

#### Domain 2: Mobility for the 21<sup>st</sup> century

The goal is to transform connected and autonomous mobility, smart mobility services, logistics and smart transportation system and decarbonisation of mobility.

#### Domain 3: Digital transformation of Slovakia

The goal is to support digital transformation of all sectors of the society in order to increase the quality of lives of citizens, increase competitiveness of the industry and the entire economy and ensure effective performance of public administration.

#### Domain 4: Healthy society

The goal is to build a system capable of effective response to current and future requirements in prevention, diagnostics, treatment and aftercare of serious diseases in relation to life expectancy.

#### Domain 5: Healthy food and environment

The goal is to set up sustainable and resistant systems of production in Slovakia that will use soil in a modest manner and provide resources and services for the society and the environment.

<sup>74</sup> The target value of the indicator comes from comparison of V4 countries, the increase to the target value represents the average value of the % difference in the number of researchers in V4 countries (without Slovakia). The data used for monitoring of the said indicator will data provided by the Slovak Statistical Office.

<sup>75</sup> The target value of the indicator comes from comparison of V4 countries, it is set as the average 2019 value (prior to the pandemic) of GII index of V4 countries (without Slovakia). The data used for monitoring the said indicator will be data from GII.

<sup>76</sup> The target value of the indicator is defined in the manner that will respect the principle of increasing the share of expenditure on RDI between the private and public sector in the 3:2 ratio. The data used for monitoring of the said indicator will data provided by the Slovak Statistical Office.

### 2.3. Compliance with national strategies and EU initiatives

This chapter reflects the broader political context of support to RDI at the national level as well as at the EU level in order to effectively map synergies and ensure clear set of measures so that the RDI stakeholders could observe them and join them at the suitable moment.

#### Connection of the SK RIS3 2021+ strategy to EU initiatives

Name of the strategic document	Description of areas with overlaps to SK RIS3 2021+ strategy
European Green Deal <sup>77</sup>	SK RIS3 2021+ will support respective goals of the said strategy, for example by means of increasing the level of digitalization, promotion of the role of RDI ecosystem in increasing social justice, supporting European culture, supporting improvement of education and emphasizing the environment protection.
Action Plan of the EU Strategy for the Danube Region (hereinafter only as the "EUSDR") <sup>78</sup>	Implementation of SK RIS3 2021+ will also contribute to the support to priority areas of EUSDR, in particular, priority area 7: Knowledge society and priority area 9: people and skills.
European Research Area <sup>79</sup>	SK RIS3 2021+ will reflect and use plans submitted in the latest communication of the EC on the new European Research Area (hereinafter only as the "ERA"), e.g. planned ERA Transformation Forum that will promote and monitor access to researchers and institutions to the excellence and support Member States in better integration of researchers to SK RIS3 2021+ in cooperation with the private sector. In the following period, it will also reflect the development of relevant research and innovation partnerships and research and innovation missions.
European Space Programme for 2021-2027 <sup>80</sup>	Space programme of the European Union puts together all existing and new activities of the Eu in space to a single programme. The EU is working on this fully integrated space programme for years 2021 – 2027 in connection to the Space Strategy for Europe of 2016, whose purpose is, inter alia, to promote competitive and innovative European space sector and enhance the strategic autonomy of the EU. The European Space Programme focuses, in the current strategy, on supporting the commercial sector and developing business in the field of space industry, which provides Slovakia (the second most industrialised country in the EU) with huge opportunity. It is also a suitable environment for development of international cooperation and searching for and

<sup>77</sup> European Commission (2019): *The European Green Deal*. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1588580774040&uri=CELEX:52019DC0640>

<sup>78</sup> Ministry of Investments, Regional Development and Informatization of the SR (2021): *EU Strategy for the Danube Region*. Available at: <https://www.dunajskastrategia.vlada.gov.sk/strategia-eu-pre-dunajsky-region/>

<sup>79</sup> European Commission: *European Research Area*. Available at: [https://ec.europa.eu/info/research-and-innovation/strategy/era\\_sk](https://ec.europa.eu/info/research-and-innovation/strategy/era_sk)

<sup>80</sup> Information portal on the European Space Area: *European Space Programme*. Available at: <https://eraportal.sk/eraportal/ine-europske-programy/european-space-programme/>

	supporting new talents and skills that are of key importance for development of RDI ecosystem in Slovakia.
ESFRI Roadmap <sup>81</sup>	Roadmap of research infrastructures - SK VI Roadmap 2020 – 2030 is the key document of the Slovak Republic for research infrastructures that monitors the recent development and current status of important public and private research infrastructure in the territory of the Slovak Republic as well as its connection to economy, smart specialisation domains, international cooperation in the context of ESFRI and the currently prepared framework programme of the European Union for research and innovations for 2021 – 2027 HE. Its implementation will be done in the form of I. and II. Action plan for implementation of the Roadmap of research infrastructures for 2021 – 2025 or 2026 – 2030. The significance of continuous development of important research infrastructure in the Slovak Republic has been demonstrated also by its beneficial influence on the economy and labour productivity in priority areas of smart specialisation SK RIS3 2021+ in the form of high added value and cooperation of university science parks and research centres with the Slovak Academy of Sciences and the business sector.
Horizon Europe <sup>82</sup>	As HE is the most extensive programme of the EU for research and innovations focused on excellence, the support and development of activities leading to higher engagement in the HE is an important part of SK RIS3 2021+. The strategy defines several measures for HE that are supposed to contribute to the excellence of scientific ecosystem and increase spending of funds from HE.
A clean planet for all <sup>83</sup>	At the time of rapid changes and risks related to technologies that do not reach the level contributing to transformation to climate neutral economy, RDI play a key role also in decarbonisation. RDI will define the pace of decarbonisation, its costs as well as benefits. Development in the field of objectives and priority areas of SK RIS3 2021+ can thus significantly contribute to the performance of the plan of the strategy titled A clean planet for all. The key to success is the development of a broad portfolio of cost effective and carbon neutral effective alternatives to current technologies and their effective use combined with improved interconnection of

<sup>81</sup> Ministry of Education, Science, Research and Sport of the Slovak Republic: *Roadmap of research infrastructures (SK VI Roadmap 2020 – 2030)*. Available at: [https://www.minedu.sk/data/files/10600\\_cestovna-mapa-vyskumnych-infrastruktur-sk-vi-roadmap-2020-2030.pdf](https://www.minedu.sk/data/files/10600_cestovna-mapa-vyskumnych-infrastruktur-sk-vi-roadmap-2020-2030.pdf)

<sup>82</sup> European Commission (2019): *Horizon Europe – Future programme of EU investments for research and innovation (2021 – 2027)*. Available at: [https://ec.europa.eu/info/sites/default/files/research\\_and\\_innovation/strategy\\_on\\_research\\_and\\_innovation/presentations/horizon\\_europe\\_sk\\_investovanie\\_do\\_formovania\\_nasej\\_buducnosti.pdf](https://ec.europa.eu/info/sites/default/files/research_and_innovation/strategy_on_research_and_innovation/presentations/horizon_europe_sk_investovanie_do_formovania_nasej_buducnosti.pdf)

<sup>83</sup> European Commission (2018): *A clean planet for all – European strategic long-term vision for prosperous, modern, competitive and climate neutral economy*. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018DC0773>

	sectors, digitalization and system integration. The success of the European system for RDI is based on the development and commercialisation of such innovative solutions and it will also contribute to the competitiveness of the EU in its existing and emerging industries.
Common Agriculture Policy <sup>84</sup>	The CAP will make sure that support will be provided to European agriculture, prosperous rural areas and production of high-quality food, also thanks to setting a more intuitive and innovation policy. Knowledge and skills are the key element of smart, resilient and sustainable agriculture sector. CAP will support increasing investments to research and innovations and will enable benefits of it for farmers and rural communities. Therefore, it is necessary to build knowledge and innovation system (AKIS) that will help stimulate the launch and development of innovation projects, dissemination of their results and their broadest possible application in practice. It represents a stimulus for structuring and implementation of the national innovation ecosystem. Building a well-functioning AKIS system will prevent doubling the effort, help save costs, increase the impact of funding from EU funds as well as national/ regional source and accelerate innovations.

### Connection of the strategy to national strategies

Name of the strategic document	Description of areas with overlaps to SK RIS3 2021+ strategy
Low-Carbon Development Strategy of the Slovak Republic until 2030 with a View to 2050 <sup>85</sup>	This strategy proposes a modernisation fund for low-carbon projects, which can be understood as a complementary activity to priority area 1-4: Increase of energy efficiency in economy, where emphasis is put on the use of alternative energy sources, use of renewable energy sources and low-emission technologies and to priority area 2-3: Decarbonisation and sustainable mobility (hydrogen, batteries, biofuels, biomethane).
Nation Hydrogen Strategy "Ready for the Future" <sup>86</sup>	The strategy defines the role of the state in the use of hydrogen technologies in the SR. in SK RIS3 2021+, hydrogen technologies are part of two domains. SK RIS3 2021+, in Domain 1 Innovative industry for the 21 <sup>st</sup> century, by means of priority area 1-4 Increase of energy efficiency in economy, puts emphasis on the use of alternative energy sources together with hydrogen, development of effective hydrogen generation and industry decarbonisation. Domain 2 Mobility for the 21 <sup>st</sup> century contains connection to the national hydrogen strategy, in particular, by means of

<sup>84</sup> European Commission: *Future of the Common Agricultural Policy*. Available at:

<https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/future-cap>

<sup>85</sup> Ministry of the Environment of the Slovak Republic (2020): *Low-carbon development strategy of the Slovak Republic until 2030 with a view to 2050*. Available at: <https://www.minzp.sk/files/oblasti/politika-zmeny-klimy/nus-sr-do-roku-2030-finalna-verzia.pdf>

<sup>86</sup> Ministry of Economy of the Slovak Republic (2021): *National Hydrogen Strategy "Ready for the Future"*. Available at: <https://rokovania.gov.sk/RVL/Resolution/19331/1>

	<p>deploying smart technologies, new business models and smart mobility services and transport systems that will contribute to the transformation to low-emission or even decarbonised transport.</p>
<p>Greener Slovakia-Environment Policy Strategy Until 2030<sup>87</sup></p>	<p>The basic vision of this strategy is to achieve a better quality of the environment and sustainable circular economy, based on consistent protection of environment components and using as few non-renewable natural sources and hazardous substances as possible, which will lead to improvement of the health of the population. Stress will also be placed on the environment protection, sustainable consumption and adaptation to the climate change. These goals overlap, especially, not limited to, goals of Domain 5: Healthy food and environment and some of its partial targets (introduction of sustainable and low-emission solutions in transport, reduction of electricity generation from coal or increase of the energy efficiency) also correspond to priority areas 1-4 and 2-3.</p>
<p>Integrated National Energy and Climate Plan of Slovakia for 2021-2030<sup>88</sup></p>	<p>Principal goals of this strategy are reduction of greenhouses gas emissions and increase of the share of renewable energy sources (hereinafter only as the "RES") in the total energy consumption. Key sectors to achieve those goals are, besides buildings, industry and transport. Among specific objectives are increase of the safety of energy supplies and reliability of nuclear power plants, reduction of the energy demand, achieving the optimum energy mix and support to the use of RES in generation of electricity, hydrogen, heat and cooling. These goals will be achieved especially thanks to the research and development in priority areas 1-4 and 1-6.</p>
<p>2030 Digital Transformation Strategy for Slovakia<sup>89</sup></p>	<p>This strategy applies cross-sectional approach and defines particular priorities of the Slovak Republic in the context of ongoing digital transformation of the economy and society under the influence of innovative technologies and global megatrends of the digital era. From this viewpoint, parts of the strategy that are of specific importance are those which concern human resources, infrastructure and regulatory changes necessary for inducing digital transformation in science, research and innovations. Research priorities in the field of digital technologies are reflected in priority areas of Domain 3.</p>
<p>National Strategy for the Labour Mobility of Foreigners in the Slovak Republic Until 2020 With a View to 2030<sup>90</sup></p>	<p>This strategy brings initiatives aimed at attracting a maintaining top scientists and researchers in Slovakia, which is one of partial targets of SK RIS3 2021+.</p>

<sup>87</sup> Ministry of the Environment of the Slovak Republic (2019): *Greener Slovakia –Strategy of the Environment Policy of the Slovak Republic Until 2030*. Available at: <https://www.slov-lex.sk/legislativne-procesy/SK/LP/2018/638>

<sup>88</sup> Ministry of Economy of the Slovak Republic (2019): *Integrated National Energy and Climate Plan for 2021 – 2030*. Available at: <https://www.economy.gov.sk/energetika/navrh-integrovaného-narodného-energetického-a-klimatickeho-planu>

<sup>89</sup> Ministry of Investments, Regional Development and Informatization of the Slovak Republic (2019): *2030 Digital Transformation Strategy for Slovakia*. Available at: <https://www.mirri.gov.sk/wp-content/uploads/2019/06/Strategia-digitalnej-transformacie-Slovenska-2030.pdf>

<sup>90</sup> Ministry of Labour, Social Affairs and Family of the Slovak Republic (2018): *Strategy for the Labour Mobility of Foreigners in the Slovak Republic*. Available at: <https://www.employment.gov.sk/files/slovensky/uvod/informacie-cudzinci/strategia.pdf>

Recovery and Resilience Plan of the Slovak Republic <sup>91</sup>	RRP as a specific tool consisting of investments and reforms overlaps with SK RIS3 2021+ in several areas: it proposes particular investment measures aimed at increasing the quality of scientific outputs and improvement of the career environment by means of grant schemes, which supports strategic objective 3; it further proposes implementation of transformation and innovation consortia aimed at cooperation in the research professionals with corporations, which supports strategic objective 2; and, last but not least, it proposes a comprehensive reform of the system of RDI management that has impact on objective 4, as well as on entire Chapter 3.
National Strategy for Open Science <sup>92</sup>	The National Strategy for Open Science presents basic propositions of the open science, describes the situation in open science in Europe, analyses the background situation in Slovakia, defines stakeholders and strategic areas for pushing through principles of open science in Slovakia. Among basic aims of the strategy are access of the public to primary outputs of the research funded from public funds – publications and data – in digital format without limitations or with minimum limitations, using public licences. This goal cannot be reached without including the idea of open science into the system of education, build-up of the technical infrastructure for open science compatible with existing and emerging European infrastructure, adaptation of the system of evaluation and funding of science. Aims of the National Strategy for Open Science will be implemented with the help of two-year action plans.
Long-term plan of state science and technical policy <sup>93</sup>	The long-term plan is a document that contains basic intentions and goals in the field of research and development, including intentions and goals in the field of human resources in research and development, intents of state research and development programmes for development of research and development infrastructure and intentions and foals in the field of international scientific and technical cooperation (the document is to be adopted by the Government of the Slovak Republic).
Long-term plan for education, research, development and other creative activity for universities <sup>94</sup>	The long-term plan is a strategic material containing a set of priority topics in education, research, artistic and other creative activity for universities.
Vision and Strategy of Development of Slovakia Until 2030 <sup>95</sup>	Strategic areas that form a part of SK RIS3 2021+ can be deemed complementary also to strategy “Vision and Strategy of Development of Slovakia Until 2030”, which focuses on 3 key areas that partially also covered by SK RIS3

<sup>91</sup> Ministry of Finance of the Slovak Republic (2021): *Recover and Resilience Plan of the Slovak Republic – Component 9 More effective management and enhancement of the funding of research, development and innovations*. Available at: <https://www.mfsr.sk/sk/verejnost/plan-obnovy-odolnosti/>

<sup>92</sup> LP/2021/193 Nation Strategy for Open Science for 2021 – 2028 and Action Plan for Open Science for 2021 – 2022. Available at: <https://www.slov-lex.sk/legislativne-procesy/-/SK/LP/2021/193>

<sup>93</sup> Long-term plan of state science and technical policy will be developed by the MESRS SR in line with SK RIS3 2021+.

<sup>94</sup> Long-term plan for education, research, development and other creative activity for universities will be developed by the MESRS SR in line with SK RIS3 2021+.

<sup>95</sup> Ministry of Investments, Regional Development and Informatization of the Slovak Republic (2021): *Vision and Strategy of Development of Slovakia Until 2030*. Available at: <https://www.mirri.gov.sk/sekcie/vizia-a-strategia-rozvoja-slovenska-do-roku-2030/index.html>

	<p>2021+. In particular, it is possible to consider, as complementary, increasing the quality of education and harmonising with expected labour market demand, development of a strong and innovation-based economy, development in the field of mobility and transport perceived as a comprehensive value chain and partial interconnection directly to priority areas of SK RIS3 2021+ domains.</p>
Farm to Fork <sup>96</sup>	<p>RDI are key factors for acceleration of the transition to sustainable, healthy and inclusive food systems ranging from primary production to consumption. They can help in development and testing of solutions, overcoming obstacles and uncovering new opportunities for the market. Therefore, it is possible to consider SK RIS3 2021+ as a strategy that will contribute, at the national level, to implementation of the vision of the Farm to Fork Strategy by supporting research, innovations, technologies and investments.</p>
Strategic framework for health for 2014 – 2030 <sup>97</sup>	<p>It is the basic document that determines the focus of health policy in the mid-term and long-term horizon. The primary motivation factor for its development is the effort to implement measures to increase the quality and efficiency of provided healthcare and improve the health status of the population. The strategy emphasizes on prevention, which should also apply to a comprehensive reform of public health services.</p>
Concept of Smart Industry for Slovakia <sup>98</sup>	<p>The Concept of Smart Industry for Slovakia is an expected response to the fourth industrial revolution, where industrial production is entering a breakthrough stage – after the age of steam, electricity and computers, there is era of digitalization coming now. The changes brought about by the concept of smart industry will primarily affect Slovak industrial companies that, thanks to the possibility of more efficient production and sale of products, will increase their competitiveness. Changes also mean benefits for SMEs, above all, vendors of equipment, technology and services thanks to interconnected industrial production. The document is relevant to industrial transformation.</p>

<sup>96</sup> European Commission (2020): "Farm to Fork" Strategy for a fair, healthy and environmentally friendly food system. Available at: <https://eur-lex.europa.eu/legal-content/SK/TXT/?qid=1590404602495&uri=CELEX%3A52020DC0381>

<sup>97</sup> Ministry of Health of the Slovak Republic (2013): Strategic framework for health for 2014 – 2030. Available at: <https://www.health.gov.sk/?strategia-v-zdravotnictve>

<sup>98</sup> Ministry of Economy of the Slovak Republic (2016): Concept of Smart Industry for Slovakia. Available at: <https://www.mhsr.sk/inovacie/strategie-a-politiky/smart-industry>



### 3. System of management

The system of RDI management in the SR showed, in the preceding programming periods, several shortcomings. In order to meet set strategic and transformation goals, it is therefore necessary to reform this system. The current chapter elaborates on the basis of the reform, whereby its key elements are reflected in the RRP, whose preparation precedes finalising of SK RIS3 2021+. The resulting model of the RDI management system will be bound to adoption of planned acts and the National Strategy of Research and Innovations Until 2030, which are defined in RRP as necessary milestones and objectives for spending funds. It is based on key principles (Chapter 3.2), responding to current challenges, which have to be kept in the preparation of the new system of management. An important shift in the RDI management is establishment of the central RDI management structure as well as setting up of the secretariat as the executive body of the SGCSTI and its committees (currently, SKS3).

Reflecting negative experience from preceding periods, it is particularly necessary to introduce regular monitoring and evaluation of goals and measures of SK RIS3 2021+.

For better transparency in decision making and improvement of available forms of assistance in RDI, there will be a new communication strategy implemented whose purpose will be to define and introduce communication methods and tools towards the RDI ecosystem while reflecting individual needs of stakeholders and application of functional principles in practice.

In order to implement the reform of RDI management system, it is also necessary to prepare and implement a set of systemic and legislative measures aimed at removing the most material shortcomings of the current system.

#### 3.1. Main challenges to an efficient RDI management

The system of RDI management can be characterised as relatively efficient in planning but inefficient in implementation. During the preceding programming period, the system did not undergo any substantial change or reform, except for merging of two operational programmes for ESIF – OP RI and OP Integrated Infrastructure – in December 2019, which, in its effects, from the viewpoint of potential financial losses in the case of failure to merge showed to be an efficient solution, even though, from the viewpoint of implementation of the material content of specified objectives of support to RDI in OP RI (transposed to OP Integrated Infrastructure), it has not been possible, so far, to assess results of this measure as positive, with certainty.

Even when the structure of responsibility and management of RDI in the SR is similar to other EU Member States, it lacks a clear legal definition of competences, which causes that exceeding of certain competences by ministries and (limited) enforceability of adopted decisions.

The system of RDI support funded by ESIF is perceived rather as excessive administrative burden, which results in extraordinarily increased burden on the part of applicants/beneficiaries that thus have less time left for creative research activity. Another consequence of high administrative burden is too long time periods for evaluation of calls, applications for amendments to contract, controls or public procurement procedures, etc. on the part of certain providers, cancellation of calls by providers and unfavourable situation in the whole society caused by the COVID-19 pandemic, which causes implementation problems and further decline in competitiveness.

Even despite the fact that there is an authority at the national level that is in charge of RDI system management – SGCSTI – its competences are currently set insufficiently with regard to tasks it is



supposed to perform, in particular, in relation to coordination of different ministries with competences in RDI policies. A significantly specific issue is the fact that the body does not have its competences set in the legislation that would enable enforceability of its decisions from other ministries. There was no professional SKS3 structure built as part of implementation of RIS3 2014-2020 that would be in charge of preparation of documents, calls, proposals, strategic planning, monitoring and continuous evaluation of the implementation as well as early identification of implementation risks.

What is also missing is a long-term state science policy as well as state innovation policy that will clearly set the frameworks and thematic focus of the support to RDI. Without framework policies and clearly defined decision-making structure based on the knowledge of needs, strengths and capacities of RDI ecosystem, it is not possible to prepare realistic long-term planning and effective implementation. The aforementioned shortcomings also resulted in a non-systemic notification of calls on ad-hoc basis of subjective assessment or a political order. Absence of such systemic settings also resulted in cancellations of calls without a broader discussion and consensus of stakeholders in the RDI management system.

A large number of supporting agencies, schemes and tools for the development of RDI managed by various ministries and operating under various rules complicate the orientation in the overall system of RDI support. Many of the obstacles that exist in the SR originated because of that fragmentation of the system of RDI management and support (including insufficient responsibility and transparency), which has led to a loss of trust in the process of making policies of the state and lack of cooperation between researchers and entrepreneurs. Therefore, it is necessary to focus on such shortcomings during the following programming period and introduce necessary reforms for their removal.

The Slovak Republic has a strong potential where it is possible to build, in the following programming period, and utilise, the current opportunity to strongly reform the system of RDI management by means of broad engagement of stakeholders that has proven to be effective in the preparation of SK RIS3 2021+.

### **3.2. Principles of effective management of RDI**

The structure of RDI management as well as quality and available human resources are considered to be the decisive driving force in ensuring added value of the strategy in the RDI ecosystem. Due to the aforementioned challenges, a successful implementation of SK RIS3 2021+ will require several updates and modifications of the management structure in the following programming period. It is necessary to ensure simplification of the entire system of RDI support, effective communication of tasks and competences to all stakeholders in the new system of RDI management and also more vigorous and systemic use of the decentralised process of engaging stakeholders by means of the EDP.

The reform of the DRI management system is projected as part of the RRP with regard to existing managing structure, whereby it also integrates new elements from the methodology of the entrepreneurial discovery process so that the updated management system contains suitable complementarity of the logic of strategic, centralised top-down management and the logic of decentralised discovery in defined priority areas in the bottom-up manner.

Reformed system of RDI management must respect these principles:

- Competences are split based on the **subsidiarity** principle. Superior levels of management adopt measures and responsibility for subordinate levels of management only in cases when it

is necessary to handle it at the higher level due to a more efficient management. Such principle will enable a bigger involvement of experts in the management process.

- Effective response to changing market environment and technological or business trends can be ensured by a **broad engagement of innovation stakeholders** by means of the EDP in order to maintain its cohesion and continuity: from the confirmation of priority areas up to initiation of the EDP (identification of transformation plans and thematic proposal of calls); as part of the support and expertise in the context of formal aspects of management of particular projects (notification of calls, evaluation, approval and funding of projects).
- The fragmentation of the system is reflected in the principle of **strategic centralisation**, with one **body** that will **coordinate** ministries in implementing particular measures and that will be in charge of proposing and harmonising strategic documents for RDI, management of their implementation and execution of individual measures.
- For effective coordination of ministries, it is necessary to strengthen competences of the SGCSTI, towards **enforceability** of its decisions and performance of planned measures.
- To use the potential of all innovation stakeholders, it is necessary to improve the communication system of operation of the RDI support, including an overview of current and planned calls or other support tools, in line with the principle of **transparency**.
- In order to enable planning of resources of individual innovation stakeholders (research teams, companies, etc.), it is necessary to ensure **predictability and systemic continuity** of provided support from all available sources.
- In order to ensure effective implementation, it will be necessary to introduce a system of continuous monitoring of the implementation by means of **monitoring and evaluation**, at the level of strategic goals, measures and transformation maps, in order to identify risks in a timely manner and implement necessary remedial measures.
- For **effective implementation and monitoring** of implementation of the strategy measures, it is necessary to significantly enhance (currently understaffed) administrative capacities of implementation units at different ministries.
- In order to prevent side effects in adopting and notifying calls, the principle of **sharing responsibility** will be respected, as part of which, the responsibility for thematic proposal and implementation of calls will be borne by other authorities than those approving it.
- Respecting the principles of **professionalism**, managing and advisory authorities will be composed of experts in RDI policy or experts in particular RDI domains in order to limit influence of political or otherwise non-transparent decisions.

### 3.3. Structure of RDI management

The principal challenge to a successful management and implementation of SK RIS3 2021+ is identification of suitable existing managing structures, use of the very continuous EDP for discovering new decentralised structures and application of the logic of entrepreneurial discovering. Structures known ex ante do not necessarily need to meet all tasks related to RDI management. Separate attention should be paid to the development of decentralised managing structures where such approach is desired and reasonable and ensure assumption of the responsibility resulting from continuous EDP for

competent units in RDI management. It is necessary to increase the efficiency of the RDI management system which concerns competences and enforceability of decisions of individual management levels.

**RRP includes a plan to carry out a significant reform of management, evaluation and support in RDI that will focus on adaptation of legislative frameworks of RDI policies management and competences of individual stakeholders with subsequent restructuring of the entire system of RDI management.**<sup>99</sup>

In general, in order to ensure successful management and implementation of SK RIS3 2021+, it is necessary to consolidate it with the RRP as well as currently valid Strategy of Research and Innovations for Smart Specialisation of the Slovak Republic, whose implementation failed also from the viewpoint of RDI management.

