Governance, financing, monitoring and evaluation of Smart Specialization

Analysis and guidelines from EU Danube region countries

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Contents

Abbreviations used in the report:

CZK – Czech koruna
EDP – entrepreneurial discovery process
ERC – European Research Council
ESIF – European structural and investment funds
EU – European Union
GDP – Gross domestic product
GODEA – Government Office for Development and European Affairs
ICT – information and communication technologies
PhD – postgraduate doctoral degree
R&D – research and development (related to measures, programmes, etc.)
R&I – research and innovation (related to policy, strategy, etc.)
S3 – Smart specialization strategy
SME – Small and medium-sized enterprises
TRL – technology readiness level

INTRODUCTION

Smart Specialization strategies (S3), introduced back in 2012 and formally adopted in 2014 as a new way of designing research and innovation strategies is nothing new to European continent, regardless of region, membership of European Union or any other geographical or political factors. The S3 became the new common language of innovation, spark for new partnerships, a tool for better stakeholder engagements and a way of more concentrated investments. The specializing in smart way, spreading of the good practices and delivering better economical results will continue in the new 2020-2027 programming period of the European Union (EU). The success and acceptance of this concept can already be seen in mid-term evaluations, but overall economic transformational effects are still early to be observed. Generally, S3 has become the best try so far to unify the concept research and innovation (R&I) priorities in the EU and beyond. A lot of decision makers and stakeholders from academia and business adopted similar understanding of the concept and similar vocabulary to describe preferences and taken actions. It also is the strong leverage to change the culture of the R&I policy making. As it came with strong analytical homework necessity and higher level of justification of decisions, it will have long-lasting effects on the evidence based policy making as well. S3 has initiated analytical approach to R&I policy cycle and a swarm of practice sharing projects, analytical tools, best practices and etc. S3 comes with higher transparency and accountability, interactive monitoring systems, constant sharing of good practices and solutions. The recent study[1] revealed that S3 has increased stakeholder engagement, prioritization process and concentration of resources. The S3 approach has encouraged many regions beyond EU borders to seek for a better R&I policies and better concentration of resources and Danube region is no exception.

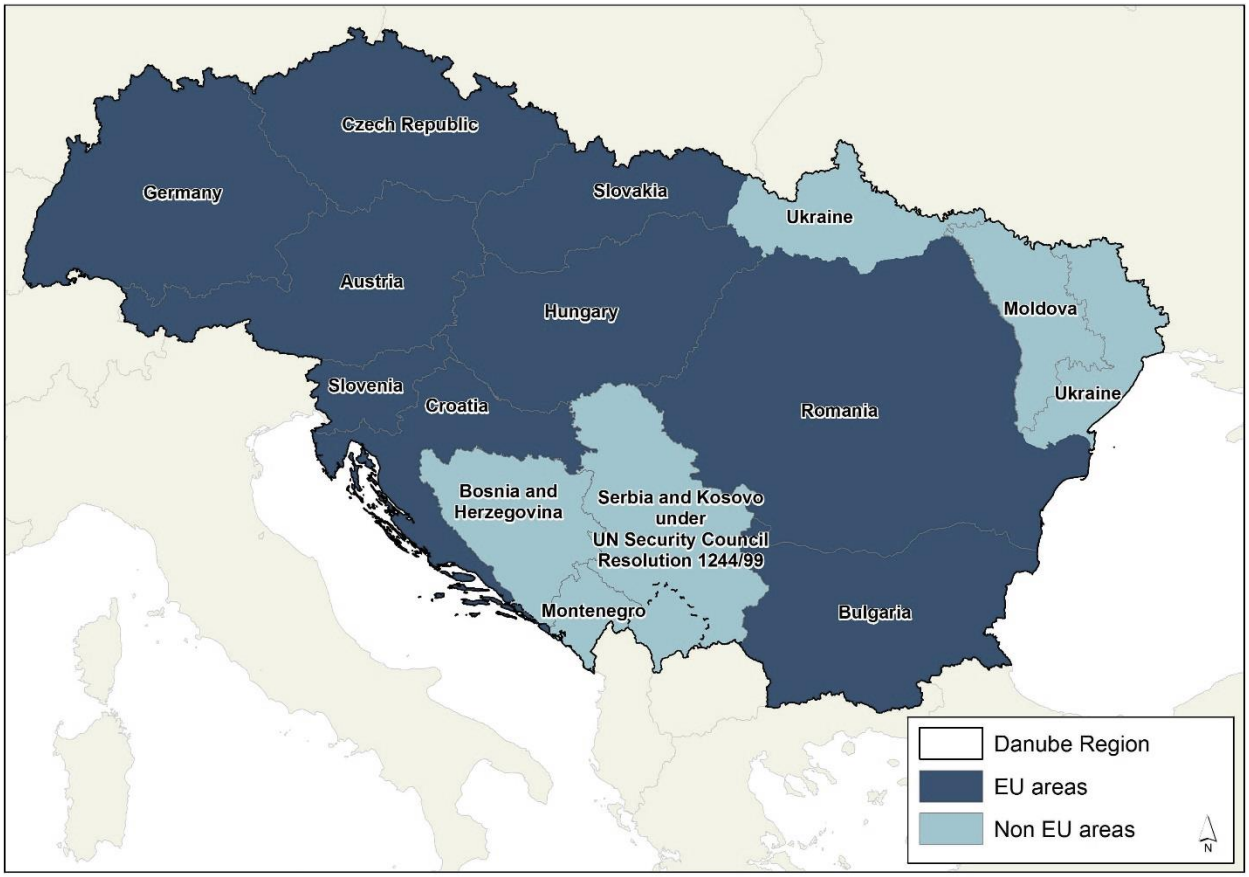
As the non-EU countries of the Danube region are finalizing the preparation of their S3 concepts, developing the necessary procedures and legislation, designing the logic of intervention and instruments, the time is right to put in place required mechanisms to ensure the proper implementation of the strategy. The practice from EU regions has demonstrated, that the crucial aspects of the implementation phase are the governance and monitoring part of the strategy. Overall aim – to keep the strategy alive, be ready and able to change while running it – is a complicated and creative task for the design of the governance. In order to understand what is happening, a sound monitoring and evaluation systems are needed as well as stakeholder engagement. The new period of S3 in EU will aim to have the continuous entrepreneurial discovery process (EDP) what should deliver the timely knowledge to steer the strategy. EDP is mostly based on good governance and proper monitoring functions and should be no exception for non-EU countries.

Therefore, the scope of this report is to provide guidance for non-EU countries of the Danube Region regarding governance, financing, monitoring and evaluation of S3. The report builds knowledge, provides examples and practical details from the selected EU Danube region countries: Slovenia, South Moravian region (Czech Republic) and Lower Austria (Republic of Austria). The reason behind such selection of example regions was to have a combination of different cases. In particular, to analyze both –

[1] Guzzo et al., S3 Working Paper Series No. 15/2018, JRC

a national level and regional level S3. Also, the differences in the existing national (or reginal) innovation systems, dependence on ESIF and most importantly – in the performance (based on European innovation scoreboard)[2] of the innovation systems is covered and reflected by such selection, combining the cases from strong and moderated innovators.

Danube region countries



Source: https://climate-adapt.eea.europa.eu/countries-regions/transnational-regions/danube

Transparent, well-functioning and responsible governance is a key element of developing and implementing Smart specialization strategy. The report aims to describe institutions and bodies responsible for governance, focusing on organizations and responsibilities. Financial logic and instruments vary depending on the political, economic and structural features of the regions. Different division of the policy fields among the ministries result in different approaches of interventions and funding. Financing part is focused on analysis of interventions, policy mix of instruments and for S3 dedicated budgets, where available. Monitoring and evaluation part focuses mainly on available indicators and logic in their selection/usage. However, the evaluation topic has not yet been evidently used in most of the cases, as the full scale evaluation of the S3 will happen only after the programme will terminate in 2020. The report concludes with the guidelines and further actions, based, but not limited to, on the gathered

[2] https://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en

evidence. Some guidelines for evaluation are provided as general possible actions for future consideration. Information in the report is provided based on the availability and integrity of publicly available information. It must be noted, that some parts of the report could not be covered in full detail due to missing or incomplete information. The authors of the report have put all efforts to obtain necessary information by, and not limited to, the direct contact with the respectful authorities of each region.

REPUBLIC OF SLOVENIA

GOVERNANCE

Strategic objective

Smart specialization is a platform for concentrating development investments in areas where Slovenia has the critical mass of knowledge, capacities and competences and where there is innovation potential for placing Slovenia within global markets and thus enhancing its visibility and recognition. S3 of Slovenia is a strategy aiming to:

- Strengthen the competitiveness of the economy by enhancing its innovation capacity;
- Diversify existing industries and service activities;
- Boost growth of new and fast-growing industries and enterprises.

Objective of Slovenian S3 is „Sustainable technologies and services for a healthy life“, based that Slovenia is willing to become a green, active, healthy and digital region with top-level conditions for fostering creativity and innovation, focused on the development of medium- and high-level technological solutions in niche areas.

Organization

The S3 of Slovenia governance system is a three-level system that consists of:

- Governmental level;
- National innovation platforms;
- Strategic partnerships.

The **Government** is responsible for S3 management, namely preparation of the strategy, amendments, implementation, monitoring and evaluation. To establish close, operational and smooth cooperation supporting S3 implementation an Implementation Working Group was established at the national level. The Working Group shall comprise representatives, namely State Secretaries from Government Office and ministries directly participating in S3 implementation. The Working Group is responsible for inter-ministerial coordination of S3 activities, implementation at the strategic and substantive level, namely by taking into account the competences of each participating institution. The Working Group also is the institution which monitors and guides S3 delivery at the political level and thus ensures that the findings and recommendations made at a lower governance levels are actually implemented.

Slovenia’s Government Office for Development and European Affairs (GODEA) is responsible for coordination of S3. Coordination related activities are implemented by the Office in close cooperation with Government stakeholders:

The strongest cooperation is established with the Ministry of Development and Technology and the Ministry of Education, Science and Sport acting as the two ministries directly responsible for the area of R&I;

Cooperation with the ministries whose contribution in their areas of responsibility is most important in terms of achieving the set S3 objectives;

Cooperation with the representatives of executing agencies (e.g. Slovenian research agency (SRA)).

To support efficient and effective delivery of S3 a **specific Unit** responsible for S3 was established in the framework of the GODEA. In addition to providing technical support (organization, preparation of materials, dissemination of messages and adopted decisions to other levels of governance, etc.) to the Working Group, the Unit is responsible for coordinated delivery of S3 at the operational level. Together with the institutions that participate in the Working Group the Unit is providing national-level support when it comes to establishment and operation of Strategic partnerships. The Unit is also responsible for S3 monitoring and evaluation. In the framework of its competences within the GODEA the Unit supervises whether implementation of Operational Programme for the Implementation of the EU Cohesion Policy 2014-2020 complies with S3 provisions, namely in accordance with the strategic guidelines and on the basis of the approved operation selection criteria.

At the second level the **National Innovation Platform** was established bringing together development-related stakeholders in compliance with the quadruple helix principle. The Platform is a consultative body which deals with national, horizontal innovation-related issues. In particular, these issues cover performance of the supportive environment for innovation and entrepreneurship, elimination of horizontal regulatory barriers, measures to promote innovation, and coordination of research and educational capacities within the government sector. The Platform is monitoring S3 implementation within the horizontal areas and provides recommendations to the national level. The Platform may also introduce the initiative to perform horizontal area-related evaluations. The Platform is established by the Minister of Development and Technology and the Minister of Education, Science and Sport.

Strategic partnerships consisted of representatives of the economy, research and education organizations and other relevant partners are the main institutional form established at the level of implementation. A limited number of partnerships deriving from the entrepreneurial discovery process were established. The established partnerships support S3 implementation. The internal management structure is tailored to the technology and market specific characteristics of each area of application. Strategic partnerships facilitate promoting system-wide and long-term cooperation of stakeholders within an individual area, namely cooperation between stakeholders, cooperation of stakeholders with other entities, and cooperation with the state. The key functions of strategic partnerships thus pertain to internationalisation, integration and development of joint R&I initiatives, including the concentration of research capacities, human resources development and representing common interest of the state.

Strategic partnerships designed action plans (roadmaps) that, inter alia, enhance further concentration of focus areas and coordination of development policies with the Government. Existence of the critical mass of capacities and competences is not the only condition for further development of focus areas and technologies, where development investments are concentrated. The specific attention is also paid to the analysis of market opportunities and the impact on competitiveness resulting from joint

and coordinated acting of stakeholders, the identification of comparative advantages of stakeholders in Slovenia in terms of the competition and the willingness of the private sector to invest in these areas.

Strategic partnerships cooperate with the national level directly with the exception of horizontal issues related to innovation – this is where strategic partnerships cooperate with the national level through the National Innovation Platform. Being a member of a Strategic partnership will not affect the funding, ensuring the transparency. Projects are selected on the competitive basis of proposals. Strategic partnerships receive funding from the state with some funding from stakeholders.