In line with the vision of SK RIS3 2021+ and necessary optimising of the system of policies and measures in RDI and human resources in order to support stimulation of structural change of the Slovak economy towards growth based on increasing research and innovation capacity and excellence in segments with the highest competitive advantage, it will be of key importance to use all available sources for its implementation. EU funds play an important role in the Slovak Republic, whereby the implementation of EU funds and OP SK will be provided by a separate implementation structure by means of a managing authority and its intermediary bodies.

Setting up of the SGCSTI secretariat at the Office of the Government of the Slovak Republic will remove one key failure in implementation of RIS3 2014-2020.

That will ensure effective top-down flow of information and vice versa:

- Transformation councils,
- SGCSTI secretariat – Section of research, development and innovations of the Office of the Government of the Slovak Republic,
- SKS3,
- SGCSTI.

**A new proposal for the RDI management system and its managing units will be included to the currently prepared draft amendment to Act No. 172/2005 Coll. on organisation of the state support for research and development and on amendment to Act No. 575/2001 Coll. on organisation of activities of the government and on organisation of central state administration as amended.**

Separate attention in the RDI management system must be paid to introduction of the application of principles of good governance and effectiveness for RDI projects, especially due to non-existence of a unified methodology, which leads to complicated application of such principles to particular SK RIS3 2021+ domains.

For effective implementation of SK RIS3 2021+, it is currently impossible to introduce this principle to already prepared RDI management system, however, due to the need to develop it, certain projects can be, during the defined interim period, scaled and categorised to the database of projects for subsequent setting of comparability indicators.

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<sup>99</sup> Ministry of Finance of the Slovak Republic (2021): *Recovery and Resilience Plan of the Slovak Republic – Component 9 More efficiency management and strengthening of funding of research, development and innovations*. Available at: <https://www.mfsr.sk/sk/verejnost/plan-obnovy-odolnosti/>

### 3.4. Systemic and legislative measures

The horizontal goal of SK RIS3 2021+ is to increase the effectiveness of management of public research institutions and universities, RDI policy and funding in the Slovak Republic. This goal can be split into the following partial targets:

<b>3.4.1</b> Ensure effective policy making for RDI and implementation of strategic goals
<b>3.4.2</b> Introduce an effective system of monitoring and evaluation of RDI policies using analytical tools for evaluation of the influence and contribution of monitored indicators on the RDI ecosystem
<b>3.4.3</b> Increase effectiveness and strengthen the support for communication tools of RDI promotion and increase the awareness of functioning, activities and forms of support to the RDI ecosystem for all stakeholders
<b>3.4.4</b> Reduce the administrative burden of the RDI funding system from EU funds as well as national funding
<b>3.4.5</b> Ensure a stable, predictable and sustainable system of RDI funding and a transparent access to information about its funding
<b>3.4.6</b> Set the legislative and legal framework of the RDI management system, intellectual property protection and RDI supporting mechanisms in order to support the RDI ecosystem

Effective system of RDI management and legislative environment supporting RDI activities are the basic preconditions for achieving strategic goals of SK RIS3 2021+. In order to introduce an effective management system and adapt legislative environment, it is necessary to carry out the following measures:

Measure	Description	Horizontal challenge	Responsibility	Timeline
<b>Definition of competences of the SGCSTI in relation to coordination of RDI policies and definition of individual levels of management and their competences</b>	The fragmentation of RDI policies management by many ministries and institutions must be dealt with by means of legislation-based strengthening of competences and responsibilities of the SGCSTI towards enforceability of its decisions and defining competences of individual levels of management. Setting up a professional secretariat will ensure effective engagement of partners on the quadruple helix principle.	Cooperation	GO SR, ministries	Q4 2021 transfer of the SGCSTI to the Office of the Government of the Slovak Republic Q2 2022 adoption of the amendment to Act No. 172/2005 Coll. on organisation of the state support for research and development and on amendment to Act No. 575/2001 Coll. on organisation of activities of the government and on organisation of central state administration as amended
<b>Consolidation of implementation agencies</b>	Continuing the process of restructuring of existing agencies should contribute to the solution of the fragmentation of the management system. Even RIS3 2014-2020 and its related implementation plan	Cooperation	GO SR, MESRS SR, ME SR	Q4 2024 Introduce a set of measures

	<p>included a plan to concentrate the responsibility for its implementation to two newly established agencies – research and technology agency. Setting up these two agencies was planned on the basis of existing agencies; however, this change was rather of a formal nature without any significant impact on the organisation and concentration of the management. However, the number of active agencies was eventually not reduced. The accelerated process of their restructuring will ensure establishment of an effective system of their management.</p>			
<p><b>Preparation of the National Strategy of Research, Development and Innovations Until 2030</b></p>	<p>Even despite the fact that the RIS3 concept as such is related to the long-term political framework of RDI, it must not be used as its substitute. Therefore, it is necessary to elaborate a new National Strategy of research, Development and Innovations Until 2030 that will determine the focus on research and development and innovation policy, its objectives, tools, KPIs and forms of support from the viewpoint of areas of support to research and development, as well as generally for the entire research-development and innovation ecosystem. Setting up such long-term will help support the shared goal and set up an effective framework to support efficient measures resulting from the needs of the RDI ecosystem with the emphasis on cooperation with the public and private sector. This strategy will take over the settings of SK RIS3 2021+, whereby it will, in line with the RRP SR and other cross-sectional strategies concerning RDI.</p>	Cooperation	GO SR ministries	Q3 2022
<p><b>Deployment of the methodology of good governance and effectiveness for supporting RDI programmes/schemes</b></p>	<p>For effective deployment of proposed principles into practice of RDI management, SK RIS3 2021+ separately requires:</p> <ul style="list-style-type: none"> <li>• clear definition of quantitative and qualitative results and benefits of the project as such and their comparability in the sense of originality of project results, weight of the CBA and other non-quantifiable benefits,</li> <li>• clear defining of the time for ex-post evaluation (impacts of the implementation of certain projects can occur after even more than 10 years),</li> <li>• quantification of the level of risk, being aware that certain projects may fail even despite good ex-ante evaluation,</li> <li>• quantification of individual differences and originality of the project in the sense of differentiated goals, methodology procedures, scope and content of projects in individual domains and overlapping in projects.</li> </ul>	RDI funding Legal framework	MF SR, GO SR	Q1 2022
<p><b>Preparation of the methodology for</b></p>	<p>The measure includes preparation of a comprehensive methodology for</p>	RDI funding	GO SR ministries	Q1 2022

<b>monitoring and evaluation of SK RIS3 2021+</b>	<p>monitoring of SK RIS3 2021+, whose purpose is to continuously collect information for implementation of the strategy and document and compare processes and identify necessary changes that could be the result of failure to implement strategy goals. The methodology of evaluation will focus on assessing information from the process of monitoring as the precondition for adopting decisions at all levels of management of the process of SK RIS3 2021+ implementation.</p>			
<b>Performance of the audit of membership in international scientific and research organisations and audit of effectiveness of the system for meeting goals for increasing the support to international scientific and technical cooperation</b>	<p>A complex structure of support to international scientific and technical cooperation (ISTC) requires simplification and systemisation for the purposes of increasing the attractiveness of conditions for participating entities. The system of ISTC funding must be sustainable and predictable and it is necessary to introduce a strategic evaluation of projects that will clearly specify the value of results of the research in question. The audit of membership in international organisations has to be carried out from the viewpoint of assessment of budgetary sustainability, benefits for Slovak scientific community and return of investments.</p>	Internationalisation	MESRS SR	3Q 2022
<b>Modification of the approval process for RDI in the system of EU funds management for higher efficiency</b>	<p>The system for proposing, approving and notification of calls is currently too time consuming, ineffective, non-transparent and it clearly does not produce sufficient number of high-quality projects necessary for spending EU funds. For each level of management or approving, it is necessary to develop a document for reference terms that defines added value, structure of management and the role of the given level of management.</p>	RDI funding	MIRRI SR, MESRS SR, agencies, GO SR	Q2 2022
<b>Simplification of the administrative burden and adaptation of requirements for submitting projects financed from EU funds for more effective and simple system of support to RDI</b>	<p>There have been several measures introduced for implementation of ESIF as part of ongoing activities aimed at reducing the administrative burden, whereby, it is necessary to continue in this process. A suitable inspiration for setting of RDI projects implementation processes is HE programme processes.</p> <p>When preparing calls and submitting applications, it is necessary to put emphasis on content requirements aimed at higher quality results and outputs. Requirements for the scope and structure of submitted documents from applicants need to be focused on the quality and achieving targets and adapt setting of calls to the size of expected consortia or projects.</p> <p>Legal regulations regulating the procedure for filing applications for non-repayable financial contribution should be reviewed so that they would not have to publish parts of applications containing sensitive information about the project (such as</p>	RDI funding Legal framework	MIRRI SR Authorities responsible for calls	Q2 2022 Introduce the first set of measures and subsequently continuously

	information related to scientific solutions or innovation concepts/solutions). The purpose is to prevent threatening of the validity of intellectual property right protection (patents or utility models, designs, etc.) by providing access to relevant information to third persons, including potential competitors of the applicant.			
<b>Preparation, updating and communication of long-term plan of RDI activity funding from the state budget, EU funds and RRP</b>	Predictability and transparency of funding of RDI activities will significantly improve their long-term plan of funding, based on which research entities and entrepreneurs could plan their research and development and innovation activities. An important part of such plan will be its regular updating, broad communication to all stakeholders and complementarity of various sources so that funds could be found for important research-development and innovation topics, either from the state budget, from EU funds as well as from the RRP. The plan will be prepared for 1 year, with the outlook for 3 years.	RDI funding	GO SR ministries	Q4 2022
<b>Performance of a comprehensive evaluation of the legal framework in order to remove legal obstacles to the development of RDI</b>	The goal of this measure is to determine the interconnection of individual relevant legal regulations and the extent to which the legal framework enables performance of RDI. The central focus will be to identify not necessarily legal regulations and legal obstacles to RDI and the plan for their subsequent removal.	Legal framework	GO SR	Q2 2022 for evaluation and preparation of the final report
<b>Preparation of conditions for more effective protection and subsequent use of intellectual property</b>	From the viewpoint of the position of the SR in the international ranking of innovation performance, it is necessary to also focus on the systemic build-up of the awareness of intellectual property protection, in particular, patent literacy. In order to increase the general access to information, this initiative should also be included to the educational system (including continuous training of scientific workers). The subject intellectual property protection should also be incorporated to technical and sales-oriented study programmes. Effective use of intellectual property right protection is often of material importance to ensuring exclusiveness in the market and subsequent sustainability. Currently, it applies mainly to the healthcare sector, where development stages are very time demanding and costly. Such systemic approach also requires effective support to a high-quality intellectual property rights protection by means of projects of targeted orientation and cooperation of experts with the scientific community by means of organisation focused on supporting innovations and technological transfer.	Legal framework	GO SR, ME SR, MESRS SR, MZ SR, ÚPV SR	Q4 2023 basic regulation of conditions and their continuous development



<p><b>Preparation of an analysis of regional RDI potential</b></p>	<p>For the needs of identifying existing RDI potential of regions and possibilities of its further development, there will be an analysis prepared on the current status, potential and perspective in the field of RDI. The analysis will focus on identification of needs of regions from the viewpoint of building capacities and quality of human resources for the development of the RDI ecosystem and making opportunities for cooperation between stakeholders and important regional players. The analysis should also identify tools for stimulation of innovations in regions and possibilities of the EDP process in regions.</p>	<p>Cooperation  Human resources</p>	<p>GO SR, MIRRI SR, MESRS SR, ME SR</p>	<p>Q4 2022</p>
<p><b>Ensuring legislative content compliance in preparation of the system for introducing postdoctoral positions at universities</b></p>	<p>With regard to the current legislation and definition of terms “researcher” and “postdoctoral fellow” in the SR, it is necessary to harmonise the content framework of the legislation in preparation of the system for introducing postdoctoral positions at universities. In the building of the system, it is also important to build interconnection with the terminology provided in the RRP, which counts with the support for young researchers up to 5 years of being granted the Ph.D. degree. When defining the position of “postdoctoral fellow”,<sup>100</sup> it is therefore necessary to ensure connection of content, terminology as well as legislative framework for setting up and introducing such positions and their support to practice.</p>	<p>Legal framework</p>	<p>MESRS SR</p>	<p>Q4 2023</p>
<p><b>Open access to the system of management in the field of secondary school education for representatives of SK8 and other stakeholders</b></p>	<p>Self-governing regions as the biggest and key founders of secondary schools, together with respective associations should, as part of interconnecting activities related to implementation of SK RIS3 2021+, actively participate in the strategic development of the RDI for smart specialisation in the field of development of providing of education at secondary schools and thus contribute to improving conditions for employment of secondary school graduates and accommodation to the needs of the labour market related to transformation of economy in priority areas of SK RIS3 2021+.</p>	<p>Legal framework</p>	<p>MESRS SR, MV SR, GO SR, MF SR</p>	<p>Q4 2022</p>

### 3.5. Monitoring and evaluation of the strategy

#### 3.5.1 Monitoring

The basic principle of the SK RIS3 2021+ strategy monitoring system is continuous monitoring and collection of information related to its implementation. The monitoring is a key component of the

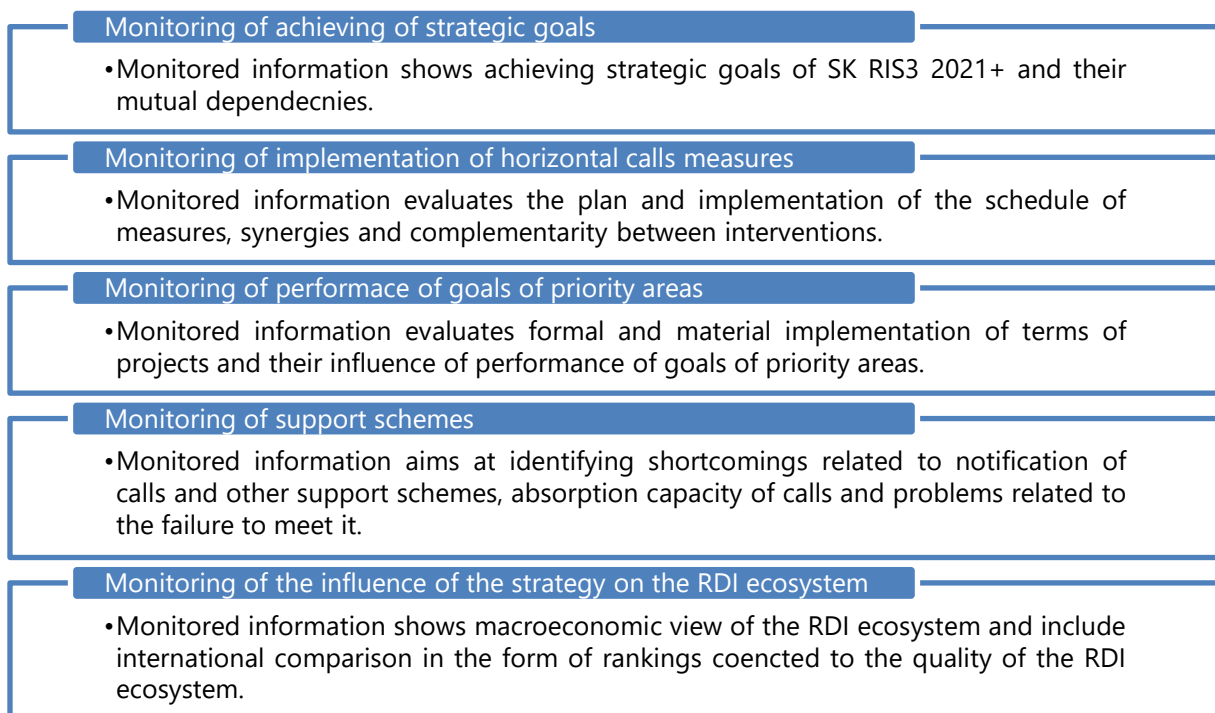
<sup>100</sup> It is possible to refer the legislative definition of “postdoctoral position” to existing legislative regulation of “researcher” and harmonise it with the terminology applied to young scientific-research workers in the RRP, where young scientific-research worker is defined as a graduate of doctoral study of no more than five years of being granted the Ph.D. degree, who takes active part in research projects and who, under the supervision of the director of the studies, also involves doctoral students to the work on projects. From the viewpoint of preferring staffing such positions, it is desirable for holders of the “postdoctoral position” to get it at a university/institution different from the one where they graduate.

decision-making process that enables adaptation of the course and structure of processes related to the implementation of the strategy. Besides legal obligations resulting from generally binding legal regulations on spending EU funds, the monitoring is connected to individual features of the system of management. The system of monitoring is going to be built in order to identify necessary changes in a timely manner, review components of the strategy based on the knowledge and data and thus contribute to the meeting of priorities and goals of the strategy. A correct setting of the monitoring and evaluation system is also one of the basic criteria of the EC for spending EU funds in the new programming period 2021-2027. The setting of the monitoring system for SK RIS3 2021+ is based on four basic goals:

- Identify disharmony between defined goals, synergies and effectiveness of implementation of the strategy at each level of monitored information and possible risks identified in the process of implementation,
- Collect information for different components of the management system with decision-making competences,
- Provides part of the empirical basis for evaluation and also forms the basic information source for the process of evaluation,
- Supports involvement and participation of stakeholders by means of transparent communication and support to building trust (open access to information).

Details on the system of monitoring will be updated, as necessary, in cooperation with ministries responsible for particular parts of policies, in separate methodology documents (containing specific guidelines for interconnection of existing system of monitoring with SK RIS3 2021+), which constitute a necessary precondition for SK RIS3 2021+ monitoring. The framework scheme of monitored information in the process of SK RIS3 2021+ implementation is provided on Figure 1.

**Figure 1: Scheme of monitored information in the process of strategy implementation**



*Source: internally prepared*

Based on the EC manual, there will be **four types**<sup>101</sup> of indicators monitored for identification of multilayer changes related to the process of implementation of the strategy, in particular:

- 1. Output indicators** – express the progress in implementation activities of SK RIS3 2021+. In detail, output indicators may also reflect outputs of funded projects (e.g. number of filed and processed patent applications or the number of granted patents or utility models, number of implemented innovations, new networks of cooperation resulting from funded projects, origin of start-ups/spin offs).
- 2. Result indicators** – present results of selected activities that should contribute to achieving strategic goals. They determine suitable means have been used for performance of strategic goals. These indicators vary greatly, depending on the type of strategic goals and they should be well formulated in the initial defining of strategic goals and means for achieving them (measuring the extent of achieving social and economic goals of the strategy), their explicit expression according to priority areas of SK RIS3 2021+ and their logical interconnection to expected changes to which they will contribute (e.g. increase of private expenditure on research and development, reduction of migration of students to abroad).
- 3. Indicators of structural changes and specialisation** – present the extent of structural changes in the region in connection to SK RIS3 2021+ targets (e.g. specialisation on strategic priorities-local companies, changes in the demographic dynamics of the society).
- 4. Contextual indicators** – express comparison of the regional economy to other regions or nations. Areas of comparison should be based on the overall SK RIS3 2021+ strategy and its poignant areas. Guide titled “Smart Specialisation Implementation” also recommends comparison in the overall research and innovations and development of production systems (they are indicators providing the view of competitiveness of regional economy and development of the regional innovation system as a whole, e.g. rate of labour force increase, indicators of innovation, research and development activities).

### Intervention logic of the monitoring

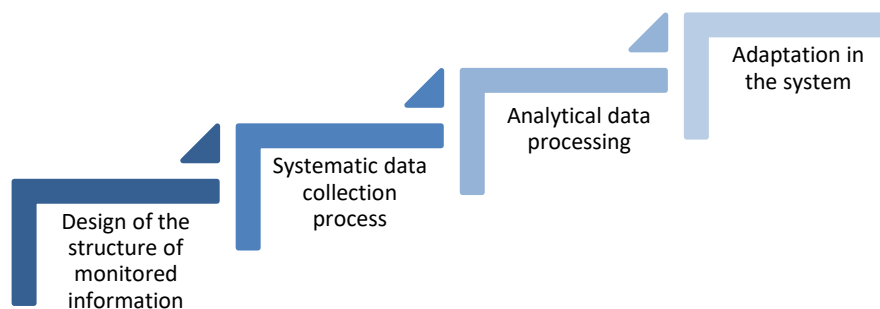
It represents identification and explanation of what should be achieved and how in individual stages of the project using logical and chronological overview of material, physical, communication and cash flows among intervention participants. The intervention logic must be based on already implemented and functioning methodologies or operational programmes and it should not result in duplicities that could even slow down the process of monitoring from the procedural and administrative viewpoint.

The intervention logic of the monitoring will be defined in the methodology of monitoring and evaluation that will be reflected in the reviewed version of existing monitoring systems (structural funds and other programmes) adapted to the conditions of SK RIS3 2021+ and to the managing structure of this strategy. A necessary part for continuing functioning of the monitoring processes is the intervention logic of the monitoring process that is composed of 4 basic steps illustrated below in Figure 2.

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<sup>101</sup> Online S3 Project: Phase 6 – Monitoring and evaluation. Available at: <http://www.s3platform.eu/6-monitoring-evaluation/?cookie-state-change=1621407081681>

**Figure 2: Intervention logic of the SK RIS3 2021+ monitoring process**



*Source: internally prepared*

- 1. Proposal of the structure of monitored information (indicators):** represents the process of discussion with stakeholders about the suitability, structure, scope and importance of monitored information for meeting transformation goals. The structure must be accommodated to each level of management and must not build red tape or slow down the implementation process.
- 2. Systematic process of data collection:** represent a consensual solution for data collection based on agreement between stakeholders while respecting principles such as economic modesty, feasibility and centralization of data at all levels.
- 3. Analytical data processing:** to support argumentation in decision-making (based on evaluation outputs) at each level of management, it is important to have monitored information objectives by means of analytical tools in order to provide feedback for stakeholders. The structure of data from the monitoring process must not be based on the possibility of exclusively subjective assessment leading to biased decision-making.
- 4. Adaptation in the system:** each management system can accelerate only as fast as its slowest part, therefore, even the "roll out" stage can identify weaknesses of the monitoring process and uncover problematic areas, insufficient connections as well as the need of procedural changes.

**Simplification of the access to information and data sources in the field of monitoring** must be supported by aggregation of decentralised systems that collect statistical data **to a single communication platform (web portal)**. Such centralisation of information will contribute to increasing credibility and transparency of the RDI ecosystem and, at the same time, it will provide access to information to entities taking part or intending to take part in the development of the RDI ecosystem and that will also fix the issue of disintegration of data for analytical activity of the structural part of the SGCSTI secretariat.

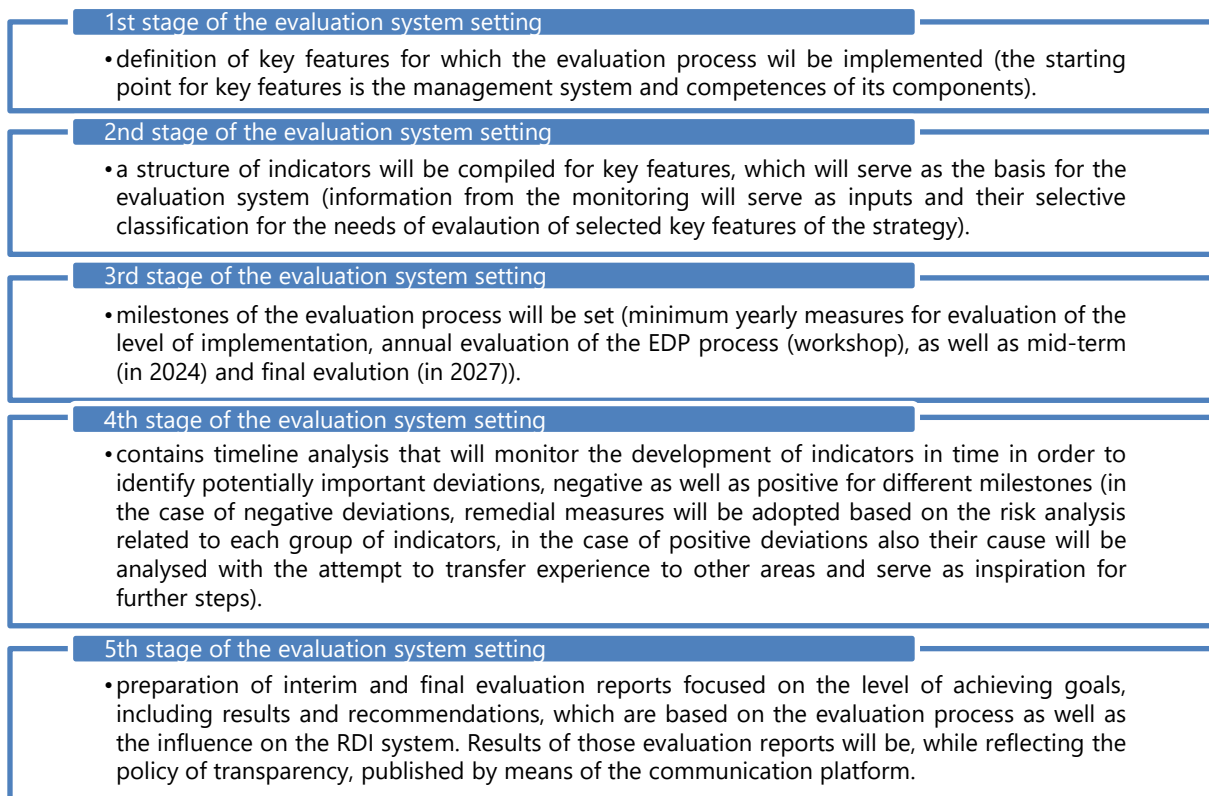
### **3.5.2 Evaluation**

The evaluation process focuses on evaluation of collected information and data in particular intervals that form the basis for adopting decisions about the need of changes at the level of projects, goals priority areas, measures, transformation plans, including goals of the strategy itself. The most important idea of the evaluation is to assess whether SK RIS3 2021+ is still feasible and whether structural changes are necessary in order to better reflect the regional situation, context or opportunities of the RDI ecosystem. The evidence basis for such evaluation is information from quality setting of the monitoring system and indicators that refer to the need of changes. Subsequently, measures will be determined, in the system of evaluation, that are to be implemented in order to increase the performance of proposed

policies, synergies and complementarities among activities and resources invested to processes leading to improvement of the RDI ecosystem.