FINANCING

Directions of intervention

In a comprehensive manner, S3 addresses a broad range of development policies related to innovation, in particular the policy of promoting research and innovation, industrial policy, entrepreneurship promotion as well as some parts of the education system, rural development policy, international relations, improved regulatory environment (procedures related to the issuing of permits), etc. The state provides financial support to the identified priority areas as well as non-financial support in close cooperation with strategic partnerships.

The main directions or S3 of Slovenia are as follows:

Research, development and innovation:

- Basic science. The key purpose of intervention is to develop scientific excellence in a broad area of research – funding for research organizations, basic research in all areas, operation of infrastructure centres, funding the development of research staff, funding of research in the framework of European Research Area, support for the breakthrough research, development of projects to transfer the results into the economy with the aim of creating innovation, technology and business solutions;
- Research, development and innovation in value chains and networks. Measures:

- "Improving international competitiveness and excellence in research to participate in value chains" promotes the preparation and implementation of joint industry research projects (TRL3-6) with the aim of linking knowledge and competences relevant for developing new products, services and processes with high value added and a demonstrated market potential at the international level;
- "Support to R&I processes" focus on research and innovation projects developing new products, processes and services within priority areas of application (TRL6-9). With regard to projects special attention is given also to non-technological innovation, including industrial design and own brands.

- Support for investments. The measure addresses the final stage of the development process of new products, namely:

- Development and installation of pilot lines, first validation activities, optimization of advanced production technologies and first production while introducing ICT solutions;

- Testing new solutions developed for direct use in practice and a demonstration of their use (e.g. Living Labs, CreativeHubs, etc.). Support is given to setting up the first reference project for demonstration solutions in real-world conditions;
- Projects focusing on commercialisation of developed solutions and on new technologies entering the market (e.g. through (innovative) public procurement procedures).

- Complementarity with Horizon 2020 and international initiatives. The measure supports integration of Slovenian partners into international networks, promoting research and attracting foreign top experts to Slovenia, mainly through schemes of complementary highly competitive international calls for proposals (e.g. ERC). Thus, complementary measures support projects which pursue and achieve scientific excellence and are internationally comparable to the best research projects. Support is also given to international research and development projects – activities pertaining to cross-border cooperation of regions, for example within the EU Strategy for the Danube Region.
- Better utilisation and development of research infrastructure. Developing research infrastructures will be implemented in line with the European Strategy Forum on Research Infrastructures (ESFRI) roadmap and the national Research Infrastructure Development Plan, in particular in terms of establishing centres or partner facilities which support functional integration of Slovenian infrastructure into international infrastructure. Specific attention will be given to infrastructure development in cooperation with economic entities. Thus, an important aspect (where possible) of research infrastructures development is the integration of the economy to promote faster economic development and direct cooperation with research organizations.
- Specific measures:
  - Sustainable food production. Supported under R&I policy. All other aspects of development in the field of sustainable food production, including human resources development and investments, are addressed under Rural Development Programme, under the measures related to knowledge transfer and information and publicity activities, quality schemes for agricultural products and food, investments in fixed assets, establishment of producer groups and organizations, cooperation;
  - Sustainable tourism. Allocates funding to developing new and innovative tourism products and services.

Human resources. Under the 2007-2013 financial perspective Slovenia has already developed and implemented certain mechanisms/projects in this field (e.g. competence centres, scholarship schemes, mentoring schemes, lifelong career orientation, co-financing of projects with social partners, etc.), however lack of integration between such mechanisms/projects has been observed. Development policy therefore established integrity and enhance focus on priority areas:

- Research potential of researchers and international mobility. With the involvement of researchers and their research potential the incentive focused on the implementation of research projects with the cooperation of research organizations and the economy, while striving to transfer best practices that have an impact on R&I activities of enterprises or the creation of new knowledge and its use in the context of research

projects with foreign research organizations in Slovenia. Specific attention is given to researchers who are returning to Slovenia after completing their research or educational work at international research and/or higher education institutions and who bring experience and know-how from abroad back home;

- Strengthening development competences and innovation potential. In the framework of this measure, which complements the measure "Research potential of researchers and international mobility", research organizations play a key role, as this segment focuses on the transfer of knowledge into economy and strengthening innovative potential of companies (e.g. mass innovation). The measure aims to initiate processes that facilitate strengthening of research and development departments in companies, in particular with the involvement of inter- and multi-disciplinary skills (creativity, art, design and other non-technological solutions).
- Employee knowledge and competences. The measure focuses on strengthening specific knowledge, competences, skills and career development of employees in companies that operate and integrate within S3 priority areas (in particular the companies the nature of which makes the measure, relating to strengthening research potential of researchers, less relevant) to enhance their competitiveness. Key instrument:
  - Competence centres for human resources development 2.0 that focuses on identifying the competences required in specific S3 priority areas of application, design and implementation of training programmes, including enhancing knowledge of engineers in order to obtain new competences, networking of companies in specific priority areas of application and transfer of knowledge and best practices in the field of human resources management, promotion of innovation, internationalization and reform of business models. This model also supports the implementation of mentoring schemes acting as one of the fundamental measures for intergenerational transfer of knowledge, skills and competences, as well as the implementation of lifelong career orientation services.
  - Scholarships. Aims to attract companies to provide long-term support for their future employees (students at universities) with the state focusing on a more systematic and long-term human resource development in selected key areas of development.
- Young and creative Slovenia. Aims to promote creativity, innovation and entrepreneurship of young people, talent development and improving their key competences in all phases of the educational process and vertically. The measure is addressing two elements:
  - Identification, promotion and development of the potential of young people and their skills;
  - Promotion of entrepreneurship and creativity of young people vertically along the entire educational process.

Entrepreneurship and innovation. The aim is to provide related, tailored and predictable/permanent support in all phases of company growth (from the pre-seed and start-up phase to the growth and maturity phase), and comprehensive support services which should cover the following key areas:

- Adequate infrastructure and services provided by supportive environment entities (one stop shop services, entities of innovative environment, etc.);
- Financial resources (subsidies, equity and debt financing – public and private);
- Content-related support (training programmes, mentoring, coaching, training courses, counselling) and generating synergies and upgrades between financial and content related support;
- Uniform implementation (by national institutions and institutions selected under a transparent public selection procedure, monitoring and effective control of the use of public resources) and promotion of programmes (including the attraction of talents).

The measures focus on start-up and knowledge transfer as well as on the development and growth phase of small and medium-sized enterprises.

There are also measures that address the promotion of enhanced international integration of Slovenian economy and attracting foreign direct investments, internationalisation. The target is to promote exports and attract foreign investment with SMEs also being a target group – the aim is to enhance their international involvement. A national one stop shop service, which provides integrated services (providing information/counselling, active assistance to investors, etc.), is very important for attracting foreign (as well promoting national) investments. Support is also given to specific projects e.g. development of strategic partnerships to promote integration of enterprises into global value chains, joint investments as pilot projects designed to further market high-quality products/services and the development and application of new business models in enterprises.

Slovenia of development. Aims to introduce some regulatory actions that leads to creation of innovation friendly environment as well as governmental actions creating the international economic links:

- The Public Procurement Act sets out the conditions relating to public procurement procedures and facilitates establishment of innovation partnerships which means that the development stage and supply of services are combined in one single procedure. Decree on green public procurement aims to reduce negative environmental impact of public procurement, namely by contacting less environmentally-burdensome goods, services and works by taking into account the prescribed (basic) environmental requirements and additional requirements established by the contracting authority;
- Tax relief. Targets well-performing profit-generating companies which can reduce tax due to their investment in R&D. In accordance with their business activities, such companies can plan R&D expenditure to achieve two results simultaneously, namely competitive advantage through their R&D activity, and tax base reduced by the relevant R&D expenditure;
- Economic diplomacy and promotion. The relevant measures to support companies are implemented in the framework of intergovernmental commissions, economic delegations, economic representations abroad, advising companies regarding the selected foreign market, providing information on foreign markets and other services provided by diplomatic and consular representations (e.g. priority issuing of visas), namely by focusing on enhancing the network of economic advisers;

- Issuing permits and eliminating regulatory barriers. Aims to eliminate regulatory barriers as well as speed-up the process of issuing and/or priority treatment of permits or consents within its jurisdiction, namely for investments and projects falling under the identified priority areas. Measures to improve the regulatory environment that eliminates administrative burdens are also implemented.
- Efficient justice administration. Aims to accelerate the settlement of commercial disputes, executions, alternative forms of resolving commercial disputes, improved insolvency proceedings and effective elimination of economic crime and corruption.

Funding

	Funding sources	Total 2016-2018, M[3] EUR	Average – annually, M EUR
R&I activities		1025,5	341,8
Operational Programme for the Implementation of the EU Cohesion Policy 2014-2020		552,9	184,3
Enhancing research and innovation infrastructure	ESIF	90,5	30,2
	SLO[4]	19	6,3
Business investment	PRIV[5]	36,5	12,2
Promoting business investment in research and innovation	ESIF	86,5	28,8
	SLO	18	6
Business investment	PRIV	243,8	81,3
Financial instruments (risk capital)	ESIF	23,4	7,8
Leverage under financial instruments	FIN[6]	23,4	7,8
Additional business investment in financial instruments	PRIV	11,7	3,9
State budget – national sources		472,5	157,5
SRA programme[7]	SLO	427	142,3
Ministry of Education, Science and Sport – science	SLO	32,3	10,7
Ministry of Education, Science and Sport – investments	SLO	3,7	1,2
Ministry of Economic Development and Technology – technology, Eureka[8], Eurostars[9]	SLO	9,6	3,2
Entrepreneurship activities		887,9	296
Operational Programme for the Implementation of the EU Cohesion Policy 2014-2020		710,9	237
Promoting entrepreneurship	ESIF	79,5	26,5
	SLO	15,6	5,2

[3] Million
[4] Slovenia state budget
[5] Private investment
[6] Leverage results from using borrowed capital as a funding source when investing to expand the firm's asset base and generate returns on risk capital. Leverage is an investment strategy of using borrowed money—specifically, the use of various financial instruments or borrowed capital—to increase the potential return of an investment
[7] National Research and Development Programme
[8] A framework programme, organizaed in different strands (sub-programmes) for European network developing cooperation between SMEs, research centres and universities for industrial innovation (https://www.eurekanetwork.org/)
[9] A funding and support programme, aimed at R&D-performing SMEs that wish to exploit the benefits that come with international collaboration (https://www.eurostars-eureka.eu/)

Business investment	PRIV	95,1	31,7
Financial instruments (risk capital)	ESIF	122,5	40,8
Leverage under financial instruments	FIN	245	81,7
Additional business investment in financial instruments	PRIV	91,9	30,6
National resources		177	59
Ministry of Economic Development and Technology programmes – entrepreneurship	SLO	27	9
Ministry of Economic Development and Technology – internationalisation and tourism	SLO	75	25
Business investment	PRIV	75	25
Human resources		56,2	18,7
Operational Programme for the Implementation of the EU Cohesion Policy 2014-2020	ESIF	29,4	9,8
Enhancing equal access to lifelong learning	SLO	7,3	2,4
Business investment	PRIV	19,4	6,5

Indicated funding was planned back in 2015 and included into Slovenia's Smart Specialization Strategy. Investment in S3 of Slovenia is distributed between the funding sources as follows:

- Slovenia state budget – 640,7 M EUR totally and 213,5 M EUR annually;
- Business investment – 604,2 M EUR totally and 201,4 M EUR annually;
- European structural and investment funds (including thematic programmes and financial instruments) – 456,3 M EUR totally and 152,1 M EUR annually;
- Leverage under financial instruments – 268,4 M EUR totally and 89,5 M EUR annually.

The total annual spending on S3 implementation is 656 M EUR what is about 1,3 % of GDP. The total gross domestic spending on R&I accounts for 1,9 % of GDP.

MONITORING

Measurement of intervention

S3 implementation in Slovenia is monitored by all three levels of governance (Governmental level, National innovation platforms and Strategic partnerships), in particular by the Working Group established at the national level, horizontally by National Innovation Platform and by Strategic partnerships at the level of individual areas of application. A monitoring and evaluation system, in cooperation with ministries and implementing institutions, has been established by the Unit under Government Office. The Unit is also responsible for coordination of the monitoring and evaluation process with the framework of European Cohesion Policy.

S3 monitoring and evaluation is based on the quantified objectives, identified based on the entrepreneurial discovery process. Measurable S3 indicators are as follows:

- Share of high-tech products in exports;
- Share of exports of knowledge intensive services in total exports;
- Entrepreneurial activity;
- Share of funds from abroad to finance the total gross domestic expenditure on R&D;

- Placing Slovenia above the EU average in the Innovation Union Scoreboard;
- Share of funds in public sector expenditure on R&D funded by the business sector;
- Share of corporate funds to finance research and development activities in GDP;
- Share of innovation-active companies;
- Number of researchers in supported entities;
- Number of companies cooperating with knowledge institutions;
- Number of supported companies;
- Number of fast-growing companies;
- Value added per employee in SMEs;
- Higher resource productivity;
- Number of companies having introduced efficient resource management measures.

The indicators are specified more precisely in the action plans (roadmaps), developed by Strategic partnerships. Monitoring of action plans takes place regularly on the basis of annual reports with the emphasis of achieving the set objectives and indicators. The annual reports are prepared by Strategic partnerships.