An effective evaluation system must be proposed in the following stages:

**Figure 3: Scheme of evaluation system setting**



*Source: internally prepared*

### 3.5.3 Communication SK RIS3 2021+

Information and communication are an essential and integral part of maintaining the principle of transparency and open access to information and the management of resources to ensure that strategic objectives are met. It aims at providing timely, comprehensive, accurate and correct information to all target groups in the process of implementing the strategy. At the same time, communication must also emphasise the qualitative nature of information flow, which will ensure a higher level of credibility and positive perception across stakeholders. The main communication tools at the level of RIS3 2021+ include:

- communication platform (central component),
- databases of monitored data,
- EDP workshops/annual conferences,
- evaluation reports,
- annual reports on the implementation process of the SK RIS3 2021+,
- departmental web domains.

Supporting communication tools that will ensure an increase in the level of dissemination of the strategy and contribute to faster implementation, can be considered in particular:

- newsletters, leaflets, brochures, newsletters, magazines, proceedings,
- training and professional information events, conferences, workshops, exhibitions and fairs, road shows, lectures, educational activities,
- professional publications (manuals, case studies and OP RDI publications),
- advertising/media (internet, radio, TV, online banners, out-of-home), promotional and publicity events,
- social networks (LinkedIn, Twitter, Google+, Facebook),
- a single design manual for all documents related to SK RIS3 2021+,
- direct contact through the information and advice centres within the IPC integrated network.

The aim of each of these communication tools is to contribute to informing and motivating stakeholders, current and future actors involved in the strategy implementation process, the scientific and research community, private corporate sector and, last but not least, the general public.

### **Communication Strategy SK RIS3 2021+**

The Communication Strategy provides a basic framework for linking the information flow to all stakeholders who can contribute to achieving the Strategy's objectives. Elaboration of a methodological framework for communication (communication strategy) constitutes a basic prerequisite for the correct setting of information flow between entities involved in the implementation of RIS3 2021+ and at the same time defines the scope, form and direction of popularisation activities related to raising awareness of the importance of RDI activities and the objectives of RIS3 2021+ at national level. The role of the communication strategy is to provide information on the following:

- content and importance of SK RIS3 2021+ for the RDI ecosystem to all target groups,
- project calls and project objectives for achieving the strategic intents,
- conditions for the provision of financial resources in project calls,
- progress in the implementation of project intents both in terms of form and content,
- progress towards achieving the transformation objectives of the priority areas,
- achievement of the RDI objectives that will ensure smart specialisation,
- opportunities for involving direct actors in the strategy implementation process,
- opportunities to involve experts and the wider public in discussions on the strategy,
- funding opportunities for project calls and the outlook for funding allocations for the next 2 years,
- the state of uptake and available financial resources during the strategy implementation period,
- the state of strategy implementation by the National Authority (sectoral ministries and the RVVTI) and the European Authority (EC).

Transfer and flow of information through the communication strategy can be seen in Figure 4, which schematically illustrates the sources of information for the wider public:

**Figure 4: Information transfer flowchart in the communication strategy at the level of general public**



*Source: internally prepared*

### **Communication platform**

The Communication Platform is a central component of the SK RIS3 2021+ communication strategy and its role will be to bring together and link information in a factual and clear digital form for all stakeholders that actively contribute or are interested in contributing to the implementation of SK RIS3 2021+. As it is a publicly accessible platform, the information is also available to the wider public. In order to fully provide centralised and objective information, elements for the needs of the communication strategy must be defined, namely:

1. the main parameters (scope, form, structure) of the source information of the communication platform, respecting the needs of the stakeholders,
2. the source databases on which the data will be based,
3. technical requirements for the system functionality, which will provide a wide range of information,
4. visual design of the communication platform, applying principles such as simplicity, clarity, comprehensiveness.



## 4. Horizontal calls and package of measures

### 4.1. Horizontal calls

#### 4.1.1. Human resources and skills

Human resource calls are at the forefront of SK RIS3 2021+ so that all other calls can be addressed and support the priorities of the national economic strategies and plans for digital skills<sup>102</sup> and new skills to support the knowledge-based economy that are being rolled out across the country.

#### Education system

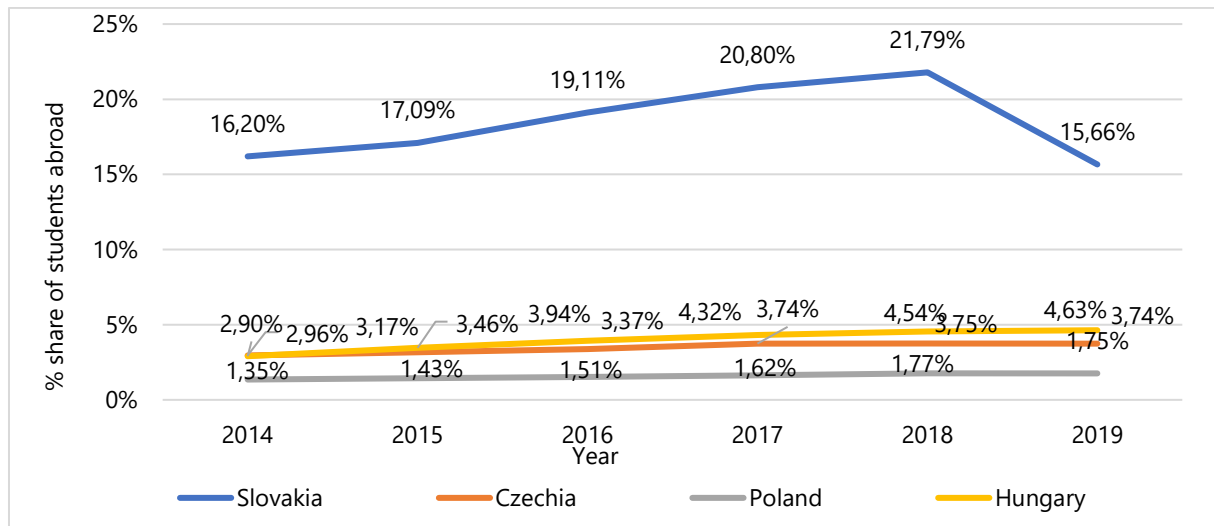
One of the main challenges in the area of skills and human resources is the Slovak education system, which is not sufficiently set up to raise the country's economic potential. Vocational education and training directly prepares and provides the workforce for the labour market, but the problem of secondary vocational education is its underfunding, the funding being focused on the number of pupils, or the lack of connection to the labour market requirements, which has an impact on the lower quality of the educational process (PISA). Another problem is the insufficient linking of ISCED 3-5 education levels with further ISCED 6-8 follow-up levels in specialisations linked to the smart specialisation domains of SK RIS3 2021+ to ensure knowledge prerequisites for addressing societal challenges related to RDI. Further (adult) education can help to address structural challenges in the economy, but the culture of further education is underdeveloped and underfunded, and poor management decisions across government sectors are also a challenge. Tertiary education has a key role to play in preparing capacities for research and for generating innovation. The number of higher education institutions contrasts with their quality. The lack of funding for educational development, the management of universities, frequent changes in legislation and the failure to implement any systemic changes, but the preference for ad hoc solutions, also affect the quality of universities. Attempts to modernise higher education have been hampered by political influences, unsystematic approach and the former accreditation system, which thus lacked transparency and independence. The newly established body - the Slovak Accreditation Agency for Higher Education - has decision-making powers, and this new body should function efficiently and to the required standard. In addition, expert groups and mutual cooperation can help in specific areas and with reforms. The various stakeholders must provide synergies in creating new and deepening existing cooperation for education system improvement. It is essential to develop measures e.g. for stimulation and design of new curricula/degree and apprenticeship programmes for schools, programmes and courses for further education, creation of qualifications for new jobs and systems for validating and recognising more non-formal skills, strengthening of creativity, innovation and other key competences as part of VET curricula, or the design of effective skills anticipation systems to provide accurate and up-to-date information on labour market needs. The education system needs to be linked to the European Qualifications Framework, the Slovak Qualifications Framework, National Occupational Framework and to measures aimed at reducing the outflow of skilled labour and students abroad for the relevant levels of the National Qualifications Framework (beyond levels 6-8, for which this measure has already been implemented). The brain drain out of Slovakia is taking place in two waves, with the first wave representing the departure of students after secondary education and the second wave representing the departure of Slovak university graduates. At the same time, the absence of more significant measures and strategic plans for the return of professionals and students from abroad back

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<sup>102</sup> Ministry of Investment, Regional Development and Informatization: *Digital skills*. Available at: <https://www.mirri.gov.sk/sekcie/informatizacia/narodne-iniciativy/digitalne-zrucnosti/index.html>

to Slovakia is a major shortcoming. The current situation with the outflow of students abroad is also illustrated by a comparison of the V4 countries in the number of university students studying abroad in relation to the total number of university students, where the Slovak Republic has the worst balance in the V4 in the long term, despite a significant statistical change in 2019, see Figure 5, and the second worst balance after Luxembourg in the EU as a whole.

**Chart 5: Proportion of higher education students studying abroad to the total number of higher education students in the V4 countries**



Source: UNESCO institute for statistics - internally prepared<sup>103</sup>

Another problematic aspect is the second wave of brain drain after university graduation, where, according to statistics from the Financial Policy Institute<sup>104</sup> about one in ten graduates is going abroad. As a result, the SR has one of the highest proportions of its population living abroad in international comparison, according to OECD statistics<sup>105</sup>. These figures also have a significant economic impact in terms of the state's investment in education, which does not translate into the creation of a skilled workforce with added value for the Slovak labour market, which affects tax and contribution revenues for employees with the highest salary potential and for Slovak science, which loses out on potential PhD students and scientists that may have a negative impact on the economic growth of the SR.<sup>106</sup>

## Research Excellence

The national system of funding public research institutions in the SR does not currently focus sufficiently on the quality and competitiveness of research. An important criterion at present is the volume of outputs and less so their quality. Institutional funding of private institutions carrying out research and development in the public interest is not regulated by legislation. The largest source of research funding is currently earmarked RDI support provided from the state budget to the Slovak Academy of Sciences, public and state universities and, to a lesser extent, to public research organisations. Funding is spread over a large number of institutions, which makes it less efficient and does not place sufficient emphasis on the quality of outputs. For the whole RDI ecosystem, there is a need to create conditions and

<sup>103</sup> UNESCO Institute for Statistics: Education. Available on the Internet: <http://data.Uis.Unesco.Org/#>

<sup>104</sup> Martinák, D.; Varsík,S.: The casting of brains I: DON'T WATCH THAT TRAIN!. Ministry of Education, Science, Research and Sport of the Slovak Republic. 2020. Available at: <https://www.minedu.sk/komentar-032020-odliv-mozgov-i-necestuj-tym-vlakom/>

<sup>105</sup> OECD Economic Surveys: *Slovak Republic*. Available at: <https://www.oecd.org/economy/surveys/Slovak-Republic-2019-OECD-economic-survey-overview.pdf>

<sup>106</sup> Martinák,D.; Varsík,S.: BRAIN DRAIN I: DO NOT TAKE THAT TRAIN!. Ministry of education, science, research, and sport SR. 2020. Available at: <https://www.minedu.sk/komentar-032020-odliv-mozgov-i-necestuj-tym-vlakom/>

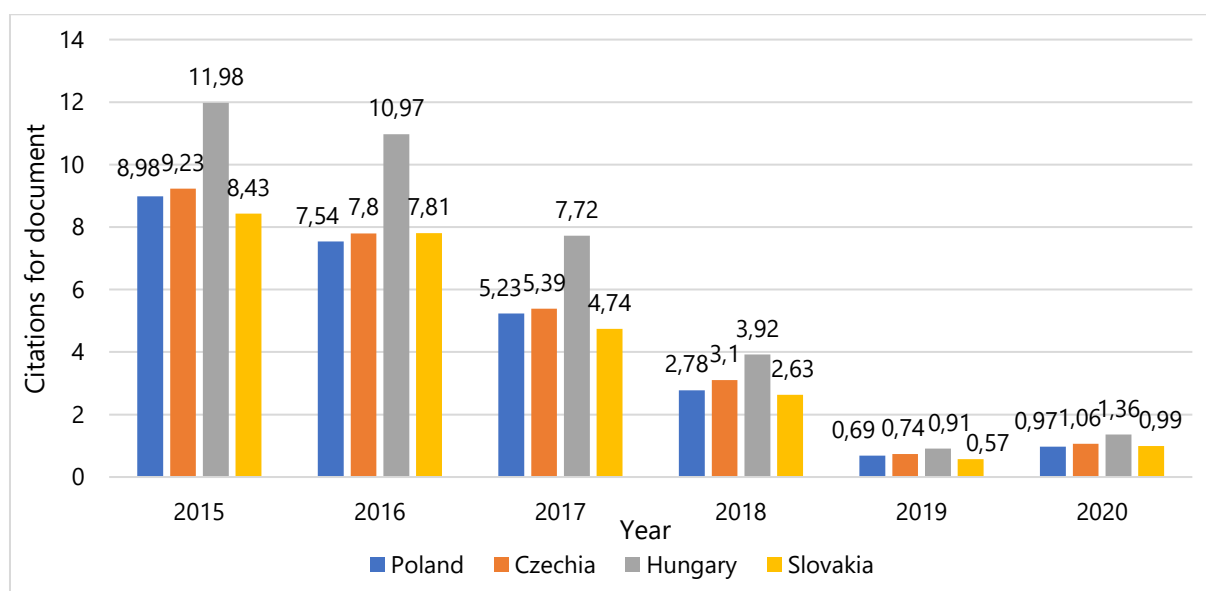
opportunities for a more open and easier access to information that can help RDI activities. Regular data collection and linked statistics with integrated data across the different institutions concerned will contribute to the development of an effective management and funding system and thus to the delivery of the RIS3 2021+ SK.

Insufficient and unsystematic national RDI funding has led to problems for Slovak researchers to participate in larger European projects such as Joint European Programmes or in research networks such as ESFRI. For each of the domains, the importance of future international projects and initiatives will be highlighted in the following sections of the strategy.

It appears that the conditions in which universities and the SAS operate allow the best universities and selected SAS institutes to maintain a solid level of research, but do not sufficiently stimulate cutting-edge scientific performance. This situation does not have the potential to contribute significantly to improving the innovation performance of the SR. It is cutting-edge research and development that has the ability to generate patents or utility models as well as other outputs and become the basis for effective transfer of knowledge into practice.

The low number of cutting-edge publications of the SR in international comparison is documented by the lower citation rate of outputs in the first years after publication. Research in the SR is more inert, it does not react rapidly enough to the "hot" topics of world research. This is a direct consequence of the unequal, insufficient and inflexible funding of research, procurement of instrument infrastructure in a multi-year process, inappropriate structure of human resources as well as a consequence of problems in the quality management of RDI institutions. The SR ranked 25th among EU countries in the SCIMAGO ranking of citations per paper statistics for 1996-2020, prior to the UK's withdrawal from the EU. For this period, the citation per document in the Czech Republic is 13.40, in Hungary 18.15, in the SR 11.66 and the developed EU countries have an average citation per document of more than 20. The statistics for all V4 countries for the period 2015-2020 are shown in Figure 6.

**Chart 6: Number of citations per document in V4 countries 2015-2020**



Source: Scimago Journal & Country Rank - internally prepared<sup>107</sup>

<sup>107</sup> The SCImago Journal & Country Rank (2021): citations per V4 country document for 2015-2020. Available at: <https://www.scimagojr.com/countryrank.php?region=EU-28&order=cd&ord=desc>

## Status and prospects for skills development

In 2014, nearly 4 200 people were employed in the private sector in the field of RDI and this number had increased to more than 7 100 by 2019. The share of the private sector workforce in the total number of RDI employees in full-time equivalent (FTE) terms was 23.6 % in 2014 and 33.6 % in 2019, representing a significant increase in RDI human resources.<sup>108</sup> In the public sector, there were approximately 13,400 FTEs in 2014, rising to approximately 14,100 by 2019. As a proportion of the total number of persons employed (private and public sector combined), these figures represent a 10 % decrease in the number of RDI persons employed in the public sector compared to 2014.<sup>109</sup>

The Slovak labour market is generally characterised by a mismatch between the skills on offer and those in demand, as well as a shortage of domestic skilled labour that is felt in key sectors of the national economy and selected professions. This is due not only to the poor quality of education and low emphasis on gaining practical experience, but also to a lack of interest in these occupations, demographic changes, insufficiently motivating environment and poor financial remuneration. It will therefore be necessary, as part of the EDP process, to analyse (refine) the characteristics of different domains based on occupations, qualifications (education and training supply), skills supply and demand, and the identification of mismatches and skills gaps in relation to study and learning disciplines and study programmes, in order to develop and better target measures to support the domain transformation.

At the same time, it will be challenging for the strategy to support the development of a set of activities to anticipate future skills needs and to put in place educational and financial incentives to retain the talent needed to drive innovation. At the same time, financial support and strengthening of STEM fields of study and schools seems essential. Although documents such as the 2018 National Education Development Programme<sup>110</sup> have already been developed, there is still a lack of a coherent application of skills assessment and anticipation (SAA) tools. In 2020, four priority areas have been outlined to improve the country's skills position: Strengthening Youth Skills, Reducing the Skill Gap, Promoting Greater Participation in Adult Learning, and Strengthening the Use of Skills in the Workplace (further specification and description is included in the input document for the strategy development).<sup>111</sup> Table 4 below proposes a number of actions for the implementation of identified priorities, several with direct relevance to the RIS3 2021+ SK are part of a set of actions.

**Table 3: OECD and SR recommendations for improving skills**

Priority	Scope	Mechanisms
Strengthening youth skills	The reading and science skills of Slovak 15-year-olds (as measured by PISA) lag behind those of their peers in other OECD countries, and the gap is widening.	<ul style="list-style-type: none"> <li>• Increase the number of children in pre-school education.</li> <li>• Support schools and teachers to work with vulnerable pupils.</li> <li>• Build a strong and quality teacher workforce.</li> </ul>

<sup>108</sup> Statistical office of the Slovak Republic (2020): *Science and technology yearbook 2019*. p. 12. Available at: <https://lnk.sk/lq69>

<sup>109</sup> Statistical office of the Slovak Republic (2019): *Science and technology yearbook 2018*. p. 12. Available at: <https://lnk.sk/vhm8>

<sup>110</sup> Ministry of Education, Science, Research and Sport of the SR (2018): *National program of training and education*. Available at: <https://www.minedu.sk/17786-sk/narodny-program-rozvoja-vychovy-a-vzdelavania/>

<sup>111</sup> OECD (2020), *OECD Skills Strategy Slovak Republic: Assessment and Recommendations*, OECD Skills Studies, OECD Publishing, Paris. Available at: <https://doi.org/10.1787/bb688e68-en>

Reducing skills imbalances	The low responsiveness of the secondary VET and tertiary education system to change has contributed to skills shortages and a mismatch between skills supply and demand in the labour market.	<ul style="list-style-type: none"> <li>• Improve information on the labour market and the skills needed.</li> <li>• Strengthen students' ability to respond to labour market needs.</li> <li>• Fortify secondary vocational school and college capacity in response to labour market needs.</li> </ul>
Encouraging greater participation in adult learning	Slovak production and exports concentrate in a small number of manufacturing sectors and the risk of automation is therefore particularly high. In this context, it is and will continue to be essential to educate adults and guide them to improve their skills, which can bring a range of personal, economic and social benefits.	<ul style="list-style-type: none"> <li>• Improve the adult education management system.</li> <li>• Increase the involvement of adults outside work.</li> <li>• Promote opportunities for employees and companies to engage in adult learning.</li> </ul>
Strengthening the use of skills in the workplace	The skills of adults in Slovakia are not being used to their full potential, while the use of employees' information processing skills, job-specific skills and general skills could be intensified in most cases. The use of ICT skills needs to be strengthened.	<ul style="list-style-type: none"> <li>• Provide Slovak companies with incentives and support for the introduction of high-performance workplace practices (HPWP).</li> <li>• Improve the management of policies and strategies that influence skills use.</li> </ul>

Source: OECD (2020) - internally prepared<sup>112</sup>

### State and public administration

Brain drain from public administration has for a long time created an unstable environment for development of various policies in the SR, including the RDI support policy. A number of interrelated and intersecting factors, persistent politicisation, lack of vision for development and management, but also operational shortcomings, such as the absence of human resource planning, salary competition, insufficient inter-ministerial as well as intra-ministerial communication, and a decision-making process that is perceived as opaque. A key problem is also the insufficient improvement of the quality of existing human resources in the state and public administration through up-skilling and continuous training development. These shortcomings have impact on the motivation to work in the state and public administration, which would lead to an increased interest in training and qualification development activities. The RIS3 2021+ EN therefore helps to lay the foundations in building the administrative capacity and human resources needed for the implementation of the 2021-2027 programming period.

The lack of impact of investment on state and public administration reform is another important aspect that needs to be addressed. Among the failures of the approach of the SR to meet the preconditions of the 2014-2020 period in the issue of human resources and the implementation of approved documents such as, in particular, the Strategy for Human Resource Management in the Civil Service, the decompilation of Act No. 55/2017 Coll. on Civil Service and on amendments and additions to certain acts, as amended, etc., the following are some of the failures of the SR approach to meeting the preconditions of the 2014-2020 period have resulted in a system that is not fully capable of functioning to ensure the responsible and efficient performance of the functions of the State, while at the same time ensuring proper implementation of a democratic form of government that would bring positive effects for all citizens of the State and the long-term economic prosperity of the country. The need for centralised human resource management, modernisation of public administration, strengthening

<sup>112</sup> OECD (2020): OECD Skills Strategy for the Slovak Republic - Assessment and Recommendations. Available at: <https://www.oecd.org/skills/centre-for-skills/OECDSkillsStrategySlovakRepublicReport%20SummarySlovak.pdf>

horizontal and vertical coordination and cooperation across ministries and central government bodies remains a challenge. This principle is part of Slovakia's Vision and Development Strategy 2030 - a long-term strategy for sustainable development and must be translated into all complementary planning documents.

#### 4.1.2. RDI funding

Current RDI funding relies heavily on EU resources and is characterised by insufficient national funding, which together with private investment in RDI is very low. Funding is unsystematic and undersized, both compared to neighbouring countries and to the EU average. Untapped potential is also represented by the resources that could flow to public research institutions from cooperation with the private sector.

Slovakia is still lagging behind EU advanced countries in scientific publishing. This is mainly related to low and poorly structured funding, inadequate human resource structure and the lack of targeted support for international cooperation under the ERA programmes. The lack of emphasis on the evaluation of the practical application of research and development (R&D) results and outputs is also a significant shortcoming.<sup>113</sup>

A key challenge for RDI funding is to address the shortcomings of national funding and to increase the allocation of national funds according to needs to cover RDI activities, while funding needs to be systemic, predictable and, above all, continuous. At the same time, maximum use should be made of existing EU funding opportunities to complement national funding. The volume of private sector funding is also insufficient. Funding is a key horizontal priority that needs to be significantly strengthened in the upcoming period and complementarity between the different sources of funding needs to be ensured in order to meet the objectives of the strategy and its vision.

#### ESIF and other international funds<sup>114</sup>

The main sources of EU funding are the ESIF and the European Framework Programmes. Compared to other Member States, the SR has used the ESIF to a lower extent to finance research and innovation activities. In the 2014-2020 programming period, RDI funding has been marked mainly by problems in the implementation of the OP RDI and its merger with the OP Integrated Infrastructure, which resulted in non-utilisation of part of the resources available from ESIF and the cancellation of key calls to support long-term strategic research and corporate R&D centres.<sup>115</sup>

Despite the low participation, Slovakia recorded an above-average application success rate in H2020 compared to the EU average of 13.6 %. Priority areas in the H2020 budget for Slovakia were food security, sustainable agriculture and forestry, inland waterways research and bioeconomy.<sup>116</sup> As of 18.02.2020,

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<sup>113</sup> VVA Economics & Policy, BAK Economic Intelligence, KPMG (2020): *AS-IS Report - Supporting the transformation of the Slovak economy by improving its innovation performance*. Available at: <https://www.mirri.gov.sk/sekcie/investicie/strategia-vyskumu-a-inovacii-pre-inteligenntu-specializaciu-sr/aktualizacia-ris3/>

<sup>114</sup> The absorption of the ESIF funds from 2007-2020 (relevant parts of the Operational Programme Research and Development and the Operational Programme Integrated Infrastructure - the former Operational Programme Research and Innovation) amounted to approx. 59 % (EUR 1 818 652 516.02) of the total allocation of funds of EUR 3 097 081 520.00 (the absorption and allocation of ESIF funds does not include the technical assistance of OP6 and OP7 for the programming period 2007-2013 and OP13 for the programming period 2014-2020).

<sup>115</sup> Disbursement of funds from the programming period 2014 - 2020 (2021): *Annex 2, Status of OP Integrated Infrastructure disbursement by priority axes in EUR as of 31.07.2021 (current status)*. Available at: <https://www.mfsr.sk/sk/media/tlacove-spravy/cerpanie-sf-kf-k-31-7-2021.html>  
PO 9 – PO 12 (former OP RD&I) (without technical assistance OP RD&I - PO 13) EU source – allocation 1,920,320,362.00 EUR, uptake 661,858,736.77 EUR (34,47 %), outstanding disbursement 1,258,461,625.23 EUR (65,53 %)

<sup>116</sup> European Commission: *HORIZON 2020 - Key achievements and impacts of Slovakia*. Available at: [http://www.szu.sk/userfiles/file/CPP/Horizon\\_2020/slovakia\\_horizon-2020-key-achievements-and-impactsrev-1.pdf](http://www.szu.sk/userfiles/file/CPP/Horizon_2020/slovakia_horizon-2020-key-achievements-and-impactsrev-1.pdf)



Slovakia had 521 participations in H2020 and the financial contribution amounted to EUR 102,984,858.<sup>117</sup> In terms of the number of participants and the amount of funding received from H2020, Slovakia ranks 24th out of 28 countries. The regional concentration of participation in H2020 and the use of these funds (55.5 % BA, 16 % KE)<sup>118</sup> corresponds to the volume of research activities concentration within the SR. Slovak SMEs lagged behind in the H2020 fund uptake - compared to the most active German SMEs, which used up to 13 % of the total amount allocated to SMEs, Slovak SMEs used only 0.3 %.<sup>119</sup>

The strong dependence of RDI funding on European resources is not necessarily a disadvantage, but due to the poor management and implementation of these funds, a necessary conceptual change is needed. Examples are the cancellation of calls due to lengthy evaluation processes as a result of refocusing support and redirecting available financial resources to other areas. Key weaknesses in the implementation of EU Funds also include insufficient administrative capacity, capacity of evaluators, complicated setting-up of calls, administrative complexity of individual processes, involvement of a number of different agencies, lack of accountability and monitoring process of ministries and advisory bodies, preventing competent, flexible and operational decision-making and leading to lengthy processes, lack of transparency of the support system and demotivation of key actors.