Monitoring by the state at the operational level is performed on a regular basis through the Unit under GODEA as well as other state-level institutions in the framework of Strategic partnerships themselves (depending on the area). The monitoring also serves as a basis for close cooperation and introduction and implementation of the planned measures as well as potential additional measures which need to be implemented at the national level. Representatives of the state, participating in Strategic partnerships, where appropriate, inform or include the Working Group when coordination and decision making at the national level is needed. The Working Groups monitors the progress at a strategic level at least once a year on the basis of the reports on the implementation of action plans. The Working Group gives its opinion about the annual reports serving as a basis for coordinating the activities at the strategic level between Strategic partnerships and the national level.

A more detailed analysis and evaluation of action plans taking into account technological and market specifics of each area was carried out in 2018. The evaluations are a subject to consideration at all institutional levels of S3 governance. The Working Group for S3 implementation took into account the recommendations of other levels of governance including action plans and the proposals given by Strategic partnerships pertaining to further concentration, and assess the potential additional amendments to S3.

SOUTH MORAVIAN REGION (CZECH REPUBLIC)

GOVERNANCE

Ecosystem

The main stakeholders of the innovation system of the region are as follows:

- Knowledge intensive companies relevant for the regional innovation system[10].
- Public universities and research organizations that are directly relevant for the innovation system:
  - Public universities. There are five public universities and one state university in the region;
  - Public research organisations. Primarily represented by the institutes of the Academy of Sciences of the Czech Republic – 9 institutes have their registered seats in South Moravian region and 15 more institutes are branches of mostly Prague institutes of the Academy of Sciences of the Czech Republic. These institutes mostly focus on basic research and to direct application of the research results. Apart from the institutes of the Academy of Sciences of the Czech Republic, other public research organisations set up by ministries reside in the region. These institutes usually implement both basic and applied research, both for the public and private sector needs.
  - Research centres. Can be regarded as an imaginary backbone of the South Moravian research that are playing a primary, but not the only role in the development of the research (and innovation) system of the region.
  - Centres of Excellence. There are four Centres of Excellence in the South Moravian Region.
  - Regional Research Centres. There are 11 Regional Research Centres Focusing on research application.
  - Centres of Competence. Represent the second key group of research projects that have a systemic approach. Centres of Competence has been set for R&I activities in progressive fields with high potential for application that have promise and potential for contributing to growing competitiveness of the Czech Republic. The idea behind the Centres of Competence programme is to establish a long-term, sustainable system in which consortia of companies and research organisations will collaborate to implement their strategic research agendas. There are 3 centres with a recipient (coordinator) that has a registered seat in the South Moravian Region, and 20 more partners who participate in the Centres of Competence with beneficiaries from other regions.

[10] A knowledge-intensive company is defined as a company owning its own technology/expert knowledge which significantly contributes to the turnover of the company; a company with its own R&D expenditure of at least 10 M CZK (391,7 K EUR) or 5 M CZK (195,9 K EUR) for companies with up to 49 employees; a company with at least 10 employees; a company which is more than 3 years old. A company should correspond to all these criteria.

- Support infrastructure for R&I. Can be classified in several categories – the form of ownership (public or private) and a focus on the target group (businessmen, researchers, students or wider public). Considering the relatively long-term and continuous political support of research and innovation policies in the region, the public support infrastructure is relatively developed. The research and innovation support in the region is implemented through the public institutions with the functions of:

  - providing information and services for the national programmes supporting businesses, assists new foreign investors coming into the region;
  - popularizing scientific results, promoting and publicizing of scientific results and motivation of children and teenagers to study natural sciences and technical subjects;
  - shared research and development platform focusing on dealing with company problems in the field of machine tools. Providing services in the field of testing and measuring, machining technology, machine construction (identification of weak points of the existing machines, proposing optimal solutions, new concepts);
  - interest association of legal entities, focusing on the support of knowledge-intensive companies, on supporting the development of new knowledge-intensive companies and on supporting the development of mature companies with growth potential;
  - focusing on supporting of gifted students and human resources for research;
  - preparation of projects for ESIF, supporting investment in the region and selected information services for the municipal sphere with the administration of small project funds;
  - Technology transfer – operating at public universities in the region;
  - Business autonomy representation, providing comprehensive advisory services (customs, export, legal, subsidies etc.), cultivation and development of human resources in order to increase innovativeness and competitiveness;
  - enabling integration of highly qualified foreigners in the region;
  - private law institutions, that implements support activities;
  - risk capital and business angels' funds, that represents key innovation "infrastructures".

- Public administration and its research and innovation support activities. Over a long period of time, the following two autonomous institutions have been most active in the South Moravian Region:

  - South Moravian Region. Supporting research and innovation since 2003. Continuously supporting the activities of organizations working on support of new and existing knowledge-intensive companies, international mobility, preparation of projects for ESIF, supporting investment in the region and selected information services for the municipal sphere with the administration of small project funds. South Moravian Region also is financing an influx of foreign scientists and a return of Czech scientists into the region, investing into the support of innovation infrastructure (technology incubators, scientific and technology parks, competence centres, science centres and acquisition of research equipment);
  - Statutory City of Brno. Has been supporting research and innovation since 2003. Has been supporting activities of supporting of new and existing knowledge-intensive companies (together with the South Moravian Region), supporting the creative industries, financing the innovation voucher programme, PhD talents, integration of highly qualified foreigners in the

region, popularizing scientific results, promoting and publicizing of scientific results, motivation of children and teenagers to study natural sciences and technical subjects, making significant investments into "hard" infrastructure" in the surroundings of the constructed R&I centres;

- In 2013, the town of Znojmo set up a business incubator in order to support new business projects of Znojmo citizens.

Organization

The implementation system of S3 in South Moravian region is based on three basic pillars:

- Implementation management;
- Monitoring;
- Evaluation of impacts.

For the purpose of implementation management S3 of the region, the following structures were set up:

The Steering Committee discusses the mission, vision, objectives, activities of S3 of the region. The Steering Committee discusses project plan proposals (Action Plan) and issues statements to the local government of South Moravian Region and the Statutory City of Brno. The composition of the Steering Committee is in accordance with recommendations of the S3 Guide of the European Commission. The Steering Committee acts in accordance with its own rules of procedure. The Rules of Procedure are approved by the Steering Committee.

The Coordination Committee discusses proposals made in working group meetings, in particular, in terms of the feasibility of interventions. The proposals are subsequently presented to the Steering Committee. The Coordination Committee comprises, in particular, representatives from institutions implementing interventions of S3 of the region. Members of the Coordination Committee are appointed by the Steering Committee of S3 of the region.

Working groups for individual areas of changes during the implementation, identification of proposals for new projects complying with the objectives of S3 of the region. Working groups meet twice a year. Proposals for new projects are processed by the leaders of working groups (appointed by S3 manager) and presented to the Steering Committee. The composition of working groups can be changed.

Manager (S3 Manager) ensures the running of the implementation structure, i.e. identification and discussion of new project plans, supervision of the Action Plan implementation, and is responsible for preparing monitoring reports and evaluation reports. The manager of S3 of the region (S3 Manager) is appointed on the basis of a tender organized by the Ministry of Education, Youth and Sports in collaboration with the Regional Office of the region through tender procedure.

Mission, vision and strategic objectives

The purpose of S3 of the South Moravian Region is to create conditions for competitive knowledge-intensive businesses, in particular, through investment into improving the quality of education, research and the image of the region, as well as through direct support of business activities where the market

fails (e.g. supporting start-up companies and supporting knowledge intensive activities in mature companies).

Mission: By increasing international competitiveness to ensure a long-term development and prosperity of the South Moravian Region (indicators of fulfilment: rate of employment, salary amounts).

Vision: To develop innovation potential of the South Moravian Region to reach the same standard as the most innovative regions in Europe (performance indicators: intensity of private investment into R&I, number of European Research Council grants, share of foreign university students).

There are 5 directions of intervention or key areas of changes in the S3 of the South Moravian Region:

1. Pro-innovation administration and governance;
2. Excellence in research;
3. Competitive innovative companies;
4. Top European education;
5. Attractive region.

The direction “Pro-innovation administration and governance” consists of strategic objectives oriented to improvement of the legal framework, administrative processes in public administration in R&I, improvement of the legal framework for (innovative) business and improvement of good quality management of S3 implementation.

Excellence in research is supposed to be reached by improvement of the quality and problematic orientation of public research and maximising economic benefits of public investment in R&D in the region.

The direction “Competitive innovative companies” is oriented to creation of suitable conditions for innovation driven by the growth of "mature" knowledge-intensive companies, increasing the number of new companies with aspirations and the potential to have a dominant position on the market as well as increasing the number of people starting their own business for the first time.

Top European education in the region must be reached by improvement of organizational and material conditions to increase the quality of primary and secondary education, by improvement of the quality and relevance of education, reflecting the needs of companies working in key industries in the region (industries by the smart specialisation domain), definition of a new educational policy for the region to ensure a long-term prosperity, by improvement of the quality and relevance of university education in the region, as well as the quality and attractiveness of teacher training. And last, but not least action aims to increasing internationalisation, openness and permeability of universities in the region.

Attractiveness of the region should be improved through the communication activities oriented to creating a new image of the region and city of Brno as an area for advanced knowledge economy with talented, creative and active people, top scientific teams, global competitive knowledge companies with a support of modern public administration which creates unique beneficial conditions as well as communication of respecting DNA of the region that consists of quality of life and attractiveness for life.

FINANCING

R&D funding in Czech Republic

There are six key areas in which the Czech Republic must achieve significant changes in order to strengthen the knowledge-intensity of the economy and to facilitate the development of the selected specialisation domains and their gradual refinement. The key changes are as follows:

- Higher innovation performance of companies;
- Improved quality of public research;
- Improved economic benefits of public research;
- Better supply of HR, in terms of both quality and quantity, for innovative enterprise, research and development;
- Development of e-Government and e-Business to improve competitiveness;
- Improvement and better utilization of social capital and creativity in addressing complex social challenges;
- The majority of funding for these key changes comes from ESIF – 7,55 B[11] EUR:
- Higher innovation performance of companies – 3,6 B EUR plus around 125 M EUR sharing with the objective „Improved economic benefits of public research";
- Improved quality of public research – 1,2 B EUR;
- Improved economic benefits of public research – 264,4 M EUR plus 125 M EUR sharing with the objective „Higher innovation performance of companies";
- Better supply of HR, in terms of both quality and quantity, for innovative enterprise, research and development – 570,4 M EUR plus 251,1 M EUR sharing with objective "Improvement and better utilization of social capital and creativity in addressing complex social challenges";
- Development of e-Government and e-Business to improve competitiveness – 1,8 B EUR;
- Improvement and better utilization of social capital and creativity in addressing complex social challenges – 45,3 M EUR plus 251,1 M EUR sharing with objective "Better supply of HR, in terms of both quality and quantity, for innovative enterprise, research and development".

In addition to operational programmes funded by ESIF resources, for which the S3 Strategy is an ex ante conditionality, the National S3 Strategy also has links to some national programmes/funding schemes and regional-level resources. In comparison with ESIF funding national R&D expenditure is quite low and in the period of 2017-2019 was about 3,8 B EUR. The overall expenditure on R&D of Czech Republic was 1.93 % of GDP in 2018.

[11] Billion

Directions of intervention and funding

It is therefore important for the Czech Republic to implement the interventions resulting not only in strengthening and developing specialisations, as is the case in the most developed countries and regions of Europe, but also to concentrate on interventions that develop the innovative system as a whole, improve its conditions and operations. Therefore, the S3 focuses on and contains two types of interventions:

- Interventions that are not oriented specifically towards selected sectors and that focus on developing the innovation system in order to improve conditions for effective investment in smart specialisation (horizontal interventions);
- Interventions that are aimed at the selected domains and that lead to strengthening smart specialisation through searching for and utilising opportunities for innovation that result in the growth of companies and their increased success in global markets.
- Interventions proposed in regional level are undertaken in various ways:
- Interventions serve as a basis for the preparation of projects that can apply for support from national-level resources, both 2014–2020 European Structural and Investment Funds programmes' resources and national programmes' resources;
- Some interventions are funded to a limited extent from regional budgets;
- Interventions in capacity-building at the regional level are funded from the tool named "Smart Accelerator".

National programmes implemented in Czech Republic are as follows:

- Competence centres. The main objective of the programme is to increase the competitiveness of Czech Republic through stimulating creation and operation of centres for research, development and innovation;
- EPSILON. Mainly focused on improving the standing of the Czech Republic, as well as European industry in a global context, through the support of applied research and experimental development, whose results have a high potential for rapid application in new products, production processes and services;
- GAMA. Aims to support the verification of the results of R&I in terms of their practical application and to prepare their subsequent commercial use. The main objective of the programme is to support and significantly streamline the transformation of R&I results achieved in research organizations and/or in collaboration between research organizations and enterprises into practical applications to enable their commercialization and support their implementation.
- TRIO. Programme for Czech Republic entities supporting applied research and experimental development in the field of key enabling technologies such as photonics, micro- and nanoelectronics, nanotechnology, industrial biotechnology, advanced materials and advanced manufacturing technologies.

Smart accelerator

The scheme supported by the national Operational Programme for Research, Development and Education. The aim of the scheme is to create administrative structure for the S3 implementation and entrepreneurial discovery process management (and in wider terms for the overall management of R&I) in all the Czech regions. Each region is invited to submit a project based on their needs (there is no one-size-fits-all approach) and it gives the regions an opportunity to address their weaknesses in terms of S3 and R&I management.

S3 of the South Moravian Region objectives are fulfilled through the Action Plan (a portfolio of project plans) that are regularly updated.

The activities introduced in the first action plan are as follows:

1. The strategic objective "To improve the legal framework for (innovative) business" of the key area of changes "Pro-innovation administration and governance" is implemented by project "Lobbying system to improve business environment" (20 K[12] EUR/year);
2. The strategic objective "To improve the quality and problematic orientation of public research in the region" of the key area of changes "Excellence in research" consists of some specific objectives that are implemented through various programs/projects:

- Specific objective "To have sufficient talents for research in the region" is implemented by projects:

- Natural sciences stellarium. It is a research popularization infrastructure, oriented to increase of the attractiveness of Brno center for teenagers and adults, the locals and tourists that completes the existing projects Natural Sciences Exploratorium and Natural Sciences Digitarium. Funding – 2,7 M EUR;
- GO_Science @ BRNO. Aims to maximise the benefit of Czech and foreign specialists visiting Brno and the South Moravian Region, to support media coverage of science, and to promote the existing scientific projects and their results and successes. Consists of such activities as lectures for public, workshops, science cafe, networking, existing scientific and popularisation projects, meetings between major scientists and representatives of the public life in Brno. Funding – 58,7 K EUR/year;
- Brno PhD Talent. Aims to motivate and support talented students to take up scientific careers by offering them a stable financial support. The project responds to the unsuitable financial conditions of PhD studies in the Czech Republic and gives prestige to supported students, enabling them to fully devote themselves to their studies and scientific work. The project will also favour applicants whose PhD work focuses on scientific directions which will strengthen smart specialisation of the region. Funding – 156,6 K EU/year;
- Support of gifted students. Aims to provide gifted pupils/students with means to extend their knowledge and skills as necessary, to make the students more desirable for scientific institutions and innovative companies, and to strengthen their links to the region. Funding – 195,8 K EUR/year.

- Specific objective "To improve material conditions for good quality" is implemented by projects:

[12] Thousand

- EurAxess. The project focuses on foreign scientists and researchers who come to work in the region for various types of research organisations and aims to create a suitable environment for the mobility of scientists and researchers which will improve their comfort and increase the attractiveness of the region for foreign researchers. Funding – 156,6 K EUR;
- SoMoPro III (South Moravian Programme for Distinguished Researchers III). The aim of the project is to bring top international scientists to the research institutions in the region, and as a result to support the development of science, research and competitiveness with relevance for key sectors in S3 of the region. Funding – 3,1 M EUR;
- e-IROI (e-Infrastructure Research and Operation Institute). The objective/aim of the project is to significantly strengthen the position of the Institute of Computer Science of Masaryk University and its transformation into an excellent research institution of international significance in the area of research, development and use of extensive e-infrastructures by creating relevant facilities, improving technical equipment and supporting the quantitative, and, in particular, qualitative growth of research teams in the institute. Funding – 21,5 M EUR;
- Masaryk University Comprehensive Simulation Centre. The project Masaryk University Comprehensive Simulation Centre aims to centralise education, development and research using simulation teaching aids at university. Funding – 47 M EUR.

1. The strategic objective “To maximise economic benefits of public investment in R&D in the region“ of the key area of changes “Excellence in research” implemented through the one project related to specific objective “To strengthen cooperation between research organisations and application sphere”:

- Regional proof of concept fund. Aims to increase the number of commercially successful transfers of technology from research organisations in the region. Funding – 391,5 K EUR.

2. The strategic objective “To create suitable conditions for innovation driven by the growth of "mature" knowledge-intensive companies in the region” of the key area of changes “Competitive innovative companies” is implemented by projects as follows:

- Competence centres in key sectors in the region. Aims to strengthen the R&D base in key sectors in the region through setting up suitable competence (R&D) centres and an intensive participation of the corporate sphere. Competence centres established in order to provide R&D services to companies. They are willing to eliminate such shortcomings as unsuitably set up processes of cooperation/unclear partners, their skills, result guarantees, too many priorities for academic staff (teaching, publications, cooperation with companies is not a priority), different perception of time needs. Funding – 783,3 K EUR – 3,9 M EUR (related to the focus of individual sectors);
- Knowledge Transfer Partnership. The main objective is to use transfer of know-how from the academic environment and to strengthen the competitiveness of small and medium-sized knowledge-intensive companies in the region. Program enables the transfer of knowledge from the academic arena to the corporate sector through long-term internships of advanced students (PhD) that will be professionally supervised by an experienced academic member of staff. The role of the student (transfer assistant) is to transfer and test the know-how in the company, and to train a necessary number of internal members of staff so that the company can use the knowledge independently in the future. Funding – 783,1 K EUR;

- Summer school. Aims to address talented students, to equip them with fundamental knowledge of specific specialisations and to practically verify the possibility to implement projects in companies. For company partners, this is an efficient tool for selecting talented and motivated employees. The summer schools offer specialised lessons for students, focusing on some of the important skills essential for their prospective employment (e.g. marketing, processes, logistics, etc.). Funding – 23,5 K EUR;
- Mobility. The objective is to create internal R&D capacity for the best companies in the region (companies pushing technology boundaries). The project will support the arrival of excellent academic staff into companies in the region for a sufficient period of time in order to create a team which would develop respective topics in the companies on a long-term basis. Funding – 978,9 K EUR/year;
- Platinn. The main objective is to use expert coaching services and to increase innovativeness and competitiveness of small and medium sized knowledge-intensive companies in the region. SME owners and top managers with a registered office, or branch in the region will be offered professional expert support targeting key opportunities of growth in their companies. Funding – 978,9 K EUR/year.

3. The strategic objective “To create suitable conditions for innovation driven by the growth of "mature" knowledge-intensive companies in the region” consists of some specific objectives with specific projects:

- Specific objective “To increase the number of companies and to support the growth of companies able to push technological boundaries in their fields” is implemented by this project:

- Knowledge Transfer Partnership international. The main aim is transfer specific know-how from top academic workplaces and to strengthen the competitive position of best companies (innovation leaders) in the region. It is an international mobility scheme financing long-term internships of specially promising PhD students from abroad in the region’ companies who are actively supported by tutors from parent research organisations. The main difference from the project “Knowledge Transfer Partnership” mentioned above – international dimension. Funding – 783,1 K EUR.

- Specific objective “To strengthen the competitive position of small and medium size enterprises from SMR” is implemented by projects:

- Brno Creative Centre. Aims to provide support to new entrepreneurs in the creative industries, attract new investors connected to creative industries and it might help to prevent outflow of talented people out of Brno. The project is willing to help to liven up a neglected part of the city and make it more attractive. The centre supposed to provide comprehensive facilities for the development of creative fields in the region, among others, by ensuring the function of incubator for starting entrepreneurs in creative industries, studios for rent, test rooms, workshops, residence premises, fabrication labs, regional film office, cineport and other suitable functions. Funding – 15,7 M EUR;
- Innovation vouchers. Aims to enable companies from the region to access know-how and create contacts with the research sphere. Proved to be an efficient tool, decreasing the barrier between the cooperation of companies and research organisations. Vouchers enabled to verify the potential of cooperation in smaller projects based on specific company needs and to subsequently continue cooperation on more demanding topics. Funding – 176,2 K EUR/year;
- Design and creative credits. Aims to increase the innovation potential and competitiveness of small and medium sized companies from the region. A proven form of cooperation between the creative industries and the industrial sector. The creative credits support small and medium-sized companies

enabling them contact and procurement of services from partners from the creative industries with the aim to increase the competitiveness of company services and products. Funding – 176,2 K EUR/year.

- Specific objective "To attract to the region talents and investors (domestic and international)" is implemented by this project:

- Brno Expat Centre. Aims to support expatriations, i.e. highly qualified foreigners who work, or intend to work in Brno. The project pays special attention to knowledge intensive companies and companies with high representation of foreigners. Funding – 26,1 M EUR.

4. The strategic objective "To increase the number of new companies with aspirations and the potential to have a dominant position on the market" of the key area of changes "Competitive innovative companies" is implemented by projects as follows:

- Seed Fund. The objective is to support intensive growth of SMEs (in particular, start-up companies) in the region. Companies are supported through investments from the seed fund and related expert advisory services. Funding – 2 M EUR;

- Incubation and acceleration programme (StarCube, Innovation Park). Aims to increase the number of viable companies set up in the region. An incubation programme focuses on the verification of business ideas and primary education of first-time businessmen. The clients are mostly technology-oriented projects with an ambition to start a company and to succeed on international markets in the long run. An acceleration programme focuses on the development of verified ideas and company growth. It follows the incubation programme. The clients mostly are knowledge intensive start-up companies with the potential of fast growth (ideally complying the characteristics of fast-growing companies, known as gazelles[13]). Funding – 587,3 K EUR/year.

5. The strategic objective "To increase the number of people starting their own business for the first time" of the key area of changes "Competitive innovative companies" is implemented by projects as follows:

- Fabrication Laboratory (FabLab). Aims to support interest in starting business in the technical sector by enabling an easy access to modern prototype technology. High entry costs (technology equipment, preparation of prototypes, material, etc.) and the related high risk of thwarted investment represent some of the barriers preventing from entering the market in these sectors. Fabrication Laboratory is a tried and tested tool decreasing the above-mentioned risks, motivating interest in the technology sector and enterprise. FabLab is an equipped digital prototype workshop, accessible to the wider public, students and companies. Funding – 195,8 K EUR/year;

- Popularisation of entrepreneurship and information on innovation for secondary school and university students. Aims to motivate students to become interested, already when at school, in the possibility of starting their own business with an emphasis on innovative and new creative procedures. Consists of such activities as special education in the areas of innovative and creative thinking, and mastering knowledge associated with innovation (creating innovation, innovation management, financing innovation, marketing and market application of innovations, etc.), as well as promotion and awareness raising (e.g. specialised workshops (presentations of local innovative companies and their success stories), networking and contact meetings (exchange of experience), various entertainment competitions and

[13] A gazelle is defined as follows: 1) turnover growth of at least 20 % per annum for the period of 4 years minimum (different every year); 2) turnover of at least 15 million CZK (587,5 K EUR) at the time of measuring; 3) a company owning its own technology/expert knowledge which significantly contributes to the turnover of the company (binary criterion); 4) a company with research and development expenditure (binary criterion); 5) a company that is not a branch of a transnational/international corporation (binary criterion)

games). The project also involves communication with the target group using modern communication channels and other PR activities (attractive website, emphasis on using social networks, entertainment, etc.). Funding – 313,2 K EUR/year;

- Support and development of business enterprise in non-metropolitan areas in the region. Aims to establish and secure business centres in cooperation with the local government and regional educational institutions in order to involve students in working experience. The support is implemented through advisory services provided to companies, small entrepreneurs and sole traders (business/marketing plan, law, accountancy, financial management, development of companies using suitable subsidy titles, product and service innovation). Special education and coaching in the areas of innovative thinking, business acumen, financial management, marketing, law etc. is also supported as well as co-working activities, experience sharing, networking and contact meetings (such as business meetings, workshops, PR activities etc.). Funding – 195,8 K EUR/year.

6. The key area of changes "Top European education" besides the above-mentioned projects that involves students of secondary schools and universities as the target group is developed by this project:

- Internationalisation of Brno universities. Aims to attract lecturers from abroad as well as foreign students. Funding – 195,8 K EUR/year

7. The strategic objective "Creating a new image of the South Moravian Region/Brno as an area for advanced knowledge economy with talented, creative and active people, top scientific teams, global competitive knowledge companies with a support of modern public administration which creates unique beneficial conditions" of the key area of changes "Attractive region (communication)" is implemented by projects as follows:

- Creating a name/slogan, i.e. putting the new regional brand into words using key ideas. The aim of the project is to come up with a sufficiently attractive, differentiating, relevant, easy to remember and graphically visible slogan fulfilling the brief. Funding – 5,9 K EUR;

- Creating a logo, i.e. graphical representation of the regional brand using key ideas. The aim of the project is to come up with a sufficiently attractive, differentiating, relevant, easy to remember and graphically visible slogan fulfilling the brief. Funding – 54,8 K EUR.

8. The strategic objective "Creating a new image of SMR/Brno region (implementation, management and monitoring of results) as an area of advanced knowledge economy: i) a centre of innovative business; ii) a research and development centre, iii) a good quality education centre. Respecting DNA of the region: Quality of life/Attractive for life" of the key area of changes "Attractive region (communication)" is implemented by projects as follows:

- Electronic data portal, i.e. electronic library of the Regional Innovation Ecosystem of South Moravia. The project aims to create one joint electronic place to share defined information by all members of the regional innovation ecosystem. It will also be used as a non-public source of information for the public portal. Funding – 15,7 K EUR;

- Advertising campaign - communication agency. Aims to select a suitable, professional, and creative communication agency to implement the communication activities of regional marketing. Funding – 19,6 K EUR.