### **National public funding**

Provision of funds from the state budget for RDI within the SR is legislatively regulated, with the key legal regulations being Act No. 172/2005 Coll. on the organisation of state support for research and development and on the amendment of Act No. 575/2001 Coll. No. 185/2009 Coll. on incentives for research and development and on supplementing Act No. 595/2003 Coll. on income tax, as amended, and Act No. 185/2009 Coll. on incentives for research and development and on supplementing Act No. 595/2003 Coll. on income tax, as amended, and Act No. 185/2009 Coll. on incentives for research and development and on supplementing Act No. 595/2003 Coll. on income tax, as amended. A diagram of the state budget for RDI is shown in Figure 5 and a view of the departmental research capacities is given in Table 6.

Funding takes two basic forms: earmarked, competitive and institutional.

In the earmarked form, funding is provided on a competitive basis, in particular to support:

- R&D and development projects through APVV,
- R&D and R&D infrastructure development projects under state programmes,
- R&D projects aimed at ensuring national defence and security,
- inter-sectoral and international cooperation projects,
- R&D incentives.

The system of earmarked and institutional funding is not sufficiently performance-oriented. The institutional modality ensures the provision of funds:

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<sup>117</sup> Ministry of Education, Science, Research and Sport of the Slovak Republic: Slovakia in Horizon 2020, Participation Statistics 2014-2019. Available at: <https://eraportal.sk/wp-content/uploads/2020/05/SR-v-H2020-statistiky-ucasti-2014-2019.pdf>

<sup>118</sup> European Commission: participation of Slovakia in the H2020 programme by NUTS3 region. Available at: <https://eraportal.sk/wp-content/uploads/2020/12/Profil-SR-H2020.pdf>

<sup>119</sup> Ministry of Education, Science, Research and Sport of the Slovak Republic: Slovakia in Horizon 2020, Participation Statistics 2014-2019. Available at: <https://eraportal.sk/wp-content/uploads/2020/05/SR-v-H2020-statistiky-ucasti-2014-2019.pdf>



- to support R&D, R&D of the SAS and its research institutions and research institutions established by central government bodies, with the largest item being researchers' salaries; the operation of instrument infrastructure is largely covered by competitive funding,
- public universities and state universities to support R&D as a prerequisite for higher education,
- for the operation of R&D infrastructure, to legal entities carrying out R&D other than public research institutions established by central authorities.<sup>120</sup>

The existence of a large number of supported institutions of different performance (e.g. universities, agencies, etc.) causes inefficiency and fragmentation of RDI funding. Funding is also unbalanced in terms of support for projects according to Technology Readiness Level (TRL). While projects in the first stages, from idea, through basic research to applied research, are mainly supported by grants from the Agency for the Promotion of Research and Development (hereinafter only as "APVV") and the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the SR (hereinafter only as "MESRaS SR") and the Slovak Academy of Sciences (hereinafter only as "VEGA"), projects in the later stages, from the development of functional prototypes to commercialisation, lack adequate support schemes. Based on a survey,<sup>121</sup> funding related to the application phase of outputs with the assumption of commercial exploitation, in particular, e.g. for large prototypes tested in the intended environment, for prototype systems tested in the intended environment close to the expected performance, for demonstration systems operating in an operational environment on a pre-commercial scale, for the first commercial system (production problems resolved) and for full commercial applications (technology available to consumers), can be considered as insufficient areas of funding according to the level of technological readiness. Closing these gaps must be a priority for the next period 2021-2027. EU funding can be the solution, but there must also be an increase in national funding. This includes the consistent application of year-on-year funding.<sup>122</sup> An overview of the sources and volumes of RDI funding is given in Table 5.

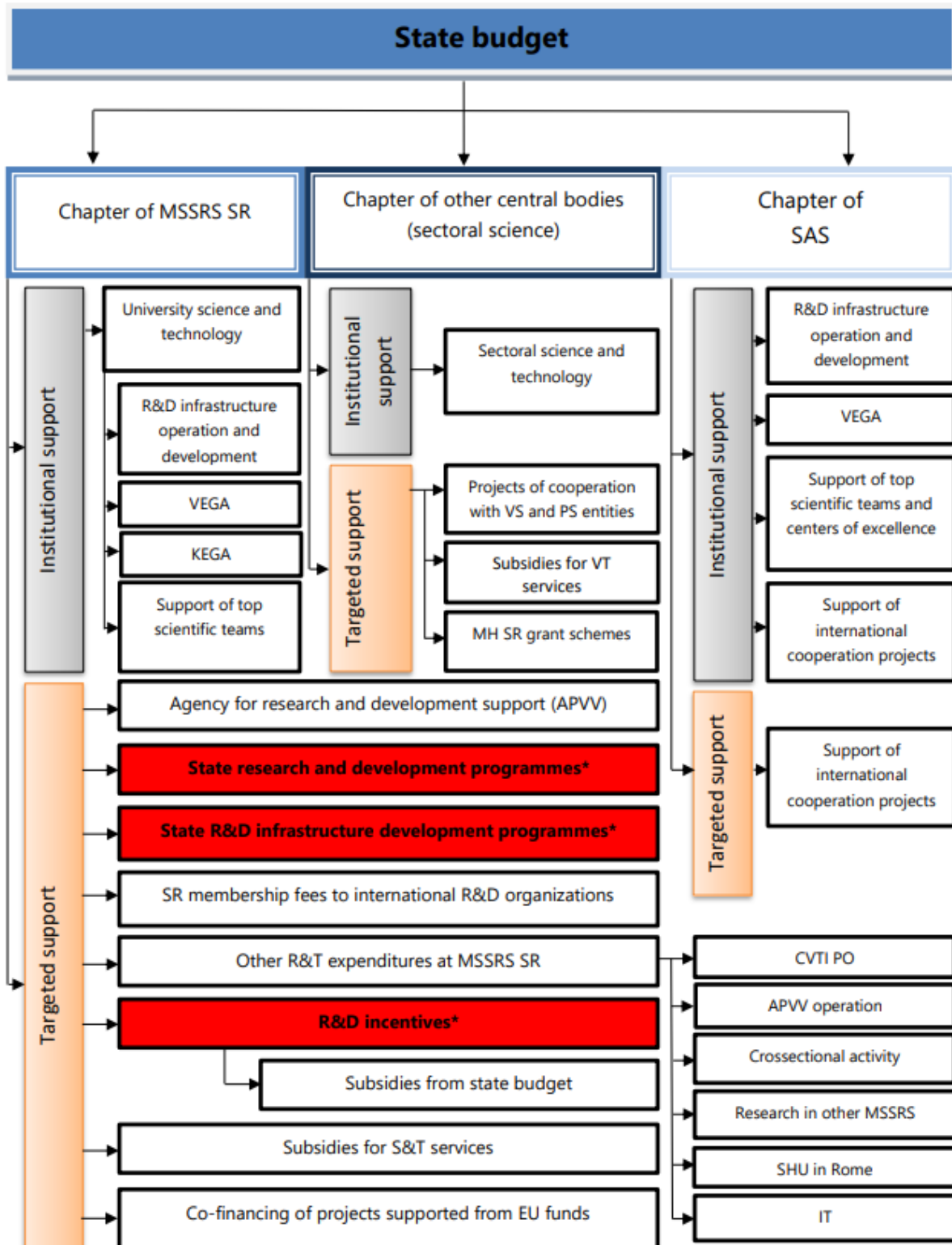
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<sup>120</sup> Supreme Audit Office of the Slovak Republic (2018): the system of public funding of research and development. Available at: <https://www.nku.gov.sk/documents/10157/c91c662a-d46e-467a-a0e9-3844f2a3a2da>

<sup>121</sup> The survey was conducted by an international consortium and its results are part of the AS-IS report published on the domain platform of the Ministry of Investment, Regional Development and Informatization. Available at: <https://www.mirri.gov.sk/sekcie/investicie/strategia-vyskumu-a-inovacii-pre-inteligentnu-specializaciu-sr/aktualizacia-ris3/index.html>

<sup>122</sup> **The application of inter-annual funding** means that if there is a legal basis for annual funding calls, they should be launched regularly each year. Where national funding does not have such a legal basis for annual calls, the rationale should be examined and, where possible, funding should be expanded to ensure some consistency of funding from year to year.

Figure 5: RDI funding scheme<sup>123</sup>



Source: Supreme Audit Office of the Slovak Republic - internally prepared<sup>124</sup>

<sup>123</sup> Note: The **red colour** highlights the current (the non-implemented schemes include also the catching-up funding through R&D Incentives, which is not continued in the upcoming period after 2021) non-implemented R&D funding schemes in Slovakia..

<sup>124</sup> Supreme Audit Office of the Slovak Republic (2018): the system of public funding of research and development. Available at: <https://www.nku.gov.sk/documents/10157/c91c662a-d46e-467a-a0e9-3844f2a3a2da>

**Table 4: Research and development expenditure by source of funding in thous. EUR**

Funding source	2015	2016	2017	2018	2019
Total R&D expenditure in the SR	927,272	640,835	748,955	750,947	776,590
Expenditure from state and public sources	296,133	262,670	265,909	285,431	314,158
Expenditure from university sources	30,208	12,443	12,463	11,612	13,713
Total expenditure from business sources	232,349	296,210	367,221	366,814	363,102
Expenditure from private non-profit org.	2,940	902	1,301	1,889	2,262
Expenditure from foreign sources	365,642	68,609	102,913	84,351	83,355

Source: Statistical Office of the Slovak Republic - internally prepared<sup>125</sup>

**Table 5: Sectoral research-development capacities**

Sector	No. of institutions conducting or supporting research and development <sup>126</sup>	Number of institutions reporting R&D expenditure in 2019	Departmental research expenditure in 2019 <sup>125</sup>
Ministry of Agriculture of the SR	5	3	64,032,650 EUR
Ministry of Culture of the SR	14	12	
Ministry of Health of the SR	13	6	
Ministry of Transport and Construction SR	2	2	
Ministry of the Interior of the SR	4	2	
Ministry of Defence of the SR	6	3	
Ministry of the Environment of the SR	8	5	
Ministry of Economy of the SR	3	0	
Other Ministries	8	8	
Ministry of Education, Science, Research and Sport of the SR	3+37 UNIV.	3+20 public UNIV.	197,214,630 EUR
Slovak Academy of Sciences	47	45	87,062,630 EUR

Source: internally prepared

### Indirect form of support for RDI funding

Since 2015, a preferential tax regime has been introduced in the Slovak Republic, which allowed entrepreneurs to deduct an additional 25 % of the expenses (costs) incurred for research and development, 25 % of the salary costs of school graduates up to 26 years of age and 25 % of the year-on-year increase in the costs incurred for research and development from the tax base reduced by the tax loss deduction. The additional deduction for R&D expenditure (costs) was gradually increased to the current 200 % of R&D expenditure (costs) and 100 % of the positive year-on-year difference in average R&D expenditure (costs). Another tax incentive in operation (effective from 1 January 2018) at national level is the patent box, which, unlike the additional deduction for R&D expenditure (costs), is aimed at promoting successful R&D results (reward for success). The application of the patent box allows for the exemption of 50 % of income (revenue) from licensing income from patents, utility models and computer programs (software), as well as the exemption of 50 % of income (revenue) from the commercial exploitation of the so-called embedded intangible assets, which are patents and utility models used in the manufacture of products. Other supporting non-financial incentives applied in the SR to support the

<sup>125</sup> Statistical Office of the Slovak Republic (2019): research and development expenditure by source of funding. Available at: [http://datacube.statistics.sk/#/view/sk/VBD\\_SLOVSTAT/vt2018rs/vt2018rs\\_00\\_00\\_00\\_sk](http://datacube.statistics.sk/#/view/sk/VBD_SLOVSTAT/vt2018rs/vt2018rs_00_00_00_sk)

<sup>126</sup> Own elaboration based on a survey of ministerial institutions.

funding of RDI activities include tax relief provided in the framework of investment aid under Act No. 57/2018 Coll. on regional investment aid and on amendment and supplementation of certain acts in relation to Act No 595/2003 Coll. on income tax, as amended, hereinafter only as the "Income Tax Act". (Section 30a of the Income Tax Act) and the tax relief for recipients of incentives granted pursuant to Act No. 185/2009 Coll. on incentives for research and development and supplementing Act No. 595/2003 Coll. on income tax (Section 30b of the Income Tax Act). To show the impact of these incentives, Table 7 has been compiled, which demonstrates the demonstrable significant year-on-year growth in 2017-2018. However, among comparable countries, the SR still does not reach values that would indicate significant support and use of indirect support instruments through tax incentives.

**Table 6: Indirect government support through RDI tax incentives<sup>127</sup>**

Year		2015	2016	2017	2018
Country	Unit				
Czech Republic	in mil. EUR	97.68*	92.27*	97.26*	99.98*
Hungary	in mil. EUR	143.58*	90.00*	70.45*	69.02*
Poland	in mil. EUR	0*	8.57*	22.64*	69.89*
Slovakia	in mil. EUR	2.1	3.7	8.3	24.9
Slovenia	in mil. EUR	46.6	45.5	45.9	45.4

Source: OECD – internally prepared <sup>128</sup>

As one example of indirect support instruments for R&D applied in the countries included in Table 7, it is possible to mention the tax advantage of investment incentives for the establishment of technology centres as it is applied in the Czech Republic (Section 35a and Section 35b of Act No. 586/1992 Coll. on taxes on income as amended). This form of support also includes tax holidays for a period of 10 years.<sup>129</sup> Poland, for example, applies a tax deduction for the cost of new technology, where entrepreneurs can claim a tax deduction of up to 50 % of the cost of the new technology in the form of a reduction of the tax base. Hungary benefits from tax relief through a reduction of tax liability of up to 80 % over a period of 10 years after the year in which the investment in the RDI asset was put into operation. As an example of indirect support applied in Hungary, it is also possible to mention the reduction of the levy obligation in the form of exemption from social contributions for scientists, researchers with academic degrees and students applying for such degrees. All of the above-mentioned instruments are alternatives to the current instruments of indirect government support through tax incentives and point to the need for their further development. Another key challenge of tax incentives is their lack of focus on SMEs and low interest from SMEs, which can be supported by data from 2018, when up to 72 % of the value of deductions went to large enterprises.<sup>130</sup> Genuine preferential tax incentives for SMEs are therefore essentially absent. In the next programming period, the SR needs to focus on adjusting tax incentives to increase SME participation. Indirect support to SMEs is not the most important support instrument for SMEs and should be deepened and extended, in particular through financial instruments of direct or indirect support that are tailored directly to the specific needs of SMEs.

<sup>127</sup> The amounts shown in the table are converted at the exchange rate of the NBS against the domestic currency as of 22.04.2021

<sup>128</sup> OECD: *R&D tax expenditure and direct government funding of BERD*. Available at: <https://stats.oecd.org/Index.aspx?DataSetCode=RDTAX#>

<sup>129</sup> Port8l CFO (2014): *Opportunities for state support of research and development in the V4 countries*. Available at: [http://www.cfo.sk/articles/moznosti-statnej-podpory-vyskumu-a-vyvoja-v-krajinach-v4#\\_YH\\_3LC0RpQI](http://www.cfo.sk/articles/moznosti-statnej-podpory-vyskumu-a-vyvoja-v-krajinach-v4#_YH_3LC0RpQI)

<sup>130</sup> SmartTech Solutions (2020): *The R&D super-deduction was claimed by significantly more entities in 2018*. Available at: <https://www.smarttech.sk/novinky/takto-ovplyvnilo-zvysenie-superodpuctu-na-100-rok-2018>

**Financial support instruments** (excluding grants and tax incentives) are therefore a more important area of support for SMEs. These financial instruments are part of the set of measures in the policy package in support of the horizontal call "Financing RDI".

#### 4.1.3. Collaboration

The RDI management system in the SR is currently not effective enough to stimulate meaningful cooperation between different stakeholder groups. Cooperation between private and the public sector is one of the weaknesses of the RDI system in the SR. The aim of the RDI system should be mainly to increase private spending on R&D, but this requires a certain amount of public sector funding, which forms a research backbone that will in turn attract and nurture quality researchers also for the private sector.<sup>131</sup> The weak link between the private and public sectors is particularly visible in terms of the low number of public-private publications per million inhabitants, the below-average performance in indicators of commercial and non-commercial research outputs in the SR and in the share of business-funded RDI carried out in universities and the Slovak Academy of Sciences.<sup>132</sup> The reason for the weak linkage between the private and public sectors is probably also due to the lack of instruments motivating mutual interaction and cooperation. Consequently, the lack of linkages does not allow the whole RDI system to function successfully. The problem of low linkages can be solved by introducing matching grants for research institutions to resources obtained from the private sector in the framework of research cooperation.<sup>133</sup> Although private sector investment in RDI is increasing, a relatively small number of mostly larger firms (including multinationals) are heavily involved in RDI. The private sector points to problems, reluctance, lack of interest and inability to cooperate on the part of the public sector. At the same time, the public sector is not motivated to identify its private sector partners.

The number of resources of universities and research institutes from research links with the private sector is low and even decreasing over time. HEIs and SAVs mainly receive public funding to carry out research, which naturally provides fewer opportunities for collaboration with the private sector. One effective solution to this problem is the implementation of grant schemes aimed at collaboration in consortia, which will allow mutual trust building and networking between the public and private sectors. The interest in collaboration is growing among the younger generation of researchers who are interested in intersectoral and international cooperation. Better collaboration between the private sector and the public sector can foster knowledge and skills exchange and help companies to innovate and develop new work and production capabilities.<sup>134</sup>

#### 4.1.4. Research infrastructure

Since 2007, the SR has invested heavily in infrastructure. Under the R&D Operational Programme 2007-2013, almost 50 % of the contracted funding for priority areas has been invested in infrastructure modernisation.<sup>135</sup> However, support for infrastructure building has not been complemented by adequate support for building applied research infrastructure in research organisations that would have the potential to cooperate intensively with universities and science parks, nor by support for the

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<sup>131</sup> European Commission (2018): *RIO Country Report Slovak Republic 2017*. Available at: <https://rio.jrc.ec.europa.eu/country-analysis/Slovakia/country-report>

<sup>132</sup> HAVLÍČKOVÁ, K., STRAKA, D. (2020): *How to improve research and innovation in Slovakia?* Available at: <http://www.sovva.eu/files/attachments/Hodnotenie%20EK.pdf>

<sup>133</sup> **Automatically leveraging private investment** that meets established conditions will increase the attractiveness of R&D investment for private companies and will also motivate universities, research institutes and other research institutions to seek more private partnerships.

<sup>134</sup> Ministry of Finance of the SR (2021): the Recovery and Resilience Plan of the SR. Available at: <https://www.mfsr.sk/sk/verejnost/plan-obnovy-odolnosti/>

<sup>135</sup> European Commission (2013): *Operational Programme 'Research & Development' for Slovakia: 2007-2013*. Available at: [https://ec.europa.eu/regional\\_policy/en/atlas/programmes/2007-2013/slovakia/operational-programme-research-development](https://ec.europa.eu/regional_policy/en/atlas/programmes/2007-2013/slovakia/operational-programme-research-development)

establishment and modernisation of corporate R&D centres. In the context of these facts, the main barriers in the field of infrastructure in the SR have been identified:

### **Use of existing infrastructure**

One of the crucial elements for development of the RDI ecosystem is to support the use of the existing research infrastructure by all relevant actors from both the SR and abroad. Investments in infrastructure have been made with the intention to promote cooperation between academia and industry and to ensure a more efficient transfer of technology and knowledge between the different RDI actors, which has not really happened.

Another major drawback for the use of infrastructure is the issue of the impossibility of its use by the private sector for remuneration, which limits the development in the field of its use and also the financing of operating costs, personnel costs of service personnel and the overall provision of the acquired infrastructure. The EN VI Roadmap 2021-2030 redefines the framework for the use of research infrastructure as a service and its action plans will define, inter alia, concrete measures for the use of research infrastructure by the business sector for remuneration. It is essential to identify large infrastructure hubs within the ESFRI National Roadmap. It is also necessary to identify projects enabling researchers to access large infrastructures worldwide. For the long-term sustainable development of large infrastructures, a strategic plan and stable public support approved by the Slovak government is essential, which is standard practice in EU countries.

### **Financing of existing infrastructure**

The State aid rules applied led to an under-utilisation of strategic research infrastructures during the previous programming period. This has also reduced the amount of private sector funding for research infrastructures. The 2019 EU Semester Report to the SR states that the amounts invested in physical upgrades have not been accompanied by equally critical investments in maintenance and staffing.<sup>136</sup> In most cases, this issue is also related to the inability of the private sector to use research infrastructure. Removing these barriers would allow for a portion of the funding to be raised to cover the costs of running the infrastructure. However, the sustainability of research infrastructure, including its necessary development, must, as is also the case in developed countries, be primarily addressed from public resources.

#### **4.1.5. Legal framework**

The functioning of the RDI ecosystem and the generation of innovations is directly dependent on the legislative and policy framework, which creates conditions for the development of RDI in the SR and is a prerequisite for the fulfilment of the objectives defined in the strategic documents. The basic legislative framework of RDI support in the SR is currently regulated by key legislation, such as Act No. 575/2001 Coll. on the organisation of government activities and central government organisations, as amended, Act No. 172/2005 Coll. on the organisation of state support for research and development and on the amendment of the Act on the organisation of state support for research and development No. 575/2001 Coll. on the organisation of government activities and the organisation of central state administration, as amended, Act No. 185/2009 Coll. on incentives for research and development and amending Act No. 595/2003 Coll. on income tax, as amended, and so on. There is no legislation on innovation. In order to

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<sup>136</sup> European Commission (2019): Slovakia Report 2019. Available at: [https://ec.europa.eu/info/sites/info/files/file\\_import/2019-european-semester-country-report-slovakia\\_en.pdf](https://ec.europa.eu/info/sites/info/files/file_import/2019-european-semester-country-report-slovakia_en.pdf)

create a functional ecosystem, legislation on the protection of intellectual property and on the movement and residence of persons, which is necessary to ensure a quick and bureaucratically simple process for foreign researchers and students, including those from outside the EU, is also entering the process.

RDI policy harmonisation and management system is considered to be a major challenge for the RDI system in the SR. The management of RDI is fragmented between the Ministry of Education and Science of the SR, Ministry of Economy of the SR (hereinafter only as "ME SR") and their subordinate agencies, MIRD SR as the chairing body within the RVVTI and other ministries. The RVVTI is the linking or coordinating element, but its outputs are only of a recommendatory nature. The underperformance in the area of RDI is also due to inflexible and lengthy processes and insufficient application of the principles of good governance and efficiency. In the case of grant funding from the EU Funds, it is possible to speak of administrative complexity, continuously changing rules, weak legal certainty in relation to the interpretation and application of European legislation (state aid), insufficient use of simplified reporting and recording procedures in RDI projects. The area of public procurement is also problematic, as it is time-consuming and administratively demanding, while the legislative regulation and related processes and procedures are over-bureaucratic compared to other EU countries and there is no specific policy in place to support public procurement of innovative solutions. Last but not least, one of the basic prerequisites for the generation of RDI results is the legislative framework for the protection of intellectual property rights.

### **RDI management**

The competency framework for the management of RDI must be anchored in legislation. A partial solution to the above shortcomings is the drafting and adoption of an amendment to Act No. 172/2005 Coll. on the organisation of state support for research and development and on the amendment to Act No. 575/2001 Coll. on the organisation of government activities and the organisation of central state administration, as amended, and the drafting and adoption of a new Innovation Act, which will legislate on the new management of RDI and its competences, thus creating the legislative basis for a new system of organisation, financing and evaluation of RDI. The new Innovation Act will regulate the coordination of public funding sources for RDI, such as funding for activities from the RRP, EU Funds and other public sources, thus ensuring coordination and consistency of public interventions.

The legislation must strengthen the coordinating role of the new RDI governance structure (e.g. define the role of RVVTI and its organisational components. It will also enable a gradual integration of processes and expert evaluation of RDI projects and simplification and standardisation of project evaluation processes in RDI.

### **EU funds**

In line with preparing new programming period 2021 - 2027, a draft Act on contributions from EU Funds is being prepared, which regulates the legal relations, procedure and conditions, rights and obligations of persons, competence of state administration bodies and bodies of territorial self-government and liability for violation of conditions in the provision of a contribution and contribution to a financial instrument in the programming period 2021 - 2027.<sup>137</sup>

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<sup>137</sup> REGULATION (EU) 2021/1060 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 24 June 2021 laying down common provisions on the European Regional Development Fund, the European Social Fund Plus, the Cohesion Fund, the Just Transition Fund and the European Maritime, Fisheries and Aquaculture Fund and laying down budgetary rules for those Funds, as well as for the Asylum, Migration and Integration Fund, the



## **State aid**

The issue of state aid and its application significantly influences the cooperation between the different RDI actors. State aid rules do not provide a clear application framework for individual institutions, which creates room for different interpretations, resulting in implementation problems. It also causes legal uncertainty and a preference for forms of aid that are not linked to State aid, especially in relation to State and public research institutions. The area of de minimis aid is also problematic due to the limitation of the duration and possible amount of aid under all schemes that benefit from it.

The priority in this area is to resolve the application of state aid rules in relation to the use of research infrastructure built from public funds under the 2007-2013 programme period to all entities within the RDI ecosystem and to ensure clear and transparent rules. In general, a clear and transparent communication of State aid rules in relation to RDI projects is essential.

## **Public procurement**

The effort to streamline, accelerate and simplify the time-consuming and administratively demanding process of public procurement is one of the main pillars of Act No. 141/2021 Coll., supplementing Act No. 343/2015 Coll. on Public Procurement and on amendments and additions to certain acts, as amended, which was prepared by the Public Procurement Office.

Act No. 141/2021 Coll. supplementing Act No. 343/2015 Coll. on Public Procurement and on amendments and additions to certain acts, as amended, provides that Act No. 343/2015 Coll. on Public Procurement and on amendments and additions to certain acts, as amended, shall not apply to research and development services, except for research and development services which benefit exclusively the contracting authority or contracting entity for use in the performance of its own tasks and consideration for the service rendered is wholly provided by the contracting authority or contracting entity.

The current public procurement legislation provides ample scope for the introduction of innovative solutions in public procurement, as well as the setting up of simplified procedures and processes that would speed up and streamline the implementation of public procurement.

## **Conditions for the migration of foreign workers/students**

Science and research are characterised by international environment, with PhD students and postdocs from all over the world, especially in the experimental laboratories of advanced research institutions. These staff are usually the driving force behind the laboratories, even though their time is limited. The recruitment of these staff/students within the SR is more difficult than in neighbouring countries. This results in the fact that talented PhD students and postdocs prefer other countries. Therefore, it is necessary to modify the system of admission of foreigners in the categories of student, postdoctoral fellow so that it is comparative with neighbouring countries. At the same time, all components of the admission process in these categories should be strengthened in proportion to the ever-increasing number of foreigners coming to our country.