It is important to mention that most of the projects contribute to some specific objectives, strategic objectives, or even key areas of changes, because they are dedicated to the wide spectre of target groups.

The region actors also are welcomed to participate in national schemes individually or with partners from the South Moravian region as well as other regions.

MONITORING

Measurement of intervention

Implementation of S3 of the region is **monitored at two levels:**

- **Project level** – monitoring implementation of projects, arising out of the S3 Action Plan, with regards to output indicators. This monitoring is being done once a year and is presented to the Steering Committee.
- **Strategic level** – monitoring compliance with the mission, vision, strategic and specific objectives. This monitoring is being done once every two years and is presented to the Steering Committee.

The evaluation of impacts of the strategy has been done in two phases, in the middle of the strategy implementation (interim evaluation by independent experts in 2017) so that it is possible to review the tools/strategy direction. The interim evaluation is used as an ex-post evaluation for the previous S3 of the region (2009–2013 – a phase delay is used to capture the actual impacts of the intervention in the area). After S3 of the region 2014–2020 is implemented, an ex-post evaluation will be done by independent experts in 2022.

There two levels of indicators used to measure the success of interventions:

- Indicators of strategic objectives;
- Indicators of specific objectives

Key areas of changes (KAoC), strategic objectives (StO) and specific objectives (SpO)	Indicators
KAoc: Pro-innovation administration and governance	
StO: To improve the legal framework and improve administrative processes in public administration in R&D	• Evaluation score (or score change) of the administrative burden of researchers in the region (on the basis of a regular sample survey); • The average time necessary to complete tenders for research equipment (from the time a researcher makes an enquiry/specifies needs until signing a supplier contract); • Change (in time) of the average size of a purpose grant from national resources acquired by research organizations from the region; • Average number of funding sources earmarked for R&D results of research organisations from region reported in

	RIV[14].
SpO: Decreasing administrative burden and rationalization of rules for financing research	• Number of initiated changes and simplifications at the national level introduced into practice and initiated by research organisations in the region; • Evaluation of administrative burden of researchers (regular evaluation essential + collating proposals to simplify procedures); • Change in satisfaction with the results of the evaluation of targeted support projects of the best research teams in the region; • Average time between closing a call for grant proposals and signing a grant contract (and the change in time); • Share of salary resources expended on research vs non-research employees in research organisations (and the change in time).
StO: To improve the legal framework for (innovative) business	• Number of identified legislative barriers for (innovative) businesses; • Share of enforced legislative changes in the overall number of identified barriers.
StO: To improve good quality management of RIS implementation	• Share of properly implemented Action Plan projects in the overall number of planned projects; • Volume of private sources contributing to S3 activities; • Number of donors contributing to S3 activities.
KAoc: Excellence in research	
StO: To improve the quality and problematic orientation of public research in SMR	• Share of scientific publications of authors and co-authors from the region/Brno, publications in the top 10% of the world most cited publications (author from Brno/region as a corresponding author); • Share of scientific publications of authors from research organisations from the region with a co-author from a business sector; • Number of Horizon 2020 grants – participation of research organisations from the region and companies; • Number of ERC grant holders and holders of foreign prestigious grants (Wellcome Trust, HFSP, EMBO etc.) employed in research organisations in the region; • International ranking of universities and research organisations in the region (their change).
SpO: To have sufficient talents for research in the region	• Selecting university students in the region (number of accepted students/number of applicants who attend admission procedures); • Choice/preference indicator of universities in the region (number of enrolled/number of accepted students); • Share (or change in share) of enrolled students with a permanent address outside the region.
SpO: To improve material conditions for good quality research teams in the region and to improve their attractiveness	• Financial volume and number of foreign grant projects (incl. Horizon, 2020) • Number of infrastructures in the region involved in the project of pan-European infrastructures ESFRI[15] and

[14] Information Register on R&D results (information data system for research, experimental development and innovation)

	included into the national roadmap of large infrastructures • Number (headcount) and share of foreign researchers employed in research organisations in the region • Number of post-doc positions staffed by researchers, PhD staff from other institutions
SpO: To improve the standard of strategic research management	• Change in the share of publications produced by research organisations in the region published in the first quarter by impact factor in sectors; • Number of research organisations in the region that have introduced internal incentives to support strategic research activities.
StO: To maximise economic benefits of public investment in R&D in the region	• Number of licences for research results provided by research organisations from the region to companies (from anywhere); • Number of companies from the region cooperating with research organisations from the region through a subsidised grant project (national programmes TA CR[16] + H2020 + innovative vouchers); • Financial volume of funds for R&D acquired from research organisations from the region from corporate resources (contracted R&D + gifts from donors).
SpO: To strengthen cooperation between research organisations and application sphere	• Number of jointly submitted grant (i.e. co-financed by companies) research projects by research organisations from the region and companies (providers of targeted support); • Number of received grant (i.e. co-financed by companies) research projects by research organisations from the region and companies; • Financial volume of funds for R&D acquired from research organisations from the region from corporate resources (contracted R&D).
SpO: To increase the commercial use of R&D results and the knowledge of research organisations	• Number of licences for research results provided by research organisations from the region to companies (Czech Statistical Office); • Volume of funds acquired by research organisations from the region from licences for the research results provided; • Average volume of licencing fees per one licence acquired by research organisations from the region from licences for the research results provided; • Number of start-up companies using intellectual property from research organisations.
KAoC: Competitive innovative companies	
StO: To create suitable conditions for innovation driven by the growth of "mature" knowledge-intensive companies in the region	• Volume of non-investment R&D expenditure of companies from the region *(non-investment BERD[17]);* • Number of PCT[18] patents *(submitted applications).*
SpO: To increase the number of companies and to support the growth of companies able	• Change in the number of companies from the region pushing technological boundaries;

[15] European Strategy Forum on Research Infrastructures
[16] GAMA national programme
[17] Business expenditure on R&D
[18] *Patent Cooperation Treaty*

to push technological boundaries in their fields[19]	• Change in the number of R&D staff in companies; • Number of successful companies/businessmen in prestigious competitions[20].
SpO: To strengthen the competitive position of small and medium size enterprises from the region	• Change in the number of knowledge-intensive companies in the region; • Change in the number of "*gazelles".*
SpO: To attract to the region talents and investors (domestic and international)	Number of foreign companies implementing R&D activities in the region
StO: To increase the number of new companies with aspirations and the potential to have a dominant position on the market	Number of knowledge-intensive start-up companies/year with own R&D
SpO: To increase the quality and relevance of services (and background facilities) for incubation programmes in the region	• Number of knowledge-intensive start-up companies entering incubation programmes/year[21]; • Number of spin-off companies/year; • Volume of business angel investment/ventures entering into incubation programmes/year; • Number of invested companies (business angel/venture) entering into incubation programmes/year; • Number of companies that employ at least 10 people (measured 5 years after the foundation) and that have been through incubation programmes.
SpO: To support the growth of knowledge-intensive start-up companies through collaboration with developed companies/experienced businessmen	• Number of investment by mature companies/businessmen into the start-up companies in the region from incubation programmes • Number of start-up companies classed as ZIF[22] suppliers in the region from incubation programmes
StO: To increase the number of people starting their own business for the first time	Share of students in their 4th year of the secondary school and in their 5th year of university stating starting a business as their preferred career choice
SpO: To increase students´ interest in business - primary school and secondary school students in the region	Share of secondary school students interested in starting their own business as the first career choice
SpO: To increase the number of secondary school and university graduates who start their own business	Number of university students in the region who show interest in business
SpO: To increase the number of starting businessmen recruited from mature companies	Number of businessmen recruited from mature companies enrolled in incubation programmes in the region
KAoC: Top European education	
StO: To improve organizational and material	The volume of resources (especially private and foreign[23]) focusing

[19] A company pushing technological boundaries is defined as follows: 1) a company owning its own technology/expert knowledge which significantly contributes to the turnover of the company (binary criterion); 2) a company with own R&D expenditure of at least 10 million CZK (391,7 K EUR), for companies up to 49 employees, 5 million CZK (195,9 K EUR) is sufficient, 3) a company with at least 10 employees; 4) a company older than 3 years; 5) a company present on world markets (three main continents – Europe, Asia, America); 6) a company owning a unique patented intellectual property (technology, procedures) – PCT, EPO, USPTO.

[20] Prestigious competitions refer to the following: Ernst&Young Entrepreneur of the Year, Delloite Fast 50, Vodafone Company of the Year, GE Money Bank Innovator of the Year, Pikes of Czech Business.

[21] A knowledge-intensive start-up is defined as follows: 1) a company with own technology/expert knowledge which significantly contributes to the turnover of the company (binary criterion); 2) a company that has been set up in the last three years; 3) a company with paying customers (not a company still developing a product).

[22] Companies implementing R&D (Chief Technology Officer).

conditions to increase the quality of primary and secondary education in the region	on the development of education in the region
SpO: To introduce a system of performance management in secondary schools in the region	• An introduced system of performance management of secondary schools in the region; • Volume of funds secured by headmasters to develop their schools, apart from funds from the founder and MEYS[24].
SpO: To improve the infrastructure and material conditions for primary and secondary education in SMR	• An implemented, regularly evaluated system of investment into the development of infrastructure and educational aids at secondary schools in the region; • Total cost of operating secondary schools (energy - consumption in units, financial cost). • Unit cost of running secondary schools.
StO: To improve the quality and relevance of education, reflecting the needs of companies working in key industries in the region (industries by the smart specialisation domain)	Students´ results at different levels of primary and secondary schooling - mathematics and natural sciences - results of the median student (the aim is to improve the average quality) in PISA[25] survey
SpO: To improve the level and relevance of technical knowledge and skills of secondary school graduates	• Existence of centres of excellent secondary technical education in priority sectors; • Number of secondary schools with modern teaching aids for mathematics, physics, chemistry and specialised technical subjects with some classes taking place directly in companies; • Number of teaching hours in companies per one secondary school student.
SpO: To improve key generic abilities of secondary school students with an emphasis on increasing own initiative and enterprise	• Number of secondary schools with modern teaching equipment and aids reaching soft skills level 2 in accordance with National Register of Qualifications; • Employers´ satisfaction with graduates (survey - using the existing employer survey).
SpO: To improve international experience, contacts and overview of secondary school and university graduates	• Percentage of secondary school students who spend at least one week studying at a secondary school abroad; • Percentage of secondary school students who spent at least half a term or more terms studying abroad.
StO: To define a new educational policy for the Region to ensure a long-term prosperity of the region	• Strategy for the development of education to ensure a long-term prosperity of the region implementation process; • A system for collating data and evaluating information on education and the job market in the region.
SpO: To provide relevant data and strategic information for an efficient educational policy of the Region and decision making of managers at schools in the region	A shared information system on the development of economy, job market and educational system in place in the region
SpO: To develop a partnership for education and the labour market, and to involve the market into the S3 of the region platform	To set up an employment pact in the region
SpO: To define the role of education in the 21st century and to state a strategy for its development in accordance with objectives of	Existence of a strategy for the development of education with synergies with S3 of the region and its implementation

[23] In particular European Structural and Investment Funds for 2014–2020 resources.
[24] Ministry of Education, Youth and Sports
[25] *Programme for International Student Assessment*

RIS of the region	
StO: To improve the quality and relevance of university education in the region	• Selecting university students in the region (number of accepted students/number of applicants who attend admission procedures); • Choice/preference indicator of universities in the region (number of enrolled/number of accepted students); • Share (or change in share) of enrolled students with a permanent address outside the region.
SpO: To strengthen the quality and relevance of general university education	Level of employer satisfaction with general competencies of university graduates in the region
SpO: To strengthen the quality and relevance of university fields of study	• Level of employer satisfaction with the knowledge and competencies of university graduates in the region in their fields; • Number of subjects partly taught by professionals from the application sphere in accredited study programmes by faculties; • Study subjects with mandatory work experience of at least 1 month.
SpO: To improve conditions for talented students	• Number of secondary schools involved in the collaboration network with universities; • Number of universities enabling studying parts of the university study programmes and acknowledging credits.
SpO: Improving strategic management at universities and evaluation of the quality of university education	• Number of universities applying the principles of European standards and guidelines when evaluating quality in order to ensure quality university education; • Number of universities – holders of ECTS[26] Label.
StO: To improve the quality and attractiveness of teacher training in the region	Share (or change in share) of students enrolled for teaching training programmes with a permanent address outside the region
SpO: To increase practical skills of graduates of teacher training programmes	Share (or change in share) of students enrolled for teaching training programmes with a permanent address outside the region
StO: To increase internationalisation, openness and permeability of universities in the region	• Share of foreign university students; • Number of accredited study programmes in foreign language by faculties; • Number of study programmes implemented jointly by two or more universities.
SpO: To increase international attractiveness of universities in the region	• Share of foreign university students; • Number of foreign students coming to universities as part of the mobility programme; • Number of accepted foreign academic members of staff at universities as part of the mobility programme; • Number of accredited study programmes in foreign language by faculties; • Number of joint/double degrees provided in collaboration with universities abroad.
SpO: To increase internal attractiveness of universities in the region	• Share of university students in the region with a permanent address outside the region; • "Selectivity" indicator (%); • "Choice" indicator (%).
SpO: Ensuring permeability of study	• Number of study programmes implemented jointly by