## **Employees**

The current legal system addresses the issue and conditions of migration of foreign persons (both employees and students) through Act No. 404/2011 Coll. on the Residence of Foreigners and on amendments and additions to certain acts, as amended (hereinafter only as the "Act on the Residence

of Foreigners"). Transitional residence for the purpose of research and development is regulated by Section 26 of the Act on the Residence of Aliens on the basis of a hosting agreement, for the time necessary to achieve its purpose, but for a maximum of two years. If the stay for research and development purposes does not exceed 90 days, there is no need to apply for temporary residence.

Special provisions on temporary residence are regulated by Section 37 of the Act on the Residence of Aliens by means of the "Blue Card", which entitles a third-country national to enter, reside and work in the territory of the SR. The Blue Card for the purpose of highly qualified employment<sup>138</sup> may be obtained for a maximum period of three years. The conditions for obtaining the aforementioned temporary residence permits are regulated by Section 38 of the Act on the Residence of Aliens. Another legal regulation defining the specifics of the procedure for admitting third-country nationals for the purposes of science and research is Council Directive 2005/71/EC of 12 October 2005 on a specific procedure for admitting third-country nationals for the purposes of scientific research (OJ L 289, 3.11.2005). On the basis of this Directive, Member States have the right to charge applicants a fee for the processing of applications for a residence permit in order to obtain a temporary residence permit. The legislation of the Aliens Residence Act defines certain subjects who are exempted from these fees (e.g. teaching staff or university teachers), researchers or scientific researchers are not listed in this exemption.

In addition to the financial difficulty of obtaining a temporary residence, the time required to complete the compulsory documents for obtaining a temporary residence and the notification and registration obligations associated with this residence are also limiting factors. At national level, an analysis in this area was carried out in 2012 under the title "National Study of the European Migration Network".

As the Act on the Residence of Foreigners has been amended several times until 2021, addressing this issue requires a review of the current barriers in terms of administrative and financial complexity and simplification of the processes related to research-oriented migration.

## Students

The status of third-country students in the system of foreign migration is regulated by the same legal framework as for employees, namely the Act on the Residence of Foreigners. It is possible to obtain a temporary stay in the territory of the SR for the purpose of studies for a maximum period of 6 years, while a third-country national who is granted a temporary residence permit for the purpose of studies by a police department may both run a business and work as an employee during the temporary stay.

The student is subject to the same notification and registration obligations as an employee, but changes due to interruption of studies, dropping out of studies, exclusion from studies or termination of studies must be notified in writing by Slovak schools to the police department within three working days. In contrast to the legal status of an employee, full-time student is exempt from temporary residence fees.

A problematic aspect is the possible exceeding of the maximum duration of the student's stay (6 years) and the continuation of e.g. doctoral studies, or interruption of studies for the purpose of deepening scientific knowledge for the dissertation. The issue of abuse of student status in visiting countries is also very much discussed, which could lead to undesirable effects in obtaining a stay in the SR due to poorly established legislation and over-simplification of conditions.

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<sup>138</sup> **High-skilled employment** as referred to in paragraph 2 is employment requiring higher professional qualifications. Higher vocational qualifications shall be understood to mean qualifications demonstrated by evidence of higher education or evidence of more than five years' professional experience in a relevant field at a level comparable to higher education, issued pursuant to a special regulation.

It is also necessary to address issues related to the limited visa policy, the policy of residence of foreigners in the SR and various administrative obstacles on the part of the foreign police, ministries and embassies of the SR abroad.

### Protection and utilisation of intellectual property rights, in particular patents<sup>139</sup>

The protection of intellectual property rights is one of the key strategic tools for applied research and innovation, guaranteeing exclusivity and therefore sustainability. In the SR, this area may be underdeveloped compared to Western Member States with strong protection regimes and traditions (such as Germany, the UK, Switzerland, France, the Netherlands, the Nordic countries or Austria).<sup>140</sup> On IP indicators, the SR also lags behind the V4 countries: while Poland and the Czech Republic are ranked first and second respectively<sup>141</sup> among the selected countries, the SR ranks last, with the exception of the number of registered trademarks, where it is ranked ahead of Hungary. In the context of international assessment of Slovakia's innovation performance (selected areas of assessment in the EIS and GII) and the associated lacklustre protection of intellectual property rights, it is therefore essential to reform the regulatory framework itself, including the creation of a clear, transparent and binding system for the generation and enforcement of publicly funded intellectual property rights.

**Table 7: Ranking of V4 countries in the World Intellectual Property Indicators in 2019**

V4 Country	2019		
	Patents	Trademarks	Utility Designs
Czech Republic	34	31	29
Hungary	43	60	50
Slovakia	56	54	59
Poland	29	23	18

Source: *World Intellectual Property Indicators (WIPO) - internally prepared*<sup>142</sup>

In addition to the lack of knowledge and experience, the level of patent fees (filing and processing a patent application up to patent registration, including patent maintenance fees and patent attorney services) has a significant impact on the performance of Slovak institutions in the context of patent protection registration, as the related financial support is lacking. In addition, patents of public institutions such as the SAS are currently also owned by the State, which severely limits the possibilities for action by these institutions. This area needs to be stimulated in order to increase capacity and efficiency also in attracting investment and licensing in the next programming period.

Another problem related to the protection of intellectual property rights is the disclosure of sensitive information in the context of applications for non-reimbursable financial contributions (NRC). Currently, in accordance with the ESIF procedure requirements, this information is disclosed as part of applications,

<sup>139</sup> A joint study by the European Patent Office and the Intellectual Property Office of the European Union shows that intellectual property is heavily used by industries that play a vital role in the EU economy and offer sustainable jobs to society. These industries currently account for almost 45 % of Europe's GDP and directly contribute to the creation of almost 30 % of all jobs (IPR intensive industries and economic performance in the EU, EUIPO-EPO, 2019) of which 22 % in trademark intensive areas of the economy, 14 % in design intensive areas, 11 % in patent intensive areas and 5.5 % in copyright intensive areas.

<sup>140</sup> Property Rights Alliance (2019): *International Property Rights Index*. Available at: <https://internationalpropertyrightsindex.org/compare/country?id=23,20,12,5>

<sup>141</sup> **Placing at 1-4. ranking** is a virtual ranking within the V4 countries, it is not linked to the overall WIPO ranking, the international ranking is part of Table 8.

<sup>142</sup> World Intellectual Property Organization (2020): *World Intellectual Property Organization*. Available at: [https://www.wipo.int/edocs/pubdocs/en/wipo\\_pub\\_941\\_2020.pdf](https://www.wipo.int/edocs/pubdocs/en/wipo_pub_941_2020.pdf)

which not only entails the risk of disclosure of patentable information to the applicant's competitors, but also the impossibility or invalidity of patent protection, given the extent of the disclosed data.

The legal framework needs to be revised in order to set clear and binding rules in relation to protecting intellectual property in all its available forms, with an emphasis on transparency and ownership relations. The setting of these rules must also ensure the necessary and effective protection of sensitive information, the disclosure of which may result in a patent being refused or invalidated. As part of the transformation of the overall environment for all relevant actors, measures are necessary to increase not only the number of patents/utility models granted, trademarks registered and the use of copyright, but also the effective enforceability and efficient use of intellectual property rights. In the context of the adopting the legal framework, measures related to the protection of intellectual property rights will be prepared in cooperation with the Office for the Protection of Intellectual Property Rights of the SR in order to be in line with the forthcoming National Intellectual Property Strategy.

#### **4.1.6. Internationalisation**

Reduced mobility of researchers is mainly due to insufficient RDI funding, less emphasis on excellence, lack of effective communication from the administration and lack of programmes aimed at mobility of researchers and internationalisation of their activities.

Therefore, in the framework of internationalisation, the MERDS is preparing a "Strategy for Internationalisation of Higher Education until 2030" and a "Long-term Plan of the State Science and Technology Policy", which will also regulate the management of international multilateral and bilateral scientific and technological cooperation and involvement in European programmes.

#### **Management of international bilateral science and technology cooperation**

Complex structure of support for international science and technology cooperation (hereinafter only as "ISTC") requires simplification and systematisation in order to make the conditions more attractive for stakeholders, to create new models for project cooperation and funding, and to clearly define the rules for external actors in order to facilitate their involvement.

The ISTC funding system needs to be sustainable and predictable, using a competitive project evaluation and funding system provided by APVV. Funding needs to be focused on full-fledged research projects with a foreign partner.

In terms of benefits for the SR, it is necessary to maintain and further develop activities in international organisations and European research infrastructures of which the SR is currently a member. Membership in European research infrastructures should be addressed in the ESFRI national roadmap as mentioned above, membership in international organisations needs to be assessed in terms of benefits for RDI.

Special attention and support should be given to existing and new partnerships<sup>143</sup> emerging within EU and the involvement of Slovak entities in them, with the issue of membership fees also to be addressed.

Strengthening these areas should support the transfer of science and research results to the Slovak science and innovation environment and improve the visibility and publicity of activities related to international cooperation to the general public.

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<sup>143</sup> Horizon Europe European Research and Innovation Partnerships.

## **Involvement of the Slovak Republic in European programmes**

It is important that the SR participates more in European programmes. Directly managed EU programmes are created through a robust process involving thousands of experts from all EU Member States and associated countries and guarantee high quality projects at international level. Support should also be directed towards building capacities that are able to follow developments and promote the interests of the SR in the development of strategic plans and work programmes.

Attractive conditions for programmes supporting the mobility of foreign researchers to Slovak sites would increase internationalisation and the two-way and balanced flow of knowledge and experience.

It is important for the SR to support cutting-edge research in EU priority areas such as digital and green themes exploiting synergies and complementarities of funding between HE programme and EU Funds.

Special attention should be given to projects that receive Seal of Excellence awards under the EIC Accelerator, MSCA Postdoctoral Fellowships and Widening Participation and spreading excellence schemes, large European projects under HE Programme Partnerships or other HE schemes, which should be supported by EU Funds as recommended by the EC as well. At the same time, consideration should be given to introducing all possibilities for synergies between the ESIF and HE, including the 5 % transfer.

In the context of the dynamic development of space industry in Europe and diversification of traditional industrial sectors at present, also following the concept of the so-called "New Space", it is necessary to support the building of space infrastructure and development of space industrial ecosystem in Slovakia, in particular by diversifying traditional sectors of the economy towards areas with higher added value. To this end, it is necessary to focus on participation in the Union Space Programme projects and on cooperation of the SR with the European Space Agency, in order to increase the involvement of industrial entities, expand and build the space industrial base; it is necessary to support cooperation of academy, universities and enterprises in the field of space activities, technologies (products, applications and services); increasing technological readiness level (so-called "space readiness"); increasing technology level of (so-called "space readiness"). Supporting the whole process of product and service development (from idea to product) and facilitating the search for end-users and customers for specific products.

To support the participation of Slovak institutions in European research and innovation partnerships and joint applied research projects, EU Funds could also be used for membership contributions and co-financing of partnership projects.

### **4.1.7. Industrial transformation**

The SR is an industrially-oriented country, where a substantial part of GDP and employment is provided by industrial production and part of services closely linked to the activities of industry. Industrial production in the SR is strongly export-oriented, which implies its high dependence on the development in the downstream markets.

The pace of convergence of the Slovak economy towards the most advanced EU countries has slowed down considerably, and the SR is currently already at the tail of the euro area countries.

**The main source of economic underdevelopment in the SR is low productivity caused by a low share of value added in total output** due to a low level of product or technological innovation, as well as the declining quality of human capital. Employers point to the declining quality of secondary and university graduates.

A separate problem is the brain drain of both workers and students. Transformation of Slovak industry to a higher technological level in order to strengthen competitiveness and the ability to respond to global challenges is possible through fundamental reforms and by strengthening funding for research, development and innovation.

### **Reforms in the area of industrial innovativeness**

In the near term, the SR has to deal with the reform of the industry towards meeting its commitments to a climate-neutral economy. It is also necessary to change the concept of industry towards the fourth industrial revolution, in which industrial production is entering a period of digitalisation.

Slovak industrial enterprises are the main recipients of the changes brought about by these challenges, and the aim of these changes is to increase the efficiency of production and sales, increase competitiveness, implement digitisation and create innovative solutions.

### **Retraining and adaptation to the green economy**

Based on the findings of the Bruegel think-tank, a major challenge for labour policy in the transition to a low-carbon economy is the so-called polarisation of jobs.<sup>144</sup> The EC 2019 Annual Survey on Employment and Social Developments in Europe<sup>145</sup> points to a fundamental gap between the skills requirements for the "green" jobs of the new, low-carbon economy and the jobs of the current economy. The survey also points to possible solutions, e.g. in the form of retraining and training of employees in sectors with a green transformation focus.

The focus on training future employees and equipping them with green economy skills for better adaptability and employability is also indispensable.

It is also important to support and stimulate training in creative activities with a focus on entrepreneurial skills in order to increase the potential of human resources in the creation, dissemination and economic valorisation of creative activities. There is also a lack of research and development jobs in the Slovak automotive sector.

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<sup>144</sup> Bruegel (2020): *A Just Transition Fund – How the EU budget can best assist in the necessary transition from fossil fuels to sustainable energy* (str. 27). Available at: <https://www.bruegel.org/wp-content/uploads/2020/05/Bruegel-JTF-report-for-EP-BUDG2.pdf>

<sup>145</sup> European Commission (2019): *Annual survey on employment and social developments in Europe 2019 - Chapter 5: Towards a greener future* (p. 199). Available at: <https://ec.europa.eu/social/main.jsp?catId=738&langId=en&pubId=8219>

1 4.2. Set of measures

<b>1. Increasing the quality and availability of human resources in RDI throughout the innovation ecosystem in Slovakia</b>					
<b>Measure</b>	<b>Description</b>	<b>Target</b>	<b>Horizontal call</b>	<b>Responsibility</b>	<b>Time frame</b>
<b>Designing an effective system to anticipate the skills required by the labour market, using the skills assessment and anticipation tool thoughtfully and reinforcing the key competences as part of the curriculum for the economic transformation</b>	The education system needs to be linked to the requirements of the labour market. Adaptation to changes in skills requirements for job creation for a carbon neutral economy is also part of the measure. At the same time, it is essential to create incentives for retraining and reskilling of employees and jobs for the needs of the transformation of the economy. It is also essential to support and stimulate the education system in the field of creative activities with a focus on entrepreneurial skills in order to increase the potential of human resources in the creation, dissemination and economic exploitation of creative activities. In addition, it is necessary to purposefully increase the qualifications of experts in companies, including top managers, in the creation and use of innovative capacity of the company and strategic management, including taking risks related to adding activities in business development to the activities of companies in Slovakia.	1	Human resources and skills  Industrial transformation	MESRS SR, ME SR, MLSAF SR	Curriculum reform for secondary schools by 2025
<b>Introducing a set of measures aimed at preventing the departure and return of Slovak researchers from abroad</b>	The Government will evaluate the effectiveness of current initiatives and measures. There is also a need for allowances or cash grants to encourage educated individuals to return from abroad for both the public and private sectors. Discussions should take place during the next programming period on awarding additional points to applications for funding of projects that will ensure cooperation with Slovak researchers currently working abroad or achieve their long-term return to the territory of the Slovak Republic.	1	Human resources and skills	MESRS SR, MLSAF SR, MI SR	24 months
<b>Introducing a set of measures aimed at reducing the % of secondary and tertiary students leaving for neighbouring countries</b>	In addition to the return of Slovak researchers from abroad, the Slovak Republic must also ensure the adoption of measures to stimulate the continuation of talented secondary and university students to study at Slovak schools as a prevention against brain drain to neighbouring countries. The measures include the creation of a plan for systematic cooperation between expert lecturers from abroad and the determination of the intensity of such cooperation in the educational process and the attractiveness of educational institutions with high-quality technical and technological facilities for practical teaching. It will	1.7	Human resources and skills	MESRS SR, MLSAF SR, MI SR	24 months



	be necessary to identify the main motivating factors for dropout and propose measures to reflect them.				
<b>Introducing a set of measures aimed at the return of Slovak graduates of foreign universities</b>	A specific set of measures will be created for the return of Slovak graduates of foreign universities according to the needs of the Slovak market environment, taking into account their professional orientation, prerequisites for financial attractiveness and motivations associated with the long-term intention to stay in Slovakia.	1.5	Human resources and skills	MESRS SR, MLSAF SR, MI SR	24 months
<b>Introducing a set of measures aimed at attracting foreign students to Slovak universities and their subsequent employment</b>	The world's best universities benefit from the diversity of their students. Increasing the number of foreign students at Slovak universities could help improve their quality by stimulating the intellectual environment. Measures should be aimed at increasing the attractiveness and quality of higher education institutions in the educational process, making educational institutions more attractive with quality technical and technological facilities, and linking the socio-economic and social conditions that foreign students take into account when choosing a higher education institution. Measures must also be aimed at removing obstacles to arrival, residence and integration into society.	1	Human resources and skills	MESRS SR, MLSAF SR, MI SR	24 months
<b>Introducing a set of measures aimed at attracting foreign researchers to Slovakia</b>	The Slovak research ecosystem could be enriched with a foreign element by creating conditions and incentives for foreign experts to come and further develop their scientific careers to Slovakia. The development of the package of measures should be based on an analysis of the legislative framework for migration and with the help of statistical, sociological and economic approaches.	1	Human resources and skills	MESRS SR, MLSAF SR, MI SR	24 months
<b>Promoting cooperation in the educational process between educational institutions and the business sector</b>	In the Slovak Republic there is a lack of match between the skills offered and needed as well as between the RDI activities carried out by the academic sector and the requirements of the business environment. It is necessary to take these requirements into account in the development of study and teaching fields (secondary vocational schools) and study programmes (higher education institutions) and subjects, to expand the possibilities of education by new vocational courses that would be prepared and co-financed in cooperation with the private sector, to support dual education and practical training of pupils and students at the employer, and also to enable students to obtain methodological and professional support in the writing of final theses directly at business entities. At the same time, conditions will be created for top practitioners to have the opportunity to work at universities as associate professors or professors. The involvement of	1.1	Human resources and skills	MESRS SR and secondary vocational schools, higher education institutions and ME SR	From academic year 2022/23

	foreign professors and experts in teaching would have a positive effect on students as well as on the quality of the educational process. <sup>146</sup>				
<b>Increasing the students' interest in study programmes in areas with high labour market demand (e.g. ICT, STEM)</b>	As in many other countries, there is a lack of STEM and ICT professionals in Slovakia, and there is also a lack of a more operational form of introducing changes in the development of these curricula in schools (currently through accreditation). Matching supply and demand in higher education, i.e., attracting students into fields where skills are in high demand, can be supported through scholarship incentives. Optimisation of the structure of HEIs will be required, and at the same time, secondary school education in these fields will be supported to increase interest in continuing studies. In addition, it is also necessary to modify the educational process in primary and secondary schools in order to increase the interest of students in studying in these fields.	1.2	Human resources and skills	MESRS SR	2021-2027 with on-going review in 2024
<b>Proposing new professional multidisciplinary study and teaching courses for secondary vocational schools and study programmes for universities responding to global trends</b>	It is essential to shape study programmes as open, flexible systems and, especially in the technical sciences, to adapt their content to the development of global trends and to consult with top experts from practice. New interdisciplinary programmes should also emerge, linking several traditional disciplines, in which several faculties or higher education institutions could participate.	1.2	Human resources and skills	MESRS SR	24 months
<b>Designing new flexible forms and opportunities for further education</b>	The further education system needs to be linked to the needs of the labour market in order to respond flexibly to global trends and new challenges. It is necessary to support the design of further education programmes and courses to acquire, develop and adapt the workforce skills, their availability and relevance based on labour market demand, as well as to increase the motivation for further education.	1.9	Human resources and skills	MESRS SR, MLSAF SR, ME SR	Strategy of lifelong learning and counselling in 2022, legislation 2022-2023, activities horizon 2022-2027
<b>2. Improving the innovation performance and position of the Slovak Republic in international comparison</b>					
<b>Measure</b>	<b>Description</b>	<b>Target</b>	<b>Horizontal call</b>	<b>Responsibility</b>	<b>Time frame</b>
<b>Extending the system of innovation vouchers for the conditions of the Slovak RDI system</b>	By extending the voucher scheme, so that it matches a scheme in comparable countries, and by broadening its scope and funding volume, the SR can reach out to a wider variety of SMEs and increase the capacity for both immediate and long-term collaboration on	2.2	RDI funding	ME SR and SIEA	Expansion by the end of 2022

<sup>146</sup> This measure is in line with the expected effect of the new accreditation model of the MESRS SR under Act No. 269/2018 Coll. on Quality Assurance in Higher Education and on Amendment to Act No. 343/2015 Coll. on Public Procurement and on Amendment to Certain Acts, as amended... It is available at: <https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2018/269/>

	<p>research projects with the private sector and experts. For a detailed comparison of voucher schemes in the V4 countries, see the report on the current state (AS-IS report). Based on the AS-IS report, this instrument has great potential for the next period and should accumulate more funding, to a wider range of companies, and needs to be extended to other areas such as health, engineering, agriculture, ICT and to intensify support in the industrial sector. At the same time, other incentive options should be sought to support the Slovak RDI system, as the voucher scheme does not solve all the problems of the funding system and can only be considered as a tool with a significant impact in the short term and with a minimal administrative burden.</p>				
<b>Supporting the research and innovation activities in clusters</b>	<p>Clusters in Slovakia perform satisfactorily compared to the EU-13<sup>147</sup>. However, in order to create opportunities for internationalisation and exchange of best practices and to benefit from all available means of financial support, their position within the legislation needs to be anchored competently. The measure also proposes to develop a cluster development strategy that should link the performance of clusters to the operation and maintenance of innovation infrastructure, similar to the Ørestad Innovation City or the Milano Innovation District. There is a need to focus on existing successful clusters that will serve as models for future clusters and to develop their cooperation with each other at national and international level. The strategy should also include specific support for the development of the knowledge and skills needed to set up and successfully manage clusters.</p>	2.2	<p>Industrial transformation</p> <p>Internationalisation</p>	MIRDI SR, ME SR, GO SR	Legislation by 2Q 2022, strategy by 4Q 2022
<b>Developing a national funding model for the sustainability of research infrastructures and a set of key performance indicators (KPIs) for research infrastructure</b>	<p>A national funding model for the sustainability of research infrastructures is a prerequisite for the sustainability and long-term operation of this infrastructure. Currently, the functioning of research infrastructure is mainly financed by research projects and partly by private sources and does not cover the entire need for sustainability. Therefore, funds must be allocated at national level for the maintenance of this equipment in the next programming period, and a system must be set up to ensure the sustainable financing of this equipment in the long term, in particular through cooperation with the private sector. A set of KPIs will be used for their analytical assessment and evaluation in order to provide inputs for a substantive argumentation of the needs</p>	2.4	Infrastructure	MESRS SR, ME SR, higher education institutions, Research Infrastructure Council	24 months to prepare a new funding model, delivery in 2024 and 12 months from the first Council meeting to develop KPIs

<sup>147</sup> EU countries that joined the EU in 2004 (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia), 2007 (Bulgaria, Romania) and 2013 (Croatia) - referred to as EU13

	for further funding of research infrastructure. At the same time, as part of the measure, an inventory of infrastructure is needed, mapping current needs and actual use of research infrastructure. A system of periodic evaluation of the scientific performance of universities, public research institutions and, prospectively, private scientific institutions will also be used.				
<b>Supporting R&amp;D infrastructures and clinical research at healthcare providers</b>	It is essential to implement a solution that would allow hospitals to apply for financial support from the ESIF/EU Funds. Such a setup is a prerequisite for the possibility of implementing clinical R&D and a real link between R&D and clinical practice.	2.4	RDI funding	MIRRI, MF SR, MH SR, MESRS SR	2021 – 2027
<b>Establishing a functional Agricultural Knowledge and Innovation System (AKIS)</b>	Knowledge transfer, innovation and digitalisation are key elements of sustainability and competitiveness for primary producers in agriculture as well as food systems. In order to build a functional AKIS system, the operational groups of the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) need to be established and developed. The objective of the EIP-AGRI for Agricultural Productivity and Sustainability is to stimulate innovation and improve knowledge exchange. EIP-AGRI supports AKIS by linking policies and tools to accelerate innovation. Building on this, added value will be continuously created by better linking research and agricultural practice, while promoting a wider use of available innovation measures. At the same time, it will bring together innovation actors and projects, promote a faster and broader translation of innovative solutions into practice and inform the scientific community about the research needs of agricultural practice. The key components in the AKIS system are the following: 1. functional and high quality holistic advisory service 2. training system at all levels. The EIP-AGRI operational groups should create the potential for their involvement in the projects of the HE Framework Programme for Research and Innovation.	2	Cooperation	MARD SR, MESRS SR	2021 – 2027
<b>3. Enhancing the contribution of research to economic growth through the development of quality RDI</b>					
<b>Measure</b>	<b>Description</b>	<b>Target</b>	<b>Horizontal call</b>	<b>Responsibility</b>	<b>Time frame</b>
<b>Modifying the national funding system to include research quality as a clear criterion for funding</b>	The institutional and competitive funding system needs to be more focused on higher quality and excellence in research. The quality of research must be assessed comprehensively, in addition to the number	3.2	RDI funding	MESRS SR	1 to 2 years to complete initial consultation on

	<p>of publications, and it is necessary to monitor the impact and response to results, outputs applicable in practice, etc., as it is used in developed countries. Competitive funding should make more consistent use of established international evaluation principles and an international team of experts. Competitive funding needs to be structured, using projects for young researchers, multidisciplinary projects, projects for excellent researchers, etc. Performance-based institutional funding should include participation in EU or international RDI projects, which would stimulate research universities to actively participate in the Framework Programmes or other EU initiatives. A system of periodic evaluation of the scientific performance of universities, public research institutions and, prospectively, private scientific institutions will also be used. The quality profiles resulting from the periodic evaluation of scientific performance will be used to assess the excellence of scientific output. It is also necessary to address the issue of remuneration of researchers who, within universities or research institutions, are involved in European projects, in particular the EU Framework Programmes for Research and Innovation. The aim should be to set above-standard remuneration beyond normal personnel costs, so as to mitigate the difference in remuneration of researchers from different Member States in joint European consortia and to make the preparation and involvement in European projects more attractive for Slovak researchers.</p>				<p>metrics with stakeholders.</p>
<p><b>Assessing the effects of tax incentives on RDI, taking into account the needs of large enterprises, SMEs, micro-enterprises and individual entrepreneurs</b></p>	<p>The measure includes an analysis and evaluation of the effectiveness of indirect support instruments and the expansion of their possibilities in order to increase the share of private sector investment in RDI and the interest in spending funds in this area. It is also important to simplify and shorten the procedure for applying tax incentives to make them accessible and economically viable for SMEs and other entities, including micro-enterprises and sole traders. In addition, the assessment will pay particular attention to the possible need for a tool to promote innovation in line with the Industry 4.0 concept, for example in the form of faster depreciation of related assets. At the same time, it is necessary to assess the adaptation of tax incentives applied abroad as an example of good practice as well as to assess the application of examples of good practice in the field of indirect forms of support for</p>	<p>3.3</p>	<p>RDI funding</p>	<p>ME SR, GO SR</p>	<p>Beginning of 2022</p>

	RDI from neighbouring countries in the conditions of the Slovak Republic.				
<b>Establishing the mechanisms to increase the participation of Slovak researchers in the HE programme in order to strengthen cooperation in the areas supported by the smart specialisation strategy</b>	It is important for the competitiveness of Slovak science that Slovakia should be more involved in European RDI support programmes. It is recommended to create special programmes within SRDA designed to support the involvement of Slovak entities in the HE programme. Existing projects to support national focal points for HE, as well as the activities of the Slovak Liaison Office for Research and Development (SLORD) will be evaluated and, on the basis of the results, a system of measures will be proposed. It is also crucial to set up and secure funding and launch support measures to increase the participation of Slovak entities in HE from the ESIF and the state budget, such as co-financing the participation of the Slovak Republic in European Research and Innovation Partnerships, funding Seal of Excellence, short listed projects, or ensuring a permanent call for proposals from the SRDA to support the preparation of projects for HE throughout the implementation of the programme.	3.4	Internationalisation	MF SR, MESRS SR	4Q 2022
<b>Extending state support financial instruments and schemes to increase business interest in RDI</b>	The specific support framework should also be concentrated on support through direct and indirect financial instruments and tax incentives. Support using public resources is attractive for enterprises and provides incentives to initiate and carry out research and development projects. Examples of the use of financial instruments (beyond those already in use) include loan/credit, government guarantees for commercial credit, interest rate subsidies for commercial credit, project bonds, equity injection, cash pool or grants with contingent return. These instruments need to be adapted and extended across the business environment to support and increase interest in funding RDI activities. Financial support instruments should also include 'matching grant' schemes, which represent a balanced incentive instrument for the level of capital participation from private and public sources.	3.3	RDI funding	MF SR, GR SR	4Q 2022 Developing new tools

## 5. Priority areas for smart specialisation<sup>148</sup>

### 5.1. Baseline for defining priority areas

EDP, the selection of smart specialisation domains and their priority areas was methodologically correct in the previous RIS3 2014-2020 and produced valuable results in terms of methodology. However, a more detailed analysis revealed the fact that the individual domains did not sufficiently take into account the priority areas. Firstly, the identified domains contained many priority areas, leading to a number of identified developments. Such a large scope was contrary to the basic principle of RIS3 - focusing on specific priorities based on available capacities. Secondly, focusing on industries to narrow down the number of priority areas contradicts the second basic principle - RIS3 should not focus on supporting already existing structures (industries) but on transforming these industries and developing their capacities.