[26] European Credit Transfer and Accumulation System.

programmes offered by universities	two or more universities; • Number of university subjects accessible at individual universities; • Number of universities – holders of ECTS Label.
KAoC: Attractive region (communication)	
StO: Creating a new image of the region /Brno as an area for advanced knowledge economy with talented, creative and active people, top scientific teams, global competitive knowledge companies with a support of modern public administration which creates unique beneficial conditions	Existence of Regional Marketing, a regional brand and a marketing plan
SpO: Creating Governance = conditions for planning and implementation of communication activities in the region/Brno	Existence of an executive team managing the brand
SpO: To create a regional brand	Definition of regional brand
SpO: Creating a network of external ambassadors	Number of external ambassadors
SpO: To link up important stakeholders of the innovation ecosystem for brand building as part of VVIP and using advantages arising out of the co-ownership of a strong brand	• Number of represented stakeholders in a working group; • Number of partners using the brand.
StO: Creating a new image of the region /Brno region (implementation, management and monitoring of results) as an area of advanced knowledge economy: i) a centre of innovative business; ii) a research and development centre, iii) a good quality education centre. Respecting DNA of the region: Quality of life/Attractive for life	Equity brand of the Region - a system of parameters measuring efficiency of the brand (regularly measured every 2 years) for target groups (image, knowledge, ...)
SpO: To increase the awareness and attractiveness of the region in the target group: TALENT (Czech and abroad): • talented university applicants; • scientists for scientific centres; • specialists for technology oriented companies. INVESTOR (Czech and abroad): • Start-up – starting businessmen who were previously employed; • ZIF – companies implementing R&D (Chief Technology Officer) RESIDENT: Parents of children age 10–13; Teachers at secondary schools (technical subjects, fields).	Increase in the determined parameters of Brand Equity

LOWER AUSTRIA (REPUBLIC OF AUSTRIA)

GOVERNANCE

Austria's approach to Smart Specialization

Austria is well-developed country which doesn't use a large amount of European structural and investment funds (ESIF) money for development of its R&I system. The majority of public expenditure for R&I comes from the federal government what means that Austria has much more freedom on constructing its S3 (as fulfilment of the ex-ante conditionalities of the ESIF) than countries/regions those R&I systems mostly depends on ESIF. It is also important to point out that Austria started on the path to Smart Specialisation very early and that all of the core elements of Smart Specialisation are well-anchored within the Austrian policy framework in one form or another. This is attributable not least to the tradition of endogenous, participative development with a focus on regional strengths as well as to the successful practice of balancing divergent interests within planning processes. For Austria, Smart Specialisation is a concept of long-term relevance that aims to boost growth and competitiveness. Therefore, the core document for Smart Specialisation in Austria is The Research, Technology and Innovation (RTI) strategy of the Federal Government "Becoming an Innovation Leader" as this strategy together with regional Economic and RTI strategies as well as the whole R&I policy of Austria corresponds the aims the European Commission is willing to achieve by the smart specialization initiative.

With the concept of Smart Specialisation, a new generation of business location strategies has been developed that defines thematic investment priorities for those locations where the specific strengths, competencies and development potentials hold the promise of boosting the economy and society. They are based on innovation and international market success thereby also enabling it to master future challenges. For Austria, the long-term potential of the concept is perceived to lie in the support provided for a new knowledge-driven location policy. The strategies are designed to facilitate the development of a productive "eco-system" that originates in the region.

The latest research by Austrian Institute of Economic Research (WIFO) for Austria shows that based on an overall economic assessment, the growth impulses for employment and the labour market tend to come less from a narrow specialisation on a few industries and leading sectors, but rather from a regional diversity of industries. A differentiated analysis by sector and region reveals that in human capital-intensive urban regions and their surrounding areas and also in manufacturing so-called "related diversity" has a significant positive correlation with employment dynamic. In the more rural regions – usually without any prominent industrial cores – the growth impulses for employment and the labour market tend to come from unrelated diversity of industries.

"Related diversity" means a portfolio of similar and related industries. Therefore, it is not individual sectors that are crucial for growth and employment, but rather a diverse array of related industries. These empirical findings thus support arguments in favour of a regional structural policy that places a greater focus on diversification of economic structures, combined with well-thought-out vertical priorities.

Therefore, the further development of a regional economic structure should not concentrate primarily on a narrow core of clusters or strong points, but rather along auxiliary, related industries and on promising technologies that are still weakly developed.

This essentially corresponds to the concept of Smart Specialisation, which, according to its fundamental conception, it is not the deepening of regional areas of competence, but rather a "recombination" (e.g. widening of existing know-how by adding new technologies/knowledge areas such as mechatronics, industry 4.0 or transformation processes such as the transition from the manufacture of textiles for garments to industrial high-tech textiles).

Therefore, the aim is to support entrepreneurial discovery processes to promote a forward-looking diversification based on existing competencies and endogenous strengths. In this respect, the empirical results are evidence of the feasibility of the concept of Smart Specialisation for Austria. However, it also shows that a narrow and static interpretation of the concept should be avoided.

Strategic objectives

The RTI strategy of the Federal Government pursues two main targets:

• To continue developing the potentials of science, research, technology and innovation in Austria, to make it one of the most innovative in the EU by 2020, strengthening the competitiveness of economy and increasing the prosperity of society;

• To continue developing the potentials of science, research, technology and innovation in Austria, using them in a holistic manner to deal with the major societal and economic challenges of the future.

From these targets the following additional objectives are derived:

- Sustainable reform of the Austrian education system: Optimise framework conditions for research, technology and innovation; improve the connections between the education and innovation systems; increase the quality and quantity of human resources available in Austria for research, technology and innovation;
- Strengthen basic research and its institutions: Increase funding of basic research while simultaneously increasing the share of funds that are awarded in competitive processes; continue with structural reforms of universities and coordination of those performing excellent research inside and outside the universities;
- Strengthen the innovative power of firms: Increase direct and indirect support to improve the technological performance and innovative power of Austrian firms; intensify applied research and technology transfer, especially among SMEs, as well as the supporting role of leading firms; strengthen the utilisation of demand-side instruments in innovation policy;
- Increase the efficiency of political governance: Increase the efficiency and effectiveness of the innovation system by means of clear governance structures; a modern research (funding) regulatory framework with principles for results-oriented funding allocation and improvement of planning reliability for all actors.

If talking about regional approach, starting from a careful consideration of the status quo and the identification of strengths and weaknesses, eight fundamental objectives in the field of R&I in Lower Austria were defined:

- Continuation of targeted investments in R&I;
- Setting thematic priorities;
- Strategic build-out of R&I structures;
- Strengthening of R&I in companies;
- Expediting education and training;
- Thinking and acting on a nationwide basis;
- Creating a high profile;
- Boosting of effectiveness.

They serve as a medium-term and long-term framework for a progressive RTI policy, on whose basis implementation concepts and measures were developed. The overall target framework is flexibly designed so that new opportunities and challenges can be addressed.

A series of economic goals were defined in Economic Strategy 2020 of Lower Austria for the orientation and focusing of all of the province's economic measures. The defined overall economic goals are as follows:

- Lower Austria is the driving force of growth in eastern Austria;
- Lower Austria creates high quality, professional jobs;
- The development of Lower Austria as an attractive business site will continue.

The producing sector in industry and commerce makes a major contribution to the strength of the economy in Lower Austria. In order to continue improving the ability to compete, especially for the producing economy, an effort is made to keep Lower Austria attractive as a business site and develop it further. This approach has been put into practice through various fields of action in the following core strategies that contain sets of measures with the aim of maintaining and further developing Lower Austria as a production site. The core strategies:

- Sustainable Business Success and Internationalization. This core strategy focuses on supporting companies in their sustainable growth and in their internationalization activities Essential fields of action in this core strategy are:
  - Funding and support for growth projects;
  - Promotion of strategic and sustainable corporate development and efficient use of resources;
  - Development and backing of process and productivity optimization;
  - Identification, counselling, and backing of potential exporters;
  - Promotion of investments by areas of focus;
  - Assistance with site establishment and expansion projects;
  - Liabilities AND participating interests for investments and businesses.
- Research, Development, and Marketing. Essential fields of action in this core strategy are:
  - Upgrading of technology and innovation skills;
  - Sponsorship of cooperative innovation projects;
  - Development and backing of cooperative R&I projects and needs-adapted education programs;
  - Promotion of research and development projects;
  - Promotion of investments in switching to series production;

- Mobilization of innovation potential.

- Start-ups with growth dynamics. Specifically promoting and funding business start-ups with growth potential lays the foundation for employment. The EU also views this as an opportunity to create new jobs and reduce poverty. Fields of action:

- Development and promotion of academic establishments;
- Identification and support of innovative, rapidly growing businesses through venture capital;
- Promotion of investments by growth-oriented business founders;
- Identification and support of business founders with growth dynamics;
- Mobilization of business start-up potentials in the college and research environment;
- Start-up promotion programs;
- Counselling & networking of business founders;
- Start-up centers.

- Attractive Business Sites. Strategy continues to focus on the Technopole centers, which have since developed into dynamic drivers of development. The development and the coordinated operation of both existing and new business parks is also intended to form the basis for providing targeted support to companies for projects in new site establishment and expansion. Fields of action are as follow:

- Development and management of technology and research centers;
- Promotion of regional flagship projects;
- Identification & support of top business establishment and expansion projects;
- Development and management of business parks and in business site cooperations;
- Business site, province image, and tourism marketing;
- Reachability of outlying business sites via modern communications infrastructure

The Economic Strategy for Lower Austria 2020 and the RTI Strategy for Lower Austria closely interacts together. Research, technology and innovation (RTI) are definitely setting the future course for the preservation of quality of life in socio-political, environmental and cultural terms. They contribute significantly to prosperity and security, to maintaining economic competitiveness and thus growth and employment. In order to account for this high level of future relevance for the development of Lower Austria, a process was initiated to draft a long-term and coherent strategy for the future formation of policies with respect to science, research, technology and innovation. RTI strategy is an umbrella strategy for existing strategies and concepts, including those for technology and innovation.

RTI Strategy of Lower Austria covers the basic areas of the current and future RTI policy of Lower Austria. Furthermore, the RTI strategy identifies potential areas of strength and makes basic statements on the future development of science and research policies.

Each of 10 topic areas has their own objectives targeted at specific goals the region is willing to achieve by developing these topics:

- Humanities, Social and Cultural Studies. The general aim is that socially relevant issues get linked and elaborated upon by the Lower Austrian Humanities, Social and Cultural research institutes on an interdisciplinary and high-quality basis;

- Collections, Lower Austria. Aims to play a leading role in the study of museum collections;
- Ecosystems and ecosystem services. The specific objective provides for the establishment of a "Network Biodiversity" so as to optimise the collaboration between existing agencies and institutions in accordance with applied and environmentally oriented research;
- Water. The aim is to build up an excellence network in Lower Austria that is internationally competitive and has a high profile, bringing forth new findings in the field of water, at the same time connecting the different sectors in research on water bodies and water;
- Renewable raw materials and bioenergy. Aims to develop foundations for eco-efficient and economically-viable process chains of the utilisation of materials, building materials, basic chemicals and fine chemicals by 2020 and link them optimally with their energy use via cascading utilisation;
- Food and feed safety. Aims to bundling and advancement of skills, an even keener networking of research institutes and companies, linking of basic research and applied research as well as promoting the transfer of results, a response to the needs of companies, utilisation of training capacities and an expansion of the focal points;
- Sustainable land management and production optimisation. Aims to make Lower Austria fit for the transformation from an input-driven toward a sustainable, resource-efficient and environmentally-sound land management;
- Medical technology and medical biotechnology. Goals at the creation of a strong network of expertise, international networking and high profile of Lower Austria as a research site as well as scholarly and scientific publications in leading "peer review" journals. In addition, a boost in the number of patents, of financial returns on licenses as well as the successful attraction of national and international third-party funding;
- Materials and surfaces. The goal is to heighten the profile further and increase the number of researchers in this topic area as well as to make substantial contributions to securing and expanding the competitiveness of the Lower Austrian economy, to secure existing jobs and create new ones;
- Manufacturing technology and automation engineering. Strategic objective is to establish Lower Austria as one of the leading regions for manufacturing technology and automation engineering.

Organization

The operationalization and concrete design of the instruments and programmes of the RTI strategy of the Federal Government is the responsibility of the competent ministries and agencies.