Unlike RIS3 2014-2020, where classification according to the codes of the Statistical Classification of Economic Activities in the EU (hereinafter only as "NACE") was considered as a prerequisite, in RIS3 2021+ the NACE classification does not necessarily imply that the entity will contribute to the desired change. In fact, it is often the other way around, entities outside the NACE classification can make a significant contribution to the required change and be its driving force.

For these reasons, there is no need to significantly modify individual domains in SK RIS3 2021+, but rather to focus on identifying the right priority areas and their transformation objectives, and also to focus on the available capacities that can be built upon. The SR will also support the participation of Slovak research and innovation teams in European R&D partnerships under the HE programme.

### 5.2. Global megatrends

The Covid-19 pandemic has influenced global developments and precipitated many systemic changes that were already evident before its emergence. Impact of the crisis has significantly affected development of many industries. The global economic recovery forecast for 2021 and 2022 is favourable, but the hallmark of a strong recovery will be inequality between countries and sectors of the economy. The most important global megatrends with negative impact on economic development of the SR are:

- advances in robotics and process automation, which, given the nature of the industrial sector, will result in the disappearance of many routine jobs and the creation of jobs for an especially skilled workforce,
- digital transformation,
- climate change and related challenges,
- unfavourable demographic developments associated with reduced birth rates,
- deteriorating health of the population due to long-standing negative factors and the negative consequences of the ongoing global pandemic, which, together with reduced immigration and

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<sup>148</sup> For each of the priority domain areas that have been defined by the EDP process, it is necessary to verify compliance with Regulation (EU) 2016/679 - Protection of natural persons with regard to the processing of personal data and the free movement of such data - when implementing activities that have an impact on the collection, processing and use of personal data. This assessment follows from point 11 of the List of processing operations subject to a Slovak Data Protection Impact Assessment as follows: 11. Processing operations using new or innovative technologies in conjunction with at least one criterion listed in the WP 248 Guidelines. Available at:

[https://dataprotection.gov.sk/uoou/sites/default/files/zoznam\\_spracovatelskych\\_operacii\\_ktore\\_podliehaju\\_posudeniu\\_vplyvu.pdf](https://dataprotection.gov.sk/uoou/sites/default/files/zoznam_spracovatelskych_operacii_ktore_podliehaju_posudeniu_vplyvu.pdf)



difficult labour mobility, as well as increased workforce skills demand, will be a challenge for the future labour market.

Given the structure, orientation and interconnectedness of the Slovak economy with developments in the EU member states, it will be crucial for the Slovak Republic to monitor and respond to the EU development trends. The main pillars of future development, as defined by the EC in its New Industrial Strategy, <sup>149</sup> will be to strengthen global leadership in the field of industrial production and to reinforce its strategic autonomy, digitalisation, increase competitiveness and achieve climate neutrality. The EU's ambition is to become the world's first climate-neutral continent by 2050, as defined in the European Green Convention, <sup>150</sup> which will require industrial transformation and modification of value chains.

### 5.3. Identified smart specialisation domains

The identification of smart specialisation domains and their priority areas for the new programming period 2021-2027 was the main objective of the workshop held on 16 July 2020. The organisation of the workshop was under the responsibility of SKS3 and the participants were coordinators and visionaries of the individual domains and representatives of the quadruple helix. As a result of the workshop, the following five domains of smart specialisation of the SR for the period 2021-2027 were identified:

**Domain 1:** Innovative industry for the 21st century

**Domain 2:** Mobility for the 21st century

**Domain 3:** Digital transformation of Slovakia

**Domain 4:** Healthy Society

**Domain 5:** Healthy food and environment

#### Domain 1: Innovative industry for the 21st century

The aim of the domain "Innovative Industry for the 21st Century" is to support the transformation of industrial production in the Slovak Republic into innovation-based production. The manufacturing-oriented nature of Slovak industry should be transformed into a manufacturing and development-oriented industry with a high share of own original innovations and research and development activities, which would significantly increase the added value of manufacturing and related services. This will ensure that the competitiveness of the industry on European and world markets is enhanced. Innovations should be original (not just adopted from other countries) so that the future position of Slovak producers and suppliers in the value chain is competitive and sustainable on a European scale. Measures will be more focused on supporting industry solutions in areas of public interest, such as in particular improving the quality of life of the population and the security of the functioning of the state in crisis situations. A transformed and innovation-oriented industry should create and sustain jobs with a high share of creative (intellectually satisfying) work in the long term, which should reduce the outflow of the best young people abroad.

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<sup>149</sup> European Commission (2020): Europe ready for the digital age-European Industrial Strategy. Available at: [https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy\\_sk](https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy_sk)

<sup>150</sup> European Commission (2019): Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. Available at: <https://eur-lex.europa.eu/legal-content/SK/TXT/PDF/?uri=CELEX:52019DC0640&from=SK>

In this domain, the following six priority areas have been identified: (1) Automation and robotisation of industrial production, Industry 4.0, ensuring resilience to external influences; (2) Processing of raw materials and semi-finished products into products with higher added value; (3) Progressive technologies and materials; (4) Increasing energy efficiency in the economy; (5) Efficient waste management; (6) Energy security of the Slovak Republic.

The EDP process to validate the identified priority areas and available research capacities has been ongoing since October 2020.

## **Domain 2: Mobility for the 21st century**

We understand mobility as a complex value chain linking transport with user-oriented industries and services, taking into account social aspects, needs and people's demands. Given the increase in complexity, the interconnectedness of sectors and the digital transformation, it is important to develop the domain within smart specialisation, which we understand as smart mobility. The concept of such smart mobility has a great potential to reduce or mitigate the impact of the consequences of cumulative social, economic and environmental problems related to transport and to contribute to a functioning transport system with a modern multimodal and safe transport infrastructure (increasing capacity congestion, environmental and social externalities).

Smart (new or future) mobility integrates innovative technologies, solutions and services from different sectors that will be transformative agents in both individual and public transport. It will deliver unique solutions that reflect the changing needs of passenger and freight transport, the evolving relationships to transport assets (intelligent products - automated transport vehicles), transport systems (intelligent services and intelligent data), including data from remote Earth observation<sup>151</sup> and satellite navigation systems, peer-to-peer (P2P)<sup>152</sup> sharing applications and assets such as physical and digital transport infrastructure (connected or smart cities and the Internet of Things).

The mobility value and production chain are dynamically evolving and undergoing major changes. RDI activities focus on the development of green ("clean"), safe, accessible and sustainable mobility based on the interoperability of a multimodal chain of interconnected intelligent transport systems.

Industry and services in the Slovak Republic have the opportunity to transform themselves to the production-development or development-supply level through the diversification of industry and developed production-technical capacities in the production of road, rail and small air transport vehicles, modern materials needed for their production, innovative logistics solutions and innovative multimodal mobility services. The sector needs to respond to current trends and improve its resilience to factors of increasing uncertainty.

The ambition of the SR is to support the creation of value-added jobs in sectors where it has the potential to grow, thus contributing to its position as a respected player in innovation in smart and new mobility, at least in Central Europe. Another ambition is to join the current activities of strong global players who are setting future trends and to prepare for the disruptive changes expected in the period 2030-2050. Foreign players should be naturally motivated to collaborate with the domestic ecosystem and order its products and services from this domain.

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<sup>151</sup> For example, the Copernicus programme is currently used for remote sensing of the Earth.

<sup>152</sup> The satellite navigation systems are Galileo and EGNOS.

SK RIS3 2021+ for this domain should respond to current issues in the Slovak Republic, to megatrends and to the activities of world leaders.

Needs related to current domain issues in the Slovak Republic include: legislation and regulation; physical and digital transport infrastructure; programme management of the smart specialisation agenda at both national and regional level; focusing support also on pilot and demonstration activities in cities and regions to streamline and decarbonise the operation of transport systems in different modes and across modes; and developing the country's competitiveness towards sustainable economic growth.

Globally, there is an intense sectoral cross-domain (cut-across/coupling) with digitalisation, energy, climate and environmental issues. We see this in the deepening trend towards electrification of drives, in the development of drives using alternative fuels, in the gradual emergence of functional prototypes and demonstrations of connected, automated and autonomous vehicles, in the use of artificial intelligence, MAAS, MoD, in the increase in the requirements for personalisation of the product portfolio of vehicle manufacturers, in smart industry (Advanced Manufacturing) or in the penetration of the Internet of Things (IoT) in all areas of RDI. Then there are the societal changes and needs brought about by growing urbanisation, public health and safety issues for travellers, and the possibilities of teleworking (work from home) on a large scale, including as a means of coping with the consequences of the Covid-19 pandemic. These trends naturally have an impact on the mobility ecosystem in the SR as well.

Within the domain, three priority areas have been agreed: (1) connected and autonomous mobility; (2) smart mobility services and intelligent transport systems; and (3) decarbonisation and sustainability of mobility. The EDP process has been launched. A national smart mobility project is being implemented, whose activities are aligned with the EDP for SK RIS3 2021+. The existing ecosystem of potential smart mobility actors has been mapped through a "road inventory survey".<sup>153</sup> Representatives from all sectors, including entrepreneurs, were contacted. In addition, a smart mobility platform is being prepared. It will bring together central government, universities and key private sector actors.<sup>154</sup> The EDP continues with further activities supporting the absorption capacity of the domain ecosystem.<sup>155</sup>

### **Domain 3: Digital transformation of Slovakia**

The SR supports the digital transformation of all areas of society in order to improve the quality of life of citizens, increase the competitiveness of industry and the economy as a whole, and ensure the efficient performance of public administration. The experience of countries where advanced digitalisation of the economy has taken place suggests that when companies innovate and digitise processes, they become successful. This is particularly true if they offer high added value services and products. At the same time, data is seen as a valuable resource and a tradable asset. If we want to build a data economy and make better use of data, it is essential to create the conditions for better decision-making based on analysis, while protecting citizens' personal data. Key areas of the data economy relevant for the SR are in particular the use of data from its own production processes and operations and the use of data providing feedback from customers. To seize these opportunities, the SR needs a skilled workforce with basic digital skills and professionals with advanced digital skills.

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<sup>153</sup> Improving public policies in the field of transport, innovation capacity in transport and supporting partnerships in the deployment of smart mobility | Operational Programme - Efficient Public Administration. Ministry of Investment, Regional Development and Informatization of the Slovak Republic. Available at: [www.mirri.gov.sk](http://www.mirri.gov.sk)

<sup>154</sup> Second validation workshop (2020-11-30)

<sup>155</sup> Further information is available in the EDP Summary Report 2021.

Activities in this area are in line with the 2030 Strategy for Digital Transformation of Slovakia, which responds to current challenges and their solutions using advanced technologies such as artificial intelligence, blockchain, 5G, high-performance computing, or quantum technologies.<sup>156</sup> The identified priority areas and, in particular, the implementation of R&D projects will contribute to exploiting the potential of the digital economy<sup>157</sup> and enable greater use of advanced technologies in industry, including small and medium-sized enterprises.<sup>158</sup>

Four priority areas have been identified within the “Digital Transformation of Slovakia” domain:

(1) Smart and connected sensors and devices; (2) Increasing the utility value of all types of data and databases; (3) smart energy systems; and (4) cybersecurity and cryptography. Key issues for the digital future include data access, processing, analysis, integration and presentation. Priority area 3-1 will contribute to the expansion of innovative ways of collecting data while reducing their cost and energy requirements. Priority area 3-2 is dedicated to maximising the potential of such data for the benefit of businesses, including SMEs, the public sector and for the benefit of research. Properly used, data have the potential to accelerate the transition to more efficient and greener energy mix and thus also support the EU's goal of becoming climate neutral by 2050, which is the main focus of Priority Area 3-3. Under priority area 3-4, the protection and correct processing of data is crucial to safeguard the EU's fundamental rights and freedoms while guaranteeing their high added value.

All priority areas will be able to make use of advanced technologies, which are effective tools to meet the objectives set. The identified priority areas in the Digital Transformation of Slovakia domain are directly linked to the reforms and investments from the RRP, in particular to component 17<sup>159</sup> Digital Slovakia, part of the digital economy. Through the RRP, investment projects will be implemented aimed at building the necessary infrastructure for the use of advanced technologies. Examples are the commissioning of the Aurel 2 supercomputer (OP II funding) and the construction of a new high-end supercomputer (RRP and DEP funding), which, once operational, will provide their computing capacity to both public and private development institutions for the implementation of research projects related to SK RIS3 2021+. This will enable projects to be carried out in relation to identified priority areas, for example in the area of big data processing, for which high performance computing capacity is required. Similarly, infrastructure will be built for other technologies, in particular quantum technologies, artificial intelligence and decentralised recording (blockchain) technologies. This will ensure the linking of the identified priorities in the field of digitalisation between the RRP (building infrastructure for advanced technologies) and the SK RIS3 2021+ and its follow-up in the OP SK (R&D projects with application of advanced technologies).

The EDP process to identify priority areas and available research capacities has been ongoing since the RIS3 Domain Refinement Workshop in July 2020. Subsequently, a number of consultations with socio-economic partners have been held, who have contributed to and agreed on the final form of the overall domain. Among the most active subjects were the IT Association of Slovakia, the Republican Union of

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<sup>156</sup> Office of the Deputy Prime Minister for Investment and Informatization (2019): *Strategy for Digital Transformation of Slovakia*. Available at: <https://www.mirri.gov.sk/wp-content/uploads/2019/06/Strategia-digitalnej-transformacie-Slovenska-2030.pdf>

<sup>157</sup> According to a McKinsey study entitled: “The Rise of Digital Challengers”, the potential of the digital economy in Slovakia is not fully exploited. The share of the digital economy in total GDP was 5.9 % in 2016, slightly below the EU average (6.5 %). Between 2012 and 2016, this share grew by only 0.7 p.p. per year, while the average growth in the five largest EU economies was 4 times higher.

<sup>158</sup> The digitalisation of SMEs lags behind the EU average. The use of cloud (14 % vs. 18 %) and big data analytics (9 % vs. 12 %) is lower than the EU average. Less than a fifth of SMEs report a high level of digitalisation of business processes. In the fourth dimension of the Digital Economy and Society Index (“The Digital Economy and Society Index”, DESI), Slovakia's ranking in 2020 has deteriorated compared to 2019, and Slovakia is only 21st in the EU.

<sup>159</sup> Ministry of Finance of the Slovak Republic (2021): *Recovery and resilience plan of the Slovak Republic-Component 17: Digital Slovakia*. Available at: <https://www.mfsr.sk/sk/verejnost/plan-obnovy-odolnosti/>

Employers, the 500 Club, the Association of Employers' Unions and Associations of the Slovak Republic, the University of Žilina, the Technical University Kosice, the Slovak University of Technology in Bratislava, and the Kempelen Institute of Intelligent Technologies.

#### **Domain 4: Healthy Society**

Health represents one of the most important human values to be addressed any society. We live in a time of globalisation, environmental change, industrial development, digitalisation, increased demands on a “healthy society”, which must respond adequately to these complex changes. The ambition of the domain transformation is also to highlight a fact that health and its aspects (including mental health) are also important and highly relevant for the development of sectors in other domains and, conversely, the promotion of certain specific areas within individual domains can directly or indirectly influence the health status of the population. The transformation of this domain is based on analyses of past and current perspectives on health. Increasing the health literacy of the population, education and training on health protection and promotion are also very important. It works with a vision of changing the view of health so that we can respond effectively to current and future demands in the prevention, diagnosis and treatment of major diseases and related aftercare in relation to the expected quality of life. In this way, it looks at the social, political and economic factors that influence: (i) population movements and behaviour (leading to the emergence of new diseases, especially infectious diseases); (ii) environmental changes; (iii) irrational population behaviour (e.g. excessive use of some forms of medication, such as (iv) an inadequate and inefficient healthcare system; (v) limited access to technological innovations and new trends in healthcare delivery (e.g. due to the high cost of these innovations); (vi) lack of systematic support for biomedical research; (vii) an ageing population, etc. A comprehensive scope allows to better respond to the challenges of a healthy society, to broaden thinking and to foster innovation in this field.

Within this domain, the following three priority areas have been identified: (1) personalised/precision medicine; (2) innovative products (including (bio)materials and biotechnologies), processes and procedures in healthcare; and (3) breakthrough technologies in healthcare. The identification of capacities within each priority area is ongoing.<sup>160</sup> In the context of capacity building in this domain, there is a need to strengthen training, “peer learning”, technology transfer, IPR awareness and to develop international collaboration. Transformation activities in all three priority areas also require amendments to national legislation.

#### **Domain 5: Healthy food and environment**

The aim of the “Healthy Food and Environment” domain is to create economically, environmentally, socially and epidemiologically resilient soil production systems in the Slovak Republic that provide resources and services to society and the environment in the long term. Soil production systems encompass a wide range of agricultural, forestry, biomass and associated industries (food and materials) as well as ecosystem services providing the conditions for healthy living, healthy and sustainable food systems and the environment.

A central requirement for achieving a sustainable and resilient food and soil production system is the full application of the One Health approach, since the health of people, animals, plants and their shared environment are inextricably linked. This holistic approach is being promoted internationally by the EU, FAO, WHO, OIE, UNEP to transform agri-food systems to be inclusive, efficient, resilient and sustainable.

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<sup>160</sup> Further information is available in the EDP Summary Report 2021.

It also serves as an approach to prevent pandemics, zoonoses and reflects the need to conserve biodiversity and natural resources as well as the importance of food safety.

This domain was chosen because of the importance of production from and on the soil. Soil and land-based resources, referred to as biomass, used for both food and non-food purposes, account for approximately one third of all materials extracted or produced in Slovakia. Agricultural land, forests and water cover more than 80 % of the territory of the Slovak Republic. These natural resources are crucial for healthy ecosystems and essential for the health and quality of life of people living in Slovakia. Healthy ecosystems are vital for human health, as they provide us with many goods and services, including food and water, regulation of natural hazards or recreation. The domain works with a vision to change the perception of biomass as a resource that must ensure the health and quality of land and landscape, food and non-food production, using innovations that take into account the principles of sustainable bioeconomy and circular economy.

In defining the priority areas of Domain 5, a key link with the research and innovation thrusts of Cluster 6 under the 9th EU Framework Programme for Research and Innovation of HE.<sup>161</sup>

This domain focuses on four main priority areas: (1) resilient and healthy local food systems; (2) biomass-based circular production systems; (3) society within the environment; (4) and sustainable natural resources (soil, water, air, biodiversity, ecosystems). The EDP focusing on capacity identification and initial transformation maps is still ongoing.<sup>162</sup>

### **Social innovation and a multidisciplinary approach**

In the context of the implementation of the domains, social innovations will also be promoted, providing new and more effective tools for tackling social challenges and engaging a wide range of actors in joint activities seeking complex solutions using new models of cooperation. The defined domains as well as the horizontal challenges create a broad space for testing, validating and measuring experimental solutions as well as creating conditions for systemic use of validated experimental solutions.

In addressing complex and multidisciplinary RDI projects in priority areas of individual domains and in order to maximise transformational effects, complementary RDI activities in relevant areas of social sciences and humanities will also be supported.

### **5.3.1. Priority areas of Domain 1: Innovative industry for the 21st century**

#### **Priority area 1-1: Automation and robotisation of industrial production, Industry 4.0, ensuring resilience to external influences**

The transformation objective of this priority area is the transformation of industrial production into production with a high degree of automation and robotisation in accordance with the principles of the Industry 4.0 concept (Industry 4.0). It should support the concept of smart factories in industrial production in Slovakia and create conditions for the introduction of hardware and software components for automation needs.

This area was chosen because today's industrial production is undergoing a transformational revolution associated with significant automation and robotisation of processes. This will enable a high degree of autonomous control in the future. Given the high share of Slovak industry in GDP, the introduction of

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<sup>161</sup> European Commission: *Horizon Europe. The next EU Research & Innovation Investment Programme (2021-2027)*. Available at: [https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe\\_en](https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en)

<sup>162</sup> Further information is available in the EDP Summary Report 2021.



the 4.0 concept will bring about an increase in added value and competitiveness and sustainable growth of the economy.

The high share of foreign firms in the total number of firms and their subcontractors operating on the Slovak market in several sectors (e.g. automotive production, electrical engineering, alternative energy sources, energy storage and transformation, etc.) and their subcontractors in Slovakia creates good preconditions for the arrival of innovative firms from these areas, if suitable conditions are created for them. Innovative industrial products in the field of automation and robotics will also find applications in sectors outside industry (healthcare, agriculture, transport), where development is also moving towards greater automation.

The high share of industry in GDP in key sectors (e.g. automotive manufacturing, electrical engineering, mechanical engineering, chemical, metallurgical industry, etc.) creates good conditions for the introduction of innovative solutions and products in the field of automation and robotisation. This will create conditions for the application of such solutions in other sectors of the economy (e.g. healthcare, agriculture, transport, etc.). In addition, the COVID-19 pandemic has highlighted the importance of building and developing the own production and R&D capacities of industrial enterprises in a critical situation where imports and exports are being disrupted. It has been shown that the Slovak Republic is not sufficiently prepared for such situations and would not be able to cope with this situation in the long term. It is therefore necessary to develop and implement protective mechanisms or alternative procedures to increase resilience to negative external influences.

### **Priority area 1-2: Processing of raw materials and semi-finished products into higher value-added products**

The transformation objective of the priority area is to increase the value added of exported raw materials and domestically produced semi-finished products by processing them into higher value-added products.

The SR has considerable potential in the valorisation of raw material currently exported in its raw state towards the export of processed raw material with added value. These are commodities such as timber, steel, aluminium, ore and non-ore raw materials (including so-called critical raw materials) and others. There is also an opportunity in promoting the finalisation of production. Raw material exports are highly dependent on foreign demand and stock market conditions, so exporters operate in a very volatile economic environment. It is often affected by global trade practices that exporters cannot control (e.g. cheap steel imports from China, dumping practices, etc.). Higher value-added production significantly eliminates this problem by increasing competitiveness, especially in cases where the value of the knowledge embedded in the product is essential.

The Slovak Republic is an open, manufacturing-oriented economy. The shift towards the development of products with higher added value supported by research and development will ensure a significant increase in the competitiveness of the Slovak economy. Given its own energy mix, the Slovak Republic is expected to have an electricity surplus in the future. If innovative solutions are introduced to rationalise and reduce energy needs, electricity may become an important export commodity. In this case, it would be appropriate to export products in which electricity is embedded instead of electricity, thus creating synergies with the use of domestic raw materials, which will result in higher added value.



### **Priority area 1-3: Advanced technologies and materials**

The transformational objective of the priority area “Advanced technologies and materials” is to enable research, development and deployment of innovative technologies and materials, delivering innovative solutions with a high positive impact on society in key areas.

The reason for choosing this priority area is that every company needs to promote innovative solutions - preferably original ones - with high added value in order to achieve long-term competitiveness and sustainability. The outcome of innovation projects must be in line with predefined qualitative and quantitative KPIs that have a demonstrably positive socio-economic impact.

Support for innovation will bring the necessary space not only in the field of industry, applied research and development, innovative start-ups, but also for creative young people who will not have to go abroad for interesting, intellectually satisfying work.

Supporting the introduction of technological innovation is a tool for companies to recover from the crisis, increase labour productivity and the quality of production, and deliver sustainable economic growth.

### **Priority area 1-4: Increasing energy efficiency in the economy**

The objective of this priority area is to achieve a substantial increase in energy efficiency by promoting the deployment of innovative solutions and, in case of waste energy, by researching, developing and deploying systems for its efficient storage, transmission and use, as well as the reduction of the total amount of waste energy produced.

Innovations in this priority area are essential for Slovakia, as Slovakia as a country with high energy intensity of industry has a great potential in the field of energy efficiency. Industry has the highest share of total energy consumption among all sectors.