- The coordination and the related overall monitoring of implementation of the strategy are managed by the Department for Research Coordination of the Federal Chancellery;

- An inter-ministerial "RTI Task Force" was established for the management and operationalisation of strategy implementation at the highest official level supported by thematically-specific Working Groups (e.g. on themes such as research infrastructure, internationalisation and RTI external policy or climate change/scarce resources). Within the work of the Task Force for the implementation of the RTI strategy and in its working groups, targeted priorities are defined based on the central problem areas to be able to identify the strengths and weaknesses of the structural transformation and thus derive concrete recommendations for actions and their implementation;
- The Council for Research, Technology Development and Innovation was commissioned by the Government to monitor strategy implementation. To this end, the Council for Research, Technology Development and Innovation prepares an annual report on Austria's capacity potential in science and technology. The progress of strategy implementation is monitored using an extensive set of indicators assigned to each of the objectives;
- The federal government prepares a Research and Technology Report every year. The two reports mentioned are brought to the attention of Parliament;
- The principle of effective budget management implies a stronger focus of the guidelines on the content of the objectives and the indicators. Thus, a written evaluation concept is prepared for each financial assistance programme and measure that is based on the RTI Guidelines. For the purpose of recording the required information, adequate monitoring must be set up that delivers standardized basic data for the life of the project;
- Evaluation culture is therefore highly developed in Austria. A separate platform for research and technology policy evaluation has been established – FTEVAL and the persons responsible for RTI policy and the evaluators are represented on this platform. In the past, evaluations have often served as the starting point for critical RTI policy changes.
- In the regional level the strategic coordination for each of the specific themes takes place using information and exchange forums:
- Mutual bilateral participation in strategy development, especially by federal organizations in the regional RTI strategy processes in order to take account of the overarching strategies;
- The "Bundesländerdialog" – the policy platform for national and regional governments and agencies in science, research and innovation set up by the Federal Ministry of Science, Research and Economy is the established platform of the federal government and regions for the exchange of information in the areas of science and research, and enlarged by the inclusion of a group of stakeholder organizations. The platform "Bundesländerdialog" creates the basis for the ministries and the Länder to coordinate their policies more closely and define the themes;
- The "Platform RTI Austria" set up by the Council for Research and Technology Development meets twice a year and serves as an information hub for the regions and the agencies for the financial assistance schemes for all areas of the innovation system. Its meetings alternate and are coordinated with the meetings of the "Bundesländerdialog";

- The federal government and the regions coordinate their structural policies within the scope of the Austrian Conference for Spatial Planning;
- At the instruments level, important RTI policy instruments are funded jointly by the federal government and regions (e.g. COMET Programme[27]) or are co-financed by the regions (e.g. financial assistance for enterprise R&D projects). The exchange of information and coordination is also supported within the Cluster Platform.

The role of universities as leading regional institutions is being given more attention in location development. Public universities have three-year performance agreements that are rolled over and renewed. In the three consecutive performance agreements (2013-2021) and in the overall university development plan 2016-2021 , the Ministry for Science, Research and the Economy calls on universities to coordinate their activities with a view to developing competitive knowledge locations and to proactively exploit their potential as leading regional institutions. A report drafted by experts on behalf of the European Commission (2014) recommends that Austria's leading institutions initiative be used as a "smart policy scheme" for the implementation of Smart Specialization.

RTI strategy of the Lower Austria as one of the main components of the Smart Specialization strategy of this region has a quite effective management system. The Department of Science and Research at the Office of the Lower Austrian government manages the planned continuous development process and provides for regular meetings of advisory and developing committees and work groups. They include:

- RTI Steering Group. Formed for the integration of relevant topics, review of ideas, ongoing monitoring of the implementation process for the RTI program, topic areas and priority projects. The Steering Group also serves to support and prepare the Management Committee, whose meetings it coordinates and prepare in terms of content;
- RTI Management Committee. The RTI process is managed by a Management Committee, which convenes twice a year. Beside section heads from the Office of the Lower Austrian government and the head of the Department of Science and Research, external experts will be part of the Management Committee.
- The Lower Austrian RTI landscape should gain further momentum from two advisory boards as well as the continuation of the topic area groups:
- RTI Location Forum. The main research institutes and educational institutions in Lower Austria are represented in the Forum. The Forum has the task of coordinating the advancement of the science and research location of Lower Austria between the relevant players and stakeholders, of improving the networking between the institutions and hence of providing more opportunities for cooperative projects. This Forum will meet twice a year and have an advisory role for the continuous adaptation of the RTI program of Lower Austria. The Department of Science and Research at the Office of Government of Lower Austria is responsible for the organisation of the RTI Location Forum;
- RTI Steering Committee. While the Location Forum was established as a platform for research institutes and educational institutions, the RTI Steering Committee is an advisory body for industry and business. It acts as an industry advisory council for research, technology and

[27] COMET – Competence Centers for Excellent Technologies is a central funding program of the Austrian R&I politics. It serves to create competence centers for various topics at selected locations.

innovation. Its composition follows the structure of industrial sectors in Lower Austria. Its task is to pick up ideas from the business sphere and integrate them in the RTI strategy process of Lower Austria. Like the Location Forum, it will convene twice a year. The Department of Economy, Tourism and Technology at the Office of Government of Lower Austria is responsible for the organisation of the RTI Steering Committee.

- Topic area groups. In order to generate dynamism with respect to contents, workshops, or discussion groups, for each of the ten defined topic areas are held at regular intervals (at least once a year). Experts from the fields of research, education, business and society who have experience in the relevant topic area will make up these workshops. In addition to further networking the various players, the workshops are intended jointly to develop new measures, projects or priorities within the topic area. The results of these work processes are in turn integrated in the rolling development process.

In addition to the adaptations set up in the process structure, the RTI program, including sub-programs, is to be evaluated by external experts at a certain point in time in order to ensure evidence-based review.

FINANCING

Thematic priorities

The RTI strategy of the Federal Government establishes the thematic priorities for the period until 2020 that form an important framework for the definition of areas of strength oriented on social and economic challenges or for which strategies for industry clusters are developed and implemented on the basis of the RTI strategy. Notwithstanding the promotion of excellence at research institutions, investments in infrastructure and initiatives to support innovation (e.g. innovation for services and tourism), the following thematic priorities – in the meaning of Smart Specialisation – have been defined for the period until 2020:

- Information and communications technologies;
- Life sciences;
- Materials sciences and intelligent manufacturing;
- Bio-economy and sustainability;
- Climate change, energy use and dealing with scarce resources;
- Intellectual, social and cultural sciences (including social innovation);
- Securing the quality of life in view of demographic change (including urbanisation, mobility and migration).

The locational profile in Austria is ultimately differentiated by the locational strategies and profiles developed at the region level. Financial assistance for location and project development is distributed by thematic area for which priorities have been defined within the regional innovation system or for which deficits have been recognized.

The regional strategies are defined in accordance with the thematic priorities specific to a location targeted for promotion and development. The goal is to build up competencies and institutions that can

become part of national and international programmes, and at the same time, can be integrated into international value chains presently and over the longer term.

Economic Strategy 2020 of Lower Austria is recognized as the Smart Specialization strategy of this region. It serves as a foundation for the activities and measures of the business areas of the Lower Austrian Ministry of Economic Affairs as well as a template for the numerous cooperative projects with intermediaries. The strategy in turn incorporates the considerations and plans of relevant partner organizations. Economic Strategy 2020 of Lower Austria is rather general and does not mention any sectors, technologies or other specializations. However, specialization is fostered by the activities of the cluster managers and Technopol managers. In each cluster, the stakeholders select specific topics and develop collaborative innovation / qualification projects for the benefit of companies (cluster members). The Technopols are 4 technology locations in Lower Austria combining tertiary education, R&D institutions and companies with competencies in specific technology niches. The Technopol managers contribute to the development of the specialization at the Technopols by facilitating networking between the actors on site, fostering a joint strategy development, supporting location marketing, supporting new settlements at the location etc.

In recent years, the federal state of Lower Austria has invested heavily in the development and expansion of science and research sites. The goal was and is to achieve a critical mass in strategically important branches of science so as to strengthen applied research and development as well as basic research and expand tertiary education programs in the state. Although strategically important decentralised facilities are also supported and upgraded, the investments of Lower Austria focus primarily on six locations:

- Krems. Connecting together universities, research centres, innovation service providers, knowledge intensive medical biotechnology companies, bio science park, Krems is a ground in biomedicine, pharmacy and health sciences. Technology fields:
  - Apheresis;
  - Regenerative medicine;
  - Inflammation;
  - Water & health.
- Tulln. One of the most internationally recognised research centers for natural resources and biobased technology research is conducted here mainly due to the synergies in the region. Technology fields:
  - Bio-based process technology;
  - Agro-biotechnology;
  - Food and feed safety.
- Wiener Neustadt. International center for medical and material technology. Technology fields:
  - Materials;
  - Medical technology;
  - Surfaces;
  - Tribology (friction, wear, lubrication);
  - Sensors/actuators.
- Wieselburg. Technopol Wieselburg focuses on a long-established research area of

the region. Today the location is regarded as a center for renewable energies, primary production, foodstuffs as well as sustainable soil and water research. Technology fields:

- Bioenergy systems;
- Agricultural technology;
- Food technology;
- Water management.

Clusters in Lower Austria network companies and science institutions, motivate them to innovate and cooperate, and initiate joint product and process development, as well as research projects and training schemes. Initiating pre-competitive collaborative projects is at the core of their activities. The Clusters in Lower Austria aim at joint pre-competitive research as a basis for product and service innovations, joint improvement of organisational and production processes as well as building-up and anchoring know-how in the region. There are five Clusters in the region:

- Green Building Cluster. Represents innovative, sustainable construction. the cluster aims to promote innovation in the domestic construction industry and boost business by pooling potential and expertise into a network of stakeholders from business, research and training as well as from specialist organizations and the government of Lower Austria. Cluster partners benefit from each other and work together on innovative, future-oriented projects. The cluster provides a company with a suitable platform to implement cross-company innovation projects through cooperative effort. A special emphasis is placed on the needs of SMEs across the entire value-added chain of the construction industry. Key areas:

- Climate-adaptive technologies;
- Constructive efficiency;
- Digitization in construction / Building Information Modeling.

- Food Cluster. The Food Cluster of Lower Austria is the information, service and contact point for the entire value chain of the food industry in Lower Austria – from agriculture to processing companies and retail. Key areas:

- Food quality and food safety;
- Sustainable use of resources.

- Plastics Cluster. A cross-industry network of the plastics sector**.** The Plastics Cluster thus provides a pre-competitive basis for innovative product development of its cluster partners in business and research. In addition, its collaboration with the Mechatronics Cluster offers high networking potential for both sectors due to their closely related subject areas. The aim is to pool potential and expertise to increase the innovative strength and international competitiveness of cluster partners. A special emphasis is placed on the needs of SMEs. Key areas:

- Bioplastics;
- Multifunctional component development;
- Material cycle / recycling.

- Mechatronics Cluster. Comprises the sectors metal, mechanical engineering, electrics, electronics as well as information and communication technology. The aim is to pool potential and expertise to increase the innovative strength and

international competitiveness of cluster partners. A special. emphasis is placed on the needs of SMEs. The focus of the Mechatronics Cluster is on business and research, innovation, cooperation, training and project initiation for specific key areas:

- Energy technology;
- Additive manufacturing;
- Smart production;
- Digitalization / Advanced Manufacturing.

- E-mobility initiative. Aims to provide a valuable contribution to CO2 and energy reduction through electro mobility, as well as provide an impetus for a new mobility trend and boost the region's economy.

According to the principle of "Strengthening strengths", Lower Austria is pledged to developing a clear profile in the field of science and research with the present RTI program. By focusing on 10 defined topic areas, public funding for science and research can be made use of even more purposefully. The aim is to achieve, or build out, critical masses within the defined thematic focuses, heighten the international profile and attain or strengthen academic excellence.

The measures and goals of the topic areas developed in a bottom-up process can be summarized in three basic focuses, which represent the framework of the RTI program in terms of content:

1. **Nature – culture – quality of life.**

The RTI program contributes to securing and improving the quality of life in Lower Austria. It aims at exploring both its own past and the current social environment and better understand ecological relationships and natural environments. Sustainable agricultural land cultivation and the innovative use of natural resources aim at preserving our biodiversity. To achieve these goals, the following topic areas within the RTI program are focused on:

- Humanities, Social and Cultural Studies;
- Collections, Lower Austria;
- Ecosystems and ecosystem services;
- Water;
- Renewable raw materials and bioenergy;
- Food and feed safety;
- Sustainable land management and production optimisation.

2. **Nutrition – medicine – health.**

The RTI program helps to improve medical standards, develop new medical technologies and guarantee food quality. It aims at enabling a long and healthy life; ensuring food reliability, feed and clean water; and improving or developing methods of medical treatment through new scientific findings. In order to accomplish these goals, the following topic areas are an integral part of the RTI program:

- Ecosystems and ecosystem services;
- Water;
- Food and feed safety;
- Medical technology and medical biotechnology.

3. **Technology – productivity – prosperity.**

The RTI program contributes to ensuring that Lower Austria will remain a leading technology base in the future. It aims at exploring innovative technologies today, applying them tomorrow, developing from an "innovation follower" into an "innovation leader" and thus shaping the future in a pioneering role. Research in this area aims at increasing prosperity. In order to accomplish these goals, the following topic areas are an integral part of the RTI program:

- Renewable raw materials and bioenergy;
- Sustainable land management and production optimisation;
- Medical technology and medical biotechnologies;
- Materials and surfaces;
- Manufacturing technology and automation engineering.