Moreover, as an industrial country, the Slovak Republic produces a lot of surplus energy in various forms, which is not further used and is unnecessarily released into the environment. It is therefore necessary to promote solutions that either contribute to reducing the production of surplus energy or enable its further efficient use. It is estimated that the amount of unused energy in the form of waste heat is approximately twice as high as the heat needed to heat all buildings. Local installations of RES, may result in overall electricity surpluses, but also in increased instability of the transmission grid. Although the surpluses can be effectively used for increased production of energy-intensive products, the instability of the transmission system needs to be addressed by temporarily storing part of the surplus electricity and then using it in case of shortages, including matching it with the use of alternative energy carriers together with hydrogen in the decarbonisation of industry.

### **Priority area 1-5: Efficient waste management**

The achievement of the transformation objectives in this priority area will lead to a substantial reduction in the production of waste, waste products and pollutants from industrial activities. This will also create the technological capacity to, for example, remove existing environmental burdens and reduce the amount of municipal waste landfilled.

Transformation in this area is necessary because the high share of industry in the Slovak economy means a potentially increased share of related negative environmental impacts. At the same time, there are still gaps in environmental care in all areas of the socio-economic sphere. There is also insufficient

integration of environmental aspects in social, economic and individual decisions. Emissions of pollutants into the air, water, soil and lithosphere, the consequences of accidents, the increasing production of waste, the consumption of natural resources and increased land occupation are factors which have a significant negative impact on the state of the country's environment.

In addition to minimising the environmental impact of industrial production, it is equally important to look for opportunities for development and technological solutions in the industrial sector, e.g. solutions aimed at the treatment, recycling or alternative use of different types of waste and secondary raw materials. Compared to developed European countries, the Slovak Republic lags behind in the quality of sorting and the use of secondary raw materials from waste processing. Support for the introduction of new, innovative technologies of waste separation, recycling of secondary raw materials, or new alternative use of products will bring, in addition to reducing the negative environmental impacts caused by non-organic landfilling of waste, an opportunity in the form of a relevant export commodity of products with high added value, which has the potential of growing demand in countries transforming to a circular economy. Recently, the long-known issue of plastic materials with an emphasis on their ecological processing and biodegradability has come to the fore, which may provide an opportunity for research activities that are already being carried out in this area in Slovakia.

#### **Priority Area 1-6: Energy Security of the Slovak Republic**

The objective of the priority area is to transform the energy system of the Slovak Republic to increase energy security, competitiveness and environmental sustainability of the Slovak economy and to support research, development and implementation of innovative solutions in the field of energy security in industrial, local distribution systems.

The power system (hereafter referred to as the "PS") requires ensuring stability, quality of control and security at the level of the national PS in accordance with the new PS regulations (power system rules and regulations). With the required increase in the share of renewables and the creation of a single pan-European market, the demands on system management and maintaining a sufficient level of security of electricity supply are significantly higher. Under these conditions, it is essential to carry out research activities leading to new knowledge, optimal procedures and state-of-the-art IT tools enabling the analysis of steady-state and transient processes in the PS, the testing and implementation of new management approaches, new quality standards, as well as prototype equipment to ensure a balanced balance of generation and off-take in the PS.

Nuclear energy forms the basis of the energy system of the Slovak Republic. In the context of the EU energy system and the gradual increase in the share of renewable sources, research is required in the field of increasing the power flexibility of currently operated nuclear facilities. Furthermore, research is required on the possibilities for the use of spent nuclear fuel, the safe storage of spent nuclear fuel and the analysis of advanced nuclear fuel types. Involvement of Slovak organisations in the development of new types of nuclear facilities with hydrogen production potential is essential.

The implementation of smart grids, i.e., systems for efficient management of both energy consumption and supply in changing conditions of operation of energy systems, with the integration of RES into distribution systems and the involvement of active customers (active customers or prosumers) help to achieve this strategic goal in line with European energy policy and the strategic objectives of the Slovak Republic in the EU.

### 5.3.2. Domain 2 priority areas: Mobility for the 21st century

#### Priority area 2-1: Connected and autonomous mobility

The aim of the priority area transformation is to prepare conditions for the use of connected, automated and autonomous means of transport, thereby supporting the future development of related sectors. This involves preparing the ecosystem and conditions for testing connected, automated and autonomous solutions, preferably with zero or low emissions, in different transport modes in order to increase safety and efficiency. It also includes the preparation of conditions for the validation of connected, automated and autonomous technologies in terms of their behaviour in comparison with human-driven vehicles and their integration into the transport system. It further includes the securing of favourable socio-economic conditions, including the social acceptance of connected, automated and autonomous technologies.

Transformation in this priority area focuses on:

- Improving road safety,
- Reducing emissions and their harmful effects on the environment and related climate change,
- Increasing traffic flow and reducing congestion,
- Preparing society for the advent of automated means of transport and intelligent logistics,
- Preparing the education system for new professions.<sup>163</sup>

#### Priority area 2-2: Intelligent mobility and intelligent transport systems services

The objective of the priority area transformation is to ensure the widespread and accessible use of smart mobility services for the transport of people and goods. It includes the promotion of new services aimed at reducing negative environmental impacts, reducing deaths and serious injuries caused by transport, as well as the time spent transporting people and goods. A further objective is to improve, open and integrate the data and analytics space for open data as well as the interoperability of intelligent transport systems across all transport modes in an integrated mode, and to achieve better dynamic and efficient transport planning, operations and intelligent mobility programme management as well as intelligent logistics at different levels.

Innovations in this priority area seek to reduce the adverse environmental impacts of transport on the quality of life in cities, and to improve the safety and efficiency of the transport system (increased incidence and intensity of traffic congestion). Smart mobility solutions will be applied to environmental improvements and other areas of smart specialisation (i.e., Smart City, Smart Industry or Smart Energy). In addition, solutions that succeed in Slovakia can work elsewhere in Europe and worldwide, hence have high export potential.

Planning traffic flows and finding optimal modes of transport by combining different transport systems is a complex task that is addressed in all agglomerations; it has a significant social and environmental impact on society. The trend in information systems is to shift the emphasis from hardware to information software. The key problem no longer entails the collection of large amounts of data, but requires the comprehensive collection, processing and presentation of useful information and the identification of solutions in real time based on analysis of the data. The priority area of Intelligent Transport Systems and Urban Mobility provides an opportunity for the development of economic

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<sup>163</sup> Examples include: smart mobility operator, door2door scheduler, remote driver, etc.

platforms in one of the fastest-growing sectors, creating the potential for future further growth of platforms due to the accumulation of expertise.

### **Priority area 2-3: Decarbonisation and sustainable mobility**

The aim of the transformation of this priority area is to prepare the territory of the Slovak Republic for the large-scale deployment of alternatively-fuelled and energy-carrying means of transport in normal operation.

The production of transport vehicles contributes significantly to the wealth of the Slovak Republic GDP growth and involves an extensive network of subcontractors. The automotive industry accounts for the greatest part of Slovak exports. Slovakia needs to transform the production of transport equipment through the value chain to a higher level and to respond to current developments with its own innovations. This is important in order to maintain the competitiveness of a key sector. Innovation activities need to be directed towards the required alternatives for propulsion and energy carriers for propulsion,<sup>164</sup> or the creation and development of an efficient distribution and filling infrastructure, as well as research and development of materials for products and technologies applied in modern transport vehicles and systems.

In this context, it is important to accelerate the transformation of manufacturing enterprises in this domain into production-development enterprises and development-delivery enterprises. In addition, it is essential to prepare the domain ecosystem for the emergence of new mobility business models for sustainable development. To achieve the objective of this priority, it is necessary to strengthen RDI capacities focusing on alternative propulsion, decarbonisation of infrastructure, means of transport and material technology research. Innovation in this priority area is essential for achieving reductions in transport emissions through alternative propulsion.

### **5.3.3. Domain 3 priority areas: Digital transformation of Slovakia**

#### **Priority area 3-1: Smart and connected sensors and devices**

The aim of the transformation of this priority is to increase the ability of Slovak society and industry to make data-driven decisions, using statistical methods and machine-learning, from the level of the individual through automated workplaces in enterprises to the level of the critical infrastructure of the state, the environment and the urban infrastructure.

The reason behind selecting this priority is that sensor systems, cloud storage and processing, and intelligent autonomous devices, robotic workplaces and IoT-connected production lines are capable of processing large volumes of data and are key elements of the approach known as the digital twin of the physical system, which is an important area of development under the EU's directly managed Digital Europe Programme.<sup>165</sup> Intelligent systems embedded directly into production equipment and final products, as well as the Internet of Things, additionally promote a new way of developing the experience of Slovak industry in the field of electrical engineering and mechanical engineering, with an emphasis on high added value. Furthermore, there is a need for the public administration to urgently address the management of information on the state of the country's environmental components and technical infrastructure, as many information systems are either inadequate or non-existent.

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<sup>164</sup> For example, in particular electricity/batteries, hydrogen and bundled hydrogen, biofuels, CNG, LNG, biogas, biomethane, synthetic fuels, etc.

<sup>165</sup> European Commission (2021): *The Digital Europe Programme*. Available at: <https://digital-strategy.ec.europa.eu/en/activities/digital-programme>

### **Priority area 3-2: Enhancing the utility of all types of data and databases**

The objective of this priority area is to provide the public and businesses with advanced information tools for the processing of large databases, resulting in high-added-value solutions.

This priority was chosen because the presentation of digital copies of the “real world” using virtual and augmented reality tools is a rapidly developing sector in which Slovak start-ups and research institutions have good international potential. In addition, natural language processing, content-based retrieval and classification are key elements of all information processing. Businesses and other entities will be able to make both operational and strategic decisions based on well-crafted and clearly presented data analyses and predictions, which may include combinations of technical production data, audio and visual recordings, as well as economic data. This may include analytically processed unstructured data in the natural language, which may relate to, for example, market information, complaints or service records. The processing of documents in the Slovak language can become a method of knowledge transfer between languages and also a support tool for people with sensory disabilities. It can also be used to process digitised data collected during healthcare. Digital data can also be used for research and development, statistics and, in particular, for preventative diagnosis of diseases in order to render healthcare and personalised medicine more efficient.

This priority will also support the analysis, integration and presentation of data from large population databases such as social, demographic, economic and educational databases. There is also significant potential for development solutions based on big-data-processing in other sectors such as transport, agriculture, energy and engineering.

R&D activities in this priority area will make full use of the infrastructure of high-performance computing and artificial intelligence tools, the development of which will be supported through the Recovery and Resilience Plan. Particularly important in this area will be the investment in building a supercomputer, which will possess a competitive computing level within Europe and will enable a more extensive and efficient use of computation, as well as the utilisation of high-performance data analytics, artificial intelligence and machine-learning tools to Slovak users from both the public and private sectors. A prerequisite for the successful implementation of activities within this domain is to ensure compliance with Regulation (EU) 2016/679 - the protection of natural persons with regard to the processing of personal data and the free movement of such data.

### **Priority area 3-3: Intelligent energy systems**

The aim of the transformation priority area Smart Energy Systems is to accelerate the transformation of energy systems towards a more efficient and greener energy mix by creating tools for the operation of distribution systems and networks. These will serve a large number of producers and customers while maximising the reliability and efficiency of the operation and the effectiveness of the energy market, not only for electricity but also for gas, heating and water services. In particular, businesses will have the opportunity to improve the energy efficiency of their operations with the help of modern digital tools, while at the same time optimising their involvement in the energy market.

The reason behind selecting this priority is that energy as a sector is undergoing digitisation and decentralisation. This requires new tools to manage energy and billing systems and to exchange data between energy market participants in a standardised, flexible and non-duplicative way. The development of small producers (and also consumers, so-called prosumers) requires new business models and complex management systems from system operators in order to integrate the many small

consumption and production points into the system. Slovak research capacities in the field of intelligent energy systems have long been successfully cooperating with customers in application practice, which is a significant export opportunity.

#### **Priority area 3-4: Cybersecurity and cryptography**

The objective of the priority area Cyber Security and Cryptography is to build a secure information society that uses modern technologies and is able to defend against cyber-attacks and promote cyber hygiene. Businesses and other actors should have digital solutions in which security is an integral part of the solution, so that they do not have to deal with the protection of their data and networks, production continuity and protection against cyber-attacks by means of additional follow-up projects.

The development of this field in the domestic research environment is in the public interest. The priority is the information society, which faces a variety of risks both in terms of the technical security of information systems and the dissemination of information in the information space.

Moreover, increasing the resilience of ICT systems to attacks and increasing the resilience of society to the spread of disinformation are important tasks in maintaining essential services for the state and society as a whole. In order to succeed in this area, it is important to research and develop natural language-processing tools so that tools and methods can be adapted to the Slovak environment.

It is also needful to have a certified operating system with guaranteed security at national and EU levels to be used in critical infrastructure, but also in standard workplaces (possibility of certification at different classification levels).

Emphasis will be placed on the use of advanced technology infrastructure, the development of which will be supported under the Recovery and Resilience Plan. An example is the building of quantum communication infrastructure in Slovakia. The development of quantum technologies is an essential part of the secure communication infrastructure to create physically guaranteed authenticity of information transmission in both the terrestrial segment (via optical cables) and in the space segment (optical transmission to satellites). A further technological solution is the use of decentralised recording technologies, such as blockchain technology, to securely transfer data with the possibility of validation without the need for a third party, in line with Regulation 2016/679.

#### **5.3.4. Domain 4 priority areas: Healthy society**

##### **Priority area 4-1: Personalised/precision medicine**

The objective of the priority area "Personalised/Precision Medicine" is to build a sustainable eco-system with scalable capacities to support RDI in prevention, diagnosis, treatment (including biobanking - storing samples in biobanks with associated data). Advancing aftercare of patients with socially serious diseases, will ultimately improve the health status of Slovak population including mental health and quality of life. The individualised treatment approach has a high potential for streamlining clinical medical practice, reducing clinical trial error rates and reducing healthcare costs. The active interest and involvement of the population in RDI not only brings more sources of knowledge, but also provides the society with tools and opportunities to influence its own health. Public health activities represent an important aspect of population health protection as well.

Personalised/precision medicine, along with the current trend of big data, still reflects one of the "megatrends" in biomedical RDI. If the Slovak Republic has the ambition to contribute effectively to international efforts in this area, it must ensure compatibility of infrastructure and capacities, while also



building excellence on the basis of RDI knowledge with the highest innovation potential from previous or ongoing project activities, identified under national grants and EU funding schemes. In the context of sustainability, the Slovak Republic aims to strengthen and broaden its attractiveness in order to successfully keep pace with international competition and further increase the innovative and added value of the *life sciences* and medical sciences sector.

This priority area also represents a societal challenge in terms of the progressive integration of knowledge from both medical and non-medical fields, including biology, chemistry, humanities, social and environmental sciences. The Entrepreneurial Discovery Process (EDP) has identified low penetration of complex "omics" methods in the Slovak Republic, not only due to limited availability of infrastructure, but also due to insufficient analytical experience to interpret their outputs. Moreover, the acceptance rate of such methods by healthcare payers in clinical practice in the Slovak Republic is very low and their use is further reduced despite their undeniable advantages. The Slovak Republic has a number of research teams with a high potential working in this field, thus linking them could lead to more significant and comprehensive results and synergies. In addition, the new EDP also underlines a need to increase human resources, which reflects one of the key aspects of development and sustainability of biomedical RDI. This requirement has been confirmed by the EDP outputs, e.g. by healthcare providers or in public health, wherein certain positions are absent, particularly in the areas of biostatistics, bioinformatics and research administration.

These issues are also closely related to use of big data, which represents a key market-driver for healthcare applications in the future. Modern, rapidly developing and highly efficient technologies in the life sciences/medical sciences emerging, including. Next Generation Sequencing (NGS), digital pathology, Real World Evidence (RWE) data generation, etc. This approach, which is associated with technological advances in information and computer sciences, represents a significant opportunity for the Slovak Republic to draw on new knowledge from the generation of complex datasets. Data integration, virtualisation and modelling are also becoming an important part of biomedical research, especially in the field of personalised/precision medicine, which includes not only data from "omics" sciences, but also data on lifestyle, clinical or treatment outcomes. In this context, data protection and data security aspects must also be taken into account. As regards to health records, they should be seen as a special category of personal data as a matter of principle, and are thereby subject to specific ethical and legal provisions. The adoption of Regulation (EU) 2016/679 of the European Parliament and of the Council (EU) of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, to which of Directive 95/46/EC (General Data Protection Regulation) was repealed in May 2016,<sup>166</sup> harmonised across EU Member States the provisions on the protection of data, when used for research purposes. As of May 2018, they are also enshrined in the national legal framework. The planned concept for the use of big data will include solutions for storage and management of different data formats (genomic data, clinical research data, imaging data, etc.) using secure hardware and software systems in a synergistic way. Such an approach should include the standardisation and harmonisation of data, while taking into account the already existing as well as planned national platforms and research infrastructures with large volumes of data (National Infrastructure Programme of Slovak Biobanks, bioinformatics platforms, Next Generation Sequencing (NGS) platforms, etc.). In addition, the Slovak Republic must comply with international standards and certification protocols, including the settings of relevant European research infrastructures (e.g. ELIXIR,

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<sup>166</sup> European Commission (2019): *EU data protection rules*. Available at: [https://ec.europa.eu/info/law/law-topic/data-protection/eu-data-protection-rules\\_en](https://ec.europa.eu/info/law/law-topic/data-protection/eu-data-protection-rules_en)



BBMRI-ERIC, Euro-BioImaging), the implementation of which will also condition the opportunities for mutual cooperation in the international context.

#### **Priority area 4-2: Innovative products (including (bio)materials and biotechnologies), processes and procedures in healthcare**

The objective of the priority area Innovative products (including (bio) materials and biotechnologies); with major focus on processes and procedures in healthcare is primarily dependent on the effective introduction of (i) new healthcare products and processes into clinical practice and (ii) the improvement of existing products and processes used in clinical practice.

Despite its potential, the Slovak Republic scores on average lower on innovation than other EU Member States. Said Slovakia's position in the international rankings assessing countries' innovation performance (e.g. EIS or GII) is also due to the overall lack of awareness of intellectual property, which is reflected in weak protection of IP rights and insufficient transfer of technology into practice. As such, new materials (including biomaterials), biotechnology, healthcare technologies and medical innovations represent crucial innovative know-how that has enormous potential to become an important part of the knowledge economy.

In addition to the lack of systemic continuous support and low national funding, there is no clear link between RDI and clinical practice. The EDP confirmed that the problem of poor implementation of RDI results into clinical practice is also behind the long-standing inefficient and wasteful use of resources in healthcare. The healthcare system is outdated, the processes in this area are incorrectly set up or not addressed, and have not been subjected to innovation for a long time. The number of application outputs is low - mostly basic research and only partially pre-clinical research is supported, RDI based on direct demand from clinical practice is absent, and there is a persistent lack of systemic support for (academic) clinical research, including the implementation of a low number of academic clinical trials.

To meet this societal challenge, it is essential to enable the implementation of RDI projects and the production of new and innovative materials, including biomaterials, biotechnologies, sensors, medical technologies with a strong potential for exclusive rights. The planned projects will foster collaboration among relevant actors leading to the creation of innovative products and services.

In order to strengthen the position of the Slovak Republic as a place for innovation, it is essential to develop cooperative scientific and business activities and to effectively transfer knowledge from basic research into practice. According to the latest international trends, such an approach can also be supported by the establishment of a Technology Research Centre (TRC), a specialised incubation programme run by industry experts which would focus on cutting-edge innovations in the field of life sciences and breakthrough technology platforms. The main responsibilities of the TRC include identifying basic research results that have promising potential for the development of commercially viable innovative products (e.g. medtech, pharma, industrial biotechnology), validating them to industry standards, and initiating the initial phase of product development. The intention is to better bridge the gap in the transfer of basic research knowledge into practice in the field of life sciences (medical sciences), which is notoriously underfunded in the Slovak Republic, when compared with other EU Member States.<sup>167</sup>

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<sup>167</sup> Further information is available in the summary report of the EDP 2021 process.

### **Priority Area 4-3: Breakthrough technologies in healthcare**

The objective of the priority area “Breakthrough Technologies in Healthcare” is to support unique, frontier RDI in medicine and related sciences, in order to enhance the competitiveness of the Slovak Republic as an innovator on a global scale.

This priority area is conditioned by the fact that excellent ideas with great potential are often generated in the field of biomedical RDI. These types of innovative ideas are largely generated in the community of (young) scientists or students who lack sufficient experience in implementing innovations in practice. In the absence of systemic support, this innovation potential is diminished or even lost.

In biomedical RDI, it is essential to identify and strengthen emerging promising areas of research and capacity (especially young innovative researchers), which require a specific type of governance and management. Such an approach can be achieved through different modes of support, through bio-incubators and accelerators (e.g. BioHub Slovakia, TUKE, UVP Incubator, InQb, etc.), or TRC-type platforms that transform ideas and innovations into scalable products.

In addition to the aspects outlined in the previous priority areas, we have identified in the EDP a need for systematic and continuous support for new discoveries and inventions using the principles of scientific excellence. The Slovak Republic has the ambition to strengthen its competitiveness in breakthrough innovations and to provide a space for exploring new ideas, strategies with new directions, new knowledge and skills, including incentive support for the next generation of researchers. The Slovak Republic will reflect these goals by building a culture of objective, systemic and continuous reinforcement of scientific excellence into the Slovak healthcare and biomedical community.

## **5.3.5. Domain 5 priority areas: Healthy food and environment**

### **Priority Area 5-1: Resilient and healthy local food systems**

The transformation objective of this priority is to improve the resilience, safety, security and added value of local food systems ensuring healthy food. A key aspect is to strengthen and support the potential for equitable and environmentally sound local food systems.

This transformation is needed because the importance of epidemiological resilience in the production, transport, storage and marketing of food is heightened not only by the current disease situation of the COVID-19 pandemic, but also by the African swine fever epidemic or other epidemiological risks. The safety of the entire food chain, ensuring the health of both animal and plant food producers, as well as healthy nutrition are everyday problems that require innovative solutions. In addition, local food systems are a key factor in mitigating the impact of climate change, the fair distribution of the value produced and the sustainability of food systems.

The legacy of several phases of major structural changes in the Slovak agri-food sector from the past still impedes the development of innovative and local food chains that are environmentally friendly, adaptable to climate change and economic volatility. The Slovak Republic is expected to continue to make a significant shift in consumer preferences in the food sector, in line with developments in other EU countries. Although the Slovak Republic has some major players in the field of innovative food systems, much greater interaction with the research and innovation ecosystem is needed.

This priority area is affected by several megatrends, underlining its importance and the need to mobilise and support innovative actors capable of responding to these megatrends.

### **Priority area 5-2: Circular production systems based on biomass**

The objective of the priority area Biomass-based Circular Production Systems is to promote innovation and ensure the long-term sustainability of biomass-based production systems.

Biomass-based circulating solutions have the potential to reduce Slovakia's dependence on non-renewable resources. Sustainable biomass-based production systems are a key factor in the implementation of a sustainable bioeconomy. In addition, innovations in biomass-processing systems and biomass-based solutions have the potential to support the local economy and improve the quality of life in rural areas.

An important aspect is to improve the position of primary producers in the value chain by enabling the sustainable production of products with higher added value. Innovation by the Slovak Republic in the field of circular and sustainable use of biomass is currently insufficient. Quite a substantial part of biomass in the form of primary production such as logs or feed is exported to other countries.

The sustainability of biomass for energy production is a major challenge for the future. Major processing technologies are imported as off-the-shelf systems, leaving the potential of the Slovak research and innovation ecosystem untapped.

### **Priority area 5-3: Society in the environment**

The objective of the priority area Society in the environment is to promote innovative, knowledge-based land management and a transformation towards agro-ecological land management.

The increasing pressure of human lifestyles on the environment and intensified land-use calls for innovative solutions to ensure the long-term sustainable provision of ecosystem services. New technologies enable us to make better decisions based on large amounts of environmental information and data. The green economy is a response to the various crises the world has faced in recent years, with an alternative paradigm offering the promise of economic growth while protecting the Earth's ecosystems.

The transformation to knowledge-based land-use management should enable the creation of added value based on the huge amount of data generated from environmental observations by the use of new technologies. The transformation process should ensure the emergence of innovative products and services that capitalise on the added value created.

Facilitating the adoption of innovative solutions that ensure the long-term sustainability of land-use is an essential step towards a successful transformation. This can include the creation of living laboratories where collaborative research and innovation take place directly in the production environment. Given the geographical heterogeneity of the Slovak Republic, any sustainable innovation in the primary production system must reflect specific local conditions. Building green infrastructures, implementing agroecology principles or managing forests in a way that is close to nature may require exploring innovations in living labs before they can be deployed on a larger scale. Various research infrastructures for long-term research on ecosystems and production systems have operated in different geographical locations in the country for decades and represent an excellent basis for building future living laboratories.

#### **Priority area 5-4: Sustainable use of natural resources (soil, water, air, biodiversity, ecosystem)**

Ensuring the quality, safety and sustainability of natural resources, including biodiversity and ecosystems, is the transformation objective of this priority. Increasing human lifestyle pressures and intensified land-use require innovations to mitigate and adapt to climate change and reverse the deterioration of natural resources. On the other hand, human activity is often confronted with natural phenomena that have a significant impact on, for example, infrastructure. Our daily lives are confronted with the need to secure a range of quality water resources, which are crucial for the sustainability of human activities and the environment.

It is vital to develop a range of complementary innovations to improve the resilience of human societies as well as ecosystems to the impacts of climate change and the different types of risks that arise from human interaction with nature and from the unsustainable use of natural resources. The Slovak Republic does not currently adequately support the creation of new risk-mitigation instruments. We lack innovative solutions to protect, restore and manage biodiversity within the context of climate change impacts. This also applies to the sustainability of genetic resources within production systems, where we are confronted with invasive non-native species and the resilience of the genetic resources used is questionable. Solutions based on local genetic resources and complemented by the biologisation of the production process can offer a sustainable solution adapted to local conditions in the future. During the transformation process, stakeholders can develop new products using innovative methods for pollution detection, prevention and remediation or innovative soil management methods.

#### **5.4 The process of continuous entrepreneurial discovery**

An integral part of the SK RI3 2021+ is **the EDP Summary Report**, which aims to summarise the progress of the EDP for each domain, the rationale for the selection of the domains, a detailed description of the process of defining the priority areas, a description of the transformation objectives and the transformation maps, including the identification of available research capacities and potential users.

The EDP Summary Report defines the specific actions for the priority areas, the methodology for their selection and updating, as well as general measures to ensure their implementation. The EDP Summary Report is to be regarded as a living document which will be updated at regular 1-2 yearly intervals on the basis of the available data and the results achieved in the previous period.

The transformation maps presented in the EDP Summary Report are also seen as a dynamic concept that will be continuously updated on the course to transformation. The updating process also includes the business activity and its possible failures and setbacks in any of the routes taken towards transformation.

SK RIS3 2021+ will define, through the EDP Process Summary Report, the framework conditions for a continuous discovery process and the mechanisms for identifying and funding complementary projects within the Transformation Maps throughout the strategy period.

To enable continuous EDP, the availability of information is seen as a prerequisite from the monitoring and evaluation of the projects already implemented and their contribution to the transformation. The monitoring system is an integral part of continuous EDP.

In terms of timing, the continuity of the EDP will be ensured by continuous monitoring of the calls for projects, monitoring of the economic development of the Slovak Republic, etc.; based on the data obtained, there will be a regular review of progress at 1–2-year intervals, evaluation of the contribution

of projects to the transformation, identification of gaps and identification of new projects for the transformation roadmap, in accordance with the EDP methodology.

**Figure 6: Continuity of the EDP process**



*Source: output of the project „Podpora transformácie hospodárstva SR zvýšením jeho inováčnej výkonnosti“ (Supporting the transformation of the Slovak economy by increasing its innovative performance) – internally prepared<sup>168</sup>*

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<sup>168</sup> Ministry of Investment, Regional Development and Informatization of the Slovak Republic (2021): *output of the project “Podpora transformácie hospodárstva SR zvýšením jeho inováčnej výkonnosti”*, on the basis of which MIRRI SR prepared the final version of SK RIS3 2021+. Available at: <https://www.mirri.gov.sk/sekcie/investicie/strategia-vyskumu-a-inovacii-pre-inteligentnu-specializaciu-sr/aktualizacia-ris3/>

## Conclusion

SK RIS3 2021+ represents a comprehensive strategic document for the development of the research and innovation ecosystem of the Slovak Republic. The economic characteristics of the country, regional specificities, current global trends and societal challenges, as well as the experience gained from previous programming periods, were taken into account in its development. The analytical phase preceding the development of the document identified key strengths, weaknesses, opportunities and threats. The key horizontal challenges that need to be addressed in order to develop the RDI ecosystem of the Slovak Republic were identified. Based on these inputs, and also based on global trends and the unique situation of the Slovak Republic, the vision of this strategy was developed, which was further developed through strategic milestones that the Slovak Republic will strive for and against which it will monitor progress in the field of RDI. The attainment of these milestones will be secured through a set of measures that respond simultaneously to the horizontal challenges.

A strategy is only as good as its implementation. It has also proved to be a weak point in the past due to the lack of conceptualisation of the RDI management system. Accordingly, a fundamental reform of the state's management of RDI policies and organisations is a prerequisite for the development of RDI in the Slovak Republic. In this respect, the RIS3 2021+ SK follows the RRP, within which specific starting points for anchoring the new RDI management system were approved. This reform will be supported through a set of systemic and legislative measures.

The Research and Innovation Smart Specialisation Strategy (RIS3) concept already bears the concept of specialisation in its name. For a small country such as Slovakia, it is particularly important to allocate scarce resources to those areas of RDI where the innovation potential of market demand is most likely and the available capacities in terms of research teams, institutions and infrastructure. An essential part of the development of SK RIS3 2021+ and its implementation is a continuous process of business discovery which, in collaboration with a wide range of partners, has enabled the identification of the main domains of specialisation and their priority areas. Transformation in the domains of specialisation will be achieved through well-defined and efficiently implemented projects that will ultimately enable the fulfilment of the strategic objectives of SK RIS3 2021+.

The drawing-up of this document reflects only the beginning of the process of economic transformation of the Slovak Republic. The strategy will be immediately followed by the publication of the EDP Summary Report, which will summarise the information on the workshops held for each domain, present the reasons for the selection of priority areas in greater detail and, in particular, identify the themes of the transformation projects from which specific challenges will later be derived. Furthermore, an Action Plan for the implementation of RIS3 2021+ will be developed, which will propose a sequence of steps for the implementation of the RIS3 2021+ objectives. It will include a more closely specified governance model, a proposal for a detailed monitoring and evaluation system, a proposal for a communications strategy, as well as a set of horizontal measures defined in detail.

However, the publication of all the above documents is only a necessary first step. Only by the steady implementation of all the proposed horizontal and systemic measures, the implementation of the RDI governance reform, the implementation of a number of domain projects and the ongoing EDP, will the RDI ecosystem really move forward in the Slovak Republic. These activities are starting now and will be ongoing throughout the next programming period 2021-2027. Their effective execution and interconnectedness are necessary preconditions for the next Smart Specialisation Strategy to build on a much stronger foundation than the current SK RIS3 2021+.

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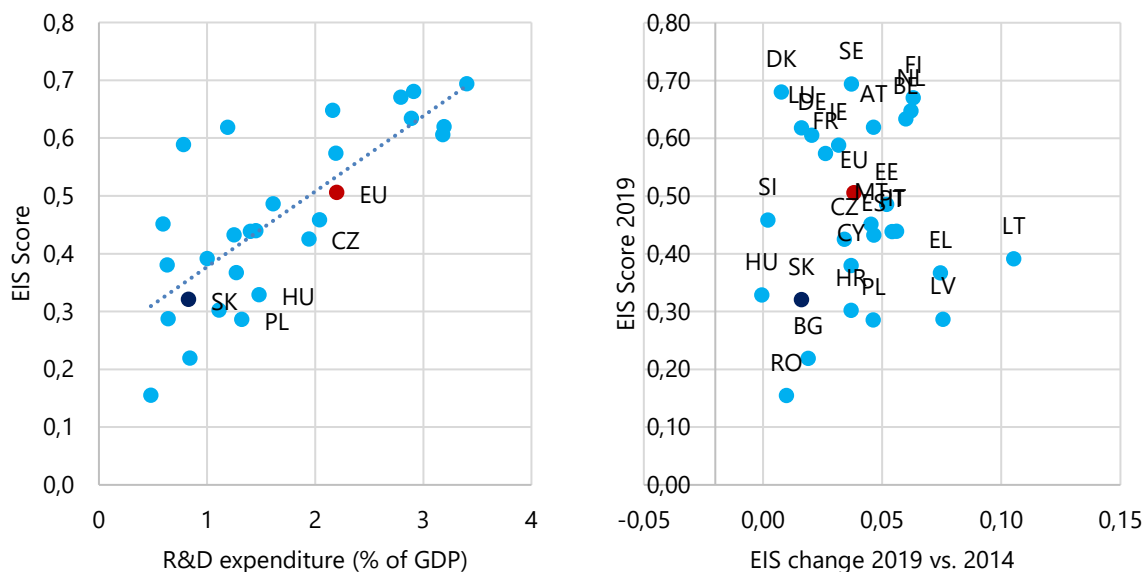
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## Annex 1 Research, development and innovation potential of the SR in figures

The Slovak Republic spends only 0.83 % of GDP on science and research (2019 statistics), performing worse than expected. The inefficient use of funding for science and research may be related to the fragmented system supporting it and the low level of coordination of the different actors, which is why even relatively limited resources are allocated inefficiently.

- Science and research expenditure and results (European Innovation Scoreboard 2019), evolution of the EIS 2019 score compared to 2014 (right graph)

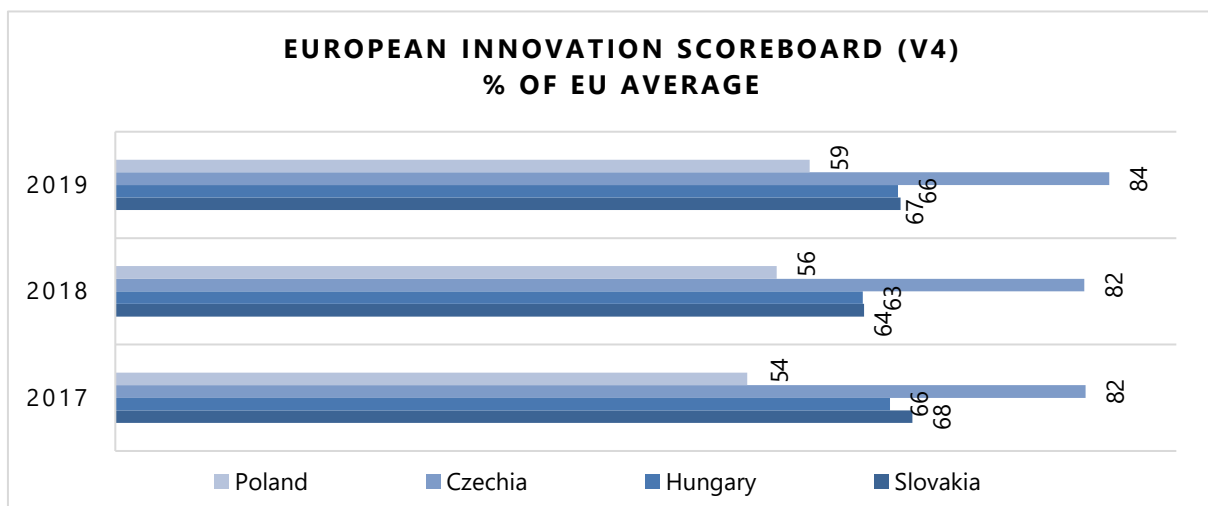


Source: compiled from EIS and Eurostat data

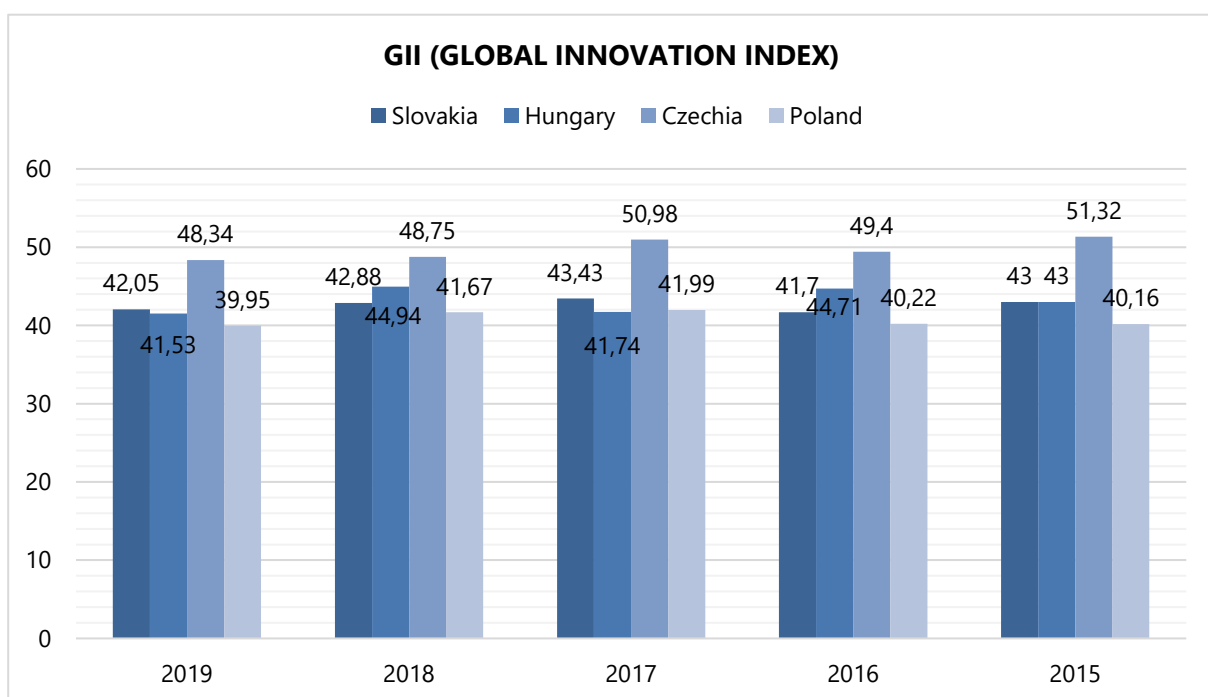
In the EIS evaluation of science and research, the Slovak Republic is rated significantly below the EU average, while at the same time the top and the European average are far apart. European Innovation Scoreboard scores increased between 2014 and 2019, but the EU average grew at twice the rate.

In the overall V4 ranking, Slovakia is ranked 2nd, behind the Czech Republic. Within the V4 countries, the SR lags behind mainly in the attractiveness of the research ecosystem (the evaluation assesses international collaboration on publications, citation rates and foreign PhD students), financial support (the evaluation assesses the level of public sector R&D spending, venture capital spending, government support for corporate R&D), business investment (business R&D expenditure, non-R&D innovation expenditure, innovation expenditure per employee are assessed) and IPR protection (PCT patent applications, trademark applications and design applications are assessed).

By contrast, human resources (doctorate graduates, population aged 25-34 with completed tertiary education, population aged 25-64 involved in education and training (further education)) and the impact of innovations on sales (this includes exports of medium and high technology goods, exports of knowledge-based services, sales of innovative products) can be considered as the strengths of the Slovak Republic in comparison with the V4 countries.



Source: compiled from European Innovation Scoreboard data

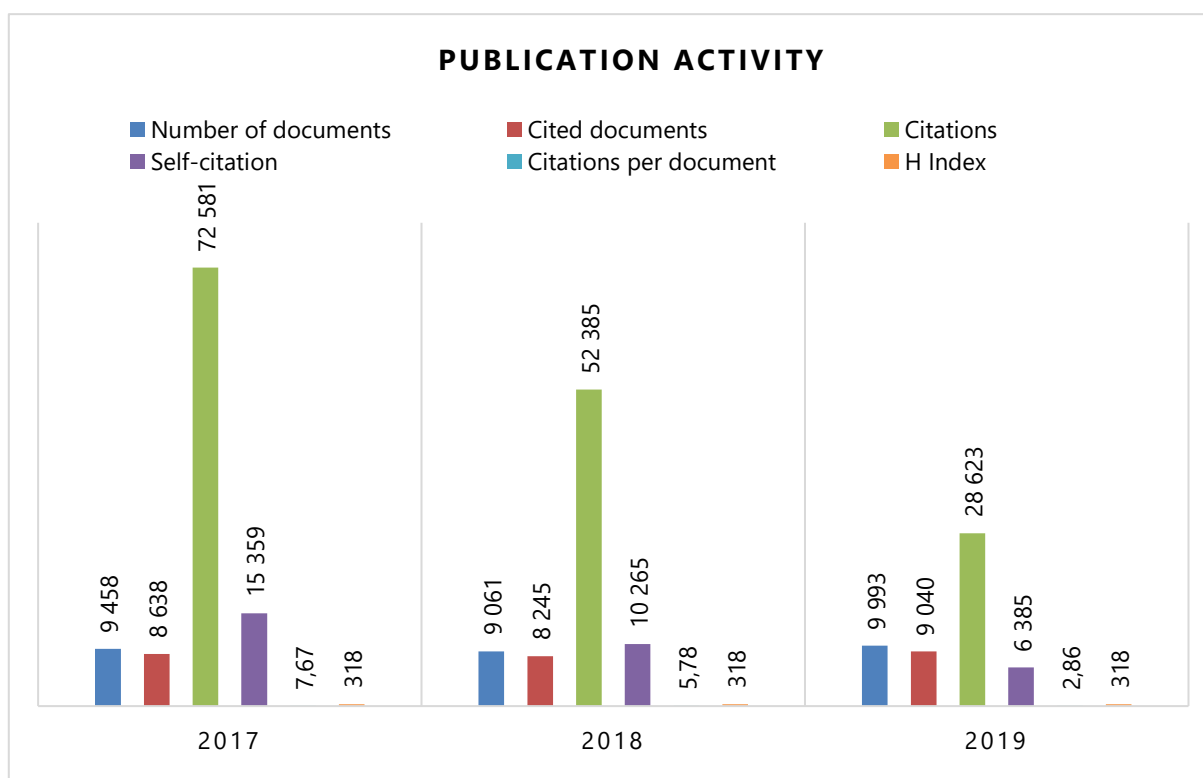


Source: compiled from Global Innovation Index data

From the analysis of international comparison within the V4 countries, Slovakia lags behind in the GII ranking in the area of institutions (the assessment assesses the political environment-political and operational stability, government effectiveness; regulatory environment-regulatory quality, rules of law, cost of redundancies; business environment - ease of starting a business, ease of resolving insolvency) a further negative area compared to the V4 countries is the assessment of human capital and research (this includes education - expenditure on education, government funding per secondary school pupil, life expectancy in school (primary to tertiary education), scores in reading, mathematics and science, pupil-teacher ratio in secondary schools; tertiary education - number of tertiary enrolments, science and engineering graduates, tertiary international mobility (inbound); research and development - number of full-time researchers (per million inhabitants), gross expenditure on research and development (GERD), average expenditure of global research companies active in the field of R&D (top 3), QS scores (world ranking) of top 3 universities.

On the other hand, infrastructure (ICT access (5 indicators), ICT use (3 indicators), government online services, e-sharing (information, consultation, decision-making) can be considered as strengths within the V4 countries; general infrastructure-electrical capacity per capita, logistics performance index LPI), gross capital formation; environmental sustainability-GDP per unit of energy consumption, environmental performance index, environmental management systems in place according to ISO 14 000 international standards (number of certificates issued).

- Publication activity of the Slovak Republic



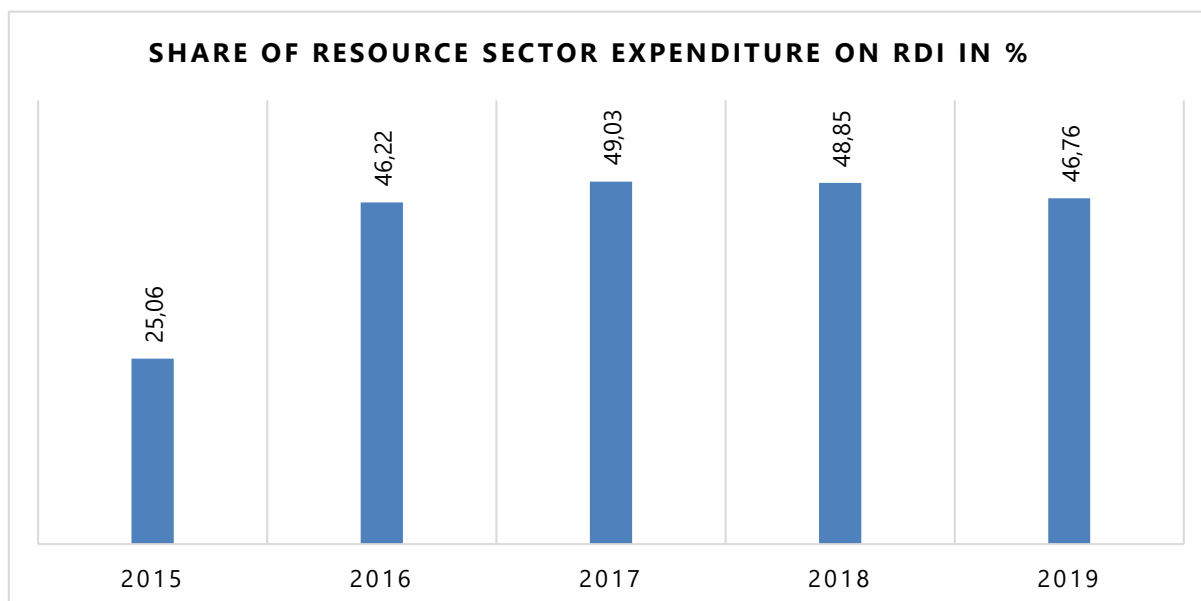
Source: compiled from Scimago Journal & Country Rank data

In terms of publications, the Slovak Republic especially lags behind in the area of total citations and citations per document. On the other hand, the total number of papers published in peer-reviewed journals is consistent and relatively high.

- Public-private R&D expenditure ratio in EUR

Year	2015	2016	2017	2018	2019
Total RDI expenditure from business sources	232 349 000	296 210 000	367 221 000	366 814 000	363 102 000
RDI expenditure from private non-profit organisations	2 940 000	902 000	1 301 000	1 889 000	2 262 000
Total RDI expenditure in EUR	927 272 000	640 835 000	748 955 000	750 947 000	776 590 000

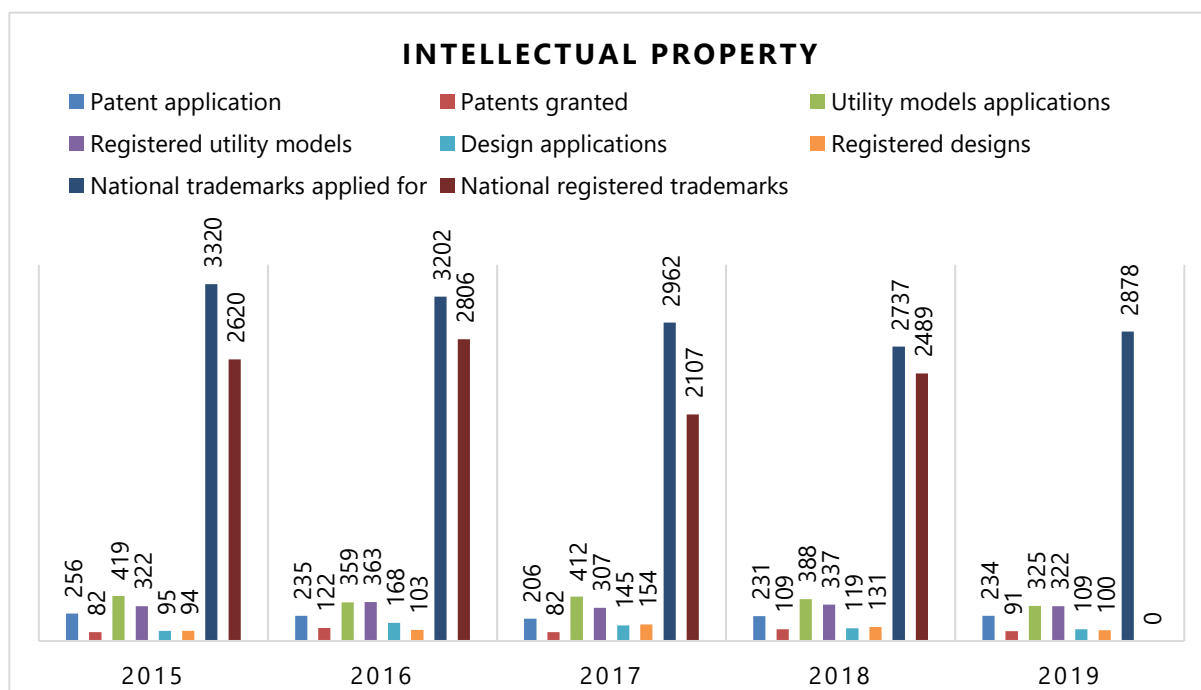
Source: compiled from data of the Statistical Office of the Slovak Republic



Source: compiled from data of the Statistical Office of the Slovak Republic

In terms of the public-private RDI expenditure ratio, the current situation is underpinned by a lack of public funding for RDI. On the positive side, the share of private sector spending in total RDI expenditure is approaching 50 % and it is essential to support this trend with appropriate instruments to achieve the target of a 3:2 private-public spending ratio by 2027.

- Use of intellectual property protection systems



Source: compiled from data of the Industrial Property Office

In the area of protection of intellectual property rights, the Slovak Republic ranks last in international comparisons, with the exception of trademarks, where Hungary ranks worse. Only 91 patents were granted in the Slovak Republic in 2019, compared to 525 patents (5.6 times more than the Slovak

Republic) and 1080 utility models (3.35 times more than the Slovak Republic) in the neighbouring Czech Republic. The main shortcoming of the Slovak Republic in the field of intellectual property rights is lack of knowledge of the importance of protecting intellectual property rights and their commercial exploitation, as well as the administrative and financial complexity of the processes. The current set-up for the disclosure of sensitive information in connection with applications for NFA (non-reimbursable financial contribution) is also a negative.

- Analysis of positive and negative changes in the core areas of the EIS evaluation

Year	Human Resources	Attractiveness of the Research System	A Favourable Environment for Innovation	Funding and Support	Corporate Investments	Use of information technology	Innovators	Cooperation	Intellectual Property	Impact on employment	Impact on Sales	Environmental Sustainability	Aggregate Innovation Index
2021 <sup>169</sup>	74.9	56.5	81.2	25.5	48.2	83.8	27.2	49.1	48.3	46.2	90.5	110.4	63.1

Year	Human Resources	Attractiveness of the Research System	A Favourable Environment for Innovation	Funding and Support	Corporate Investments	Innovators	Cooperation	Intellectual Property	Impact on Employment	Impact on Sales	Aggregate Innovation Index
2020	81.9	49.4	50.2	24.5	63.7	41.7	61.2	42.7	130.3	114.8	66.6
2019	70.4	41.5	57.5	23.8	66.9	41.7	57.9	39.8	108.5	111.2	63.5
2018	92.6	57.4	79.3	29.7	63.7	29.2	68.7	35.6	119.2	105.4	67.6
2017	96.5	52.5	70.4	72.4	69.4	28.6	62.4	38.6	111.8	105.6	70
Year	Human Resources	An Open, Excellent Research System		Funding and Support	Corporate Investments	Innovators	Cooperation	Intellectual Property	Economic Effects		67
2016	112	36		52	63	79	44	43	86		
2015	113	31		61	63	74	42	43	81		64

Source: compiled from European Innovation Scoreboard data

- Analysis of positive and negative changes in the core areas of the GII evaluation

Year	Institutions	Human Capital and Research	Infrastructure	Market Sophistication	Business Sophistication	Knowledge and Technology Outputs	Creative Outputs	Global Innovation Index
2021	72.8	32.8	50.5	44.9	32.5	34.3	33.0	40.2
2020	72	31.2	52.5	45.3	31.7	34.4	31.3	39.7
2019	73.1	32.4	54.2	47.4	35.6	34	37.1	42.05
2018	74	31.9	53.3	48.9	38.5	34.7	38.1	42.88
2017	74.5	34.4	55.3	45.8	38.3	33.5	40.8	43.43
2016	75	32.8	53.3	44.2	34.5	32.3	38.6	41.7
2015	75.1	33.2	49.3	50.4	36.7	33.7	40.4	43

Source: compiled from Global Innovation Index data

<sup>169</sup> In 2017 and 2021, the European innovation scoreboard expanded the assessment with new domains (in 2017, the domain Enabling environment for innovation was added, the domain Economic effects was split into two separate domains, namely, Employment Impact and Sales Impact, in 2021 the EIS assessment was expanded to include the domains Use of information technology and Environmental sustainability) and related indicators for the assessment. This change may also have had an impact on more significant changes in the position of the Slovak Republic in international comparisons of innovation performance.