Directions of intervention

The topic areas of RTI strategy of Lower Austria mentioned in the section above are developed by implementing priority projects that address the specific needs of each topic area:

- Humanities, Social and Cultural Studies. Priority projects:

- Research Network Interdisciplinary Regional Studies (FIRST) – Network Management. Specifies at the coordination of cross-institute (research) activities of the individual institutes, boosting the research potential, attracting a high rate of national and international project funding;

- Migration Research Network. The specific goal is an excellently networked research community with a shared knowledge base for migration research that successfully attracts third-party funds and establishes a functioning mediation instrument for the dialogue between academic research and society;

- Nutrition Research Network. Specific goals are the establishment of an internationally high-profile research network in the field of (agricultural) food studies; the network is successful in attracting project funds, publishes research findings and provides public and private stakeholders with strategies for issues of poverty and nutrition.

- Collections, Lower Austria. Priority projects:

- Establishment of an endowed chair for Museum Collection Studies. Aims at the establishment of museological basic research in Lower Austria and the transfer of theoretical, methodological and empirical knowledge to and from the state collections of Lower Austria;

- Setup of a Centre for Museum Collection Studies. Aims at reappraisal and securing of the state collections in Lower Austria and networking with all major regional and city museums.

- Ecosystems and ecosystem services. Priority projects:

- Establishment of a coordination office for the "Network Biodiversity". Goals at the installation of a central coordination office at an existing institution in Lower Austria. The "Network Biodiversity" includes partners from the scientific and scholarly sphere, education as well as business and commerce and will be continuously developed and enhanced;

- Setup of a central data management (biodiversity database). Aims at the implementation and filling of a central data management system. In addition, necessary staff resources should be established in the institution and secured in the longer term.

- Water. Priority projects:

- Structural development of experimental facilities and pilot areas. Specific goal of the project: the setup, renewal and long-term protection of the infrastructures and the necessary personnel to operate the facilities; as well as an increase in the number of cooperative projects, procured research funds and publications at the locations;

- Modelling of the occurrence and behaviour of organic trace elements in the aquatic environment and in urban water management plants. The specific goal is to develop a GIS (geo information system) map that shows the occurrence of organic trace elements (primary substances of anthropogenic use) in surface water bodies, ground water bodies as well as in the untreated water of water supply systems and in urban water management.

- Action plans for organic trace elements in the water supply and ecosystems. Aims at support for the application of the "Water Safety Plans" for organic trace elements even in terms of small water utilities; appraisal based on the catchment area, taking into account wastewater treatment; and the development of appropriate guidelines for procedures; as well as the support of management and operators.

- Renewable raw materials and bioenergy. Priority projects:

- Building with timber in multi-story construction. Aims at the establishment of a research network with companies in a "K project" from the federal COMET program[28]. It is intended to prove the feasibility by way of a multi-story residential building constructed of timber with innovative solutions in Vienna or Lower Austria;

- Sustainable bio-heat technologies in Lower Austria. The specific goal is to continue the existing COMET K1[29] Centre Bioenergy2020+ on a successful basis and build out the strong cooperative ties between science and industry;

- Innovative hardwood technologies and products. Aims at the development and use of new hardwood processing technologies in a COMET K1 Centre or K project[30], an initial spark for increasing hardwood processing through attractive and market-based hardwood products as well the development of a new supply chain management for efficient processing chains.

- Food and feed safety. Priority projects:

- COMET K1[31] Centre Feed and Food Safety, Quality and Innovation "FFOQSI". Aims at new, innovative solutions and research approaches for sustainable food and feed safety as well as marketable products;

- High-throughput analysis of metabolites. Aims at the build-out of the equipment park and the operation of large-equipment infrastructure;

[28] https://www.ffg.at/en/comet-competence-centers-excellent-technologies
[29] ibid
[30] ibid
[31] https://www.ffg.at/en/comet-competence-centers-excellent-technologies

- Metabolism, decontamination and current risk assessment of mycotoxins. Aims at new insights into the metabolism of mycotoxins and new findings in terms of the toxicity of this substance class for improving risk assessment. Furthermore, new and relevant biomarkers for mycotoxins are to be identified and purified and used for exposure studies on an individual basis.

- Sustainable land management and production optimisation. Priority projects:

- Top soil management and regional bio-fertiliser production. The specific goal is to develop new products for the optimal use of organic waste and bio-fertilisers as well as the development of a package of measures for the sustainable conservation of top soil and soil quality;

- Production of commodities for the processing industry. Aims at reduce dependency on imports, the definition of new goals in the breeding of wheat varieties as well as the protection of rye production in unfavourable locations.

- Medical technology and medical biotechnology. Priority projects:

- Christian Doppler Laboratory for Innovative Therapies in Sepsis. The focus of the project is on new supportive therapies for improving existing aphaeresis procedures and the development of new bio-materials for aphaeresis;

- COMET-K[32] Project OptiBioMat. The specific goal is to replace the permanent implants currently used, so that high-risk, stressful and expensive explantations can be dispensed with;

- COMET K1[33] Centre "Surgical Technologies". The specific goal is to establish the ACMIT[34] even more steadfastly as one of the leading European R&D centres and recognised partner of the industry for minimally-invasive surgical interventions in mechatronic technologies.

- Materials and surfaces. Priority projects:

- "Materials and surfaces" Excellence Map. The specific goal is the detailed presentation of the expertise, resources and capabilities of relevant Lower Austrian companies and all theme-related R&D institutions in Lower Austria;

- Continuation COMET K2[35] Centre for Tribology. The specific goal is the successful development of the COMET K2[36] Centre of Excellence for Tribology in the current funding period until 2020;

- Continuation of the COMET K1[37] Centre for Electrochemistry. This project focuses on the continuation of the work for science and industry, the development of additional skills and the expansion of the network of cooperative projects with industry.

- Manufacturing technology and automation engineering. Priority projects:

- Additive Manufacturing (3-D printing). The specific goal is to expand the existing infrastructure of FOTEC/FH Wiener Neustadt[38] for the 3-D printing of metals by the research

[32] ibid
[33] ibid
[34] Austrian Centre for Medical Innovation and Technology
[35] https://www.ffg.at/en/comet-competence-centers-excellent-technologies
[36] ibid
[37] ibid
[38] One of the four technopols operating in Lower Austria

expertise needed by companies in order to use these new technologies purposefully in their production;

- High performance machining. The specific goal is to provide companies with a permanent and simplified access to know-how and proven technologies;

In addition to concentration in terms of content and profiling, the RTI strategy is designed to create new momentum in the area of "education and training" as well as awareness-raising.

- Training and further training. Identifying, developing and utilising individual strengths, talents and skills should be encouraged at all levels of education. Educators as multipliers should provide parents and children with guidance and perspectives for education and career professions and thus highlight the special opportunities entailed in the areas of research, technology and innovation. At the same time, the transition to a suitable professional occupation should be facilitated by a multifaceted networking of education, business and commerce as well as scientific and research institutes. Numerous measures are closely linked to the strategic concepts in the area of awareness-raising. Objectives:
  - Information and guidance on existing target group-specific offerings in education;
  - Establishment of Lower Austria as an educational and research site;
  - Increasing interest and curiosity; encouraging and facilitating the exchange of RTI-relevant content;
  - Talent promotion, individual guidance, interface optimisation;
  - Individual promotion of talent and young scientists;
  - Incentive system for the consistent processing and communicating of RTI-relevant;
  - Identification of regional training needs and coordination of corresponding offers;
  - Think tank and "creative engine" for medium-term initiatives and projects in the area of education and training;
  - Demand-driven development of the range of offers in tertiary education;
  - Increasing the quantity and quality of research at Lower Austrian universities and technical colleges.
- Awareness-raising. Aims to increase the value and appreciation of science in society, bringing young people as early as possible into contact with the scientific community in order to promote interest in and enjoyment of a scientific/technological training and career, as well as to strengthening skills and individual talents. Objectives:
  - It is planned to establish a "University for the Young" at all locations of technical colleges;
  - Every student in Lower Austria – including children from educationally alienated backgrounds – should come into direct contact with science and research at least once in his/her school life. Scientific programs that were already completed will be taken into account in follow-up programs;
  - Bundled information on range of course offers. Demand-driven development of the range of offers in tertiary education;

- Sustainable and inclusive strengthening and networking of proactive measures for awareness-raising and demand in future fields;
- The population is to be informed by means of targeted and bundled measures of what the fields are in which research is conducted in Lower Austria.

Policy instruments

The goal of Lower Austria is to support by means of various instruments the entire spectrum of science in Lower Austria, from education to basic research to applied research. The term instruments refers to both funding and support instruments and services. By providing such instruments along the entire innovation chain, strategically important special subjects in particular will be strengthened in the long term. Instruments:

- Services. The services are needs-based and target group-appropriate. They are organised as programs that are geared to one another and will be constantly revised:
  - Services to promote talent by identifying and supporting talented students in science and research and aiding young people with educational choices;
  - Services to strengthen transfer of knowledge, publication and utilisation of research findings;
  - Services to build critical mass and an international high profile by means of networking existing institutions, project generation and promotion of cooperative projects with potential users.
- Financing. Along the entire innovation chain, the federal state of Lower Austria offers funding instruments in the area of RTI. In addition to funding in the form of subsidies, this offer includes other financial instruments, such as assumption of liabilities, investments or venture capital. All these instruments are seen as measures to supplement programs of the federal government and the European Union. Financing forms:
  - Project funding. In order to strengthen the defined RTI topic areas, the available financial resources for project funding in the field of science and research are focused on these areas. In addition, the federal state of Lower Austria is committed to a greater use of competitive procurement procedures for project funding so as to increase the scientific quality of scientific projects funded by the government of Lower Austria;
  - Endowed Chairs. To strengthen individual topic areas in a targeted way, increase their research potential and expedite the scientific teaching in relevant areas, endowed professorships are selectively awarded;
  - Scholarship systems. A wide range of scholarships contributes to the promotion and support of young scientists in Lower Austria;
  - Promoting dissemination activities. In order to heighten the national and international profile of the research work performed in Lower Austria, targeted dissemination activities (e.g. scientific publications and conferences) of scientists and research institutions located in Lower Austria are supported;
  - Promotion of innovation in companies. Since innovation in companies is the engine for growth and employment, the federal state of Lower Austria – in accordance with

the Economic Strategy 2020 – offers several financing instruments to support research and development, with a focus on market implementation.

- Infrastructure. In the area of building infrastructure, the federal state of Lower Austria supports selected projects for the settlement and further expansion of research facilities. This support comes in the form of provisioning (technology parks, IST Austria, MedAustron, etc.) or operating the building infrastructure (Krems Campus, Klosterneuburg Campus, Tulln Campus). To strengthen the scientific institutions in Lower Austria, the government of Lower Austria will invest selectively in the equipment and technology infrastructure in the future, since it is a prerequisite for high-quality science and research, especially in the area of the natural sciences and technology. The concept is implemented in close coordination with the Ministry of Science as part of the infrastructure plan.

Funding

The federal government's decision to adopt the RTI strategy is a declaration to provide financing for RTI measures in accordance with the strategy for a multiyear period. Within this scope, the competent ministries for research, technology development and innovation have a budget and commission agencies with the execution of financial assistance programmes. As of April 2019, Statistics Austria is expecting an additional increase in Austrian R&D investments in 2019, both in relative and absolute terms. According to their forecast, 12,8 B EUR will be spent on research and experimental development in 2019. This corresponds to a research intensity (R&D expenditures as a percentage of GDP) of 3,19 %. In 2019 the public sector will account for over one third of all R&D funding in Austria, with nearly 35 % of the total (Federal government: 33,9 % (3,8 B EUR), Regional governments: 4,3 % (547 M EUR). At a total of 48,96 % (6,3 B EUR), Austrian firms will have financed almost half of all R&D. 15,6 % (2 B EUR) of R&D funding in 2019 will come from outside Austria; the majority of this sum comprises financing from foreign enterprises for research being carried out in their subsidiaries in Austria, but it also includes funds from EU research programmes. This shows that the role of the business sector and its' willingness and possibility to invest in R&D is the crucial for the economy which calls itself an innovation leader. The returns from the EU Research Programmes are also included in the foreign funding.

MONITORING

Measurement of intervention

Monitoring the impact of its economic and innovation policy is of course also an integrated part of Lower Austria's S3 implementation with application of a broad bundle of instruments on project, program and regional strategy level. One of these instruments is the Balanced Scorecard System (BSC), which is applied for the regional Economic and Innovation Strategy as overall strategic framework for Lower Austria's Economic and Innovation Policy. BSC documents the overall objectives of the regional innovation and economic policy, the target figures and the monitored achievements for these objectives.

The BSC Target Map defines the objectives for the 4 LEVELs "economy", "company" (= clients of the regional policy), "performance (instruments and process)" and "learning" in answering the following questions:

- Which economic targets do we want to achieve? (level 1);
- What has to be achieved by our clients in order to meet the economic goals? (level 2);
- What do we need in terms of tools and processes (level 3);
- What do we have to learn and to improve in order to run the instruments and processes effectively (level 4).

For every level 3 to 4 objectives are defined, each objective has minimum one indicator, but in average up to 5 indicators with concrete target figures.

The BSC indicators of LEVEL 1 – economy and partly LEVEL 2 – clients are mainly macroeconomic ones, which are available via Eurostat, Statistik Austria or The Lower Austrian Chamber of Commerce. Another source of data is the regionalized Community Innovation surveys every two years, the national R&D surveys every two years and further surveys of statistical experts ordered by the Lower Austrian Government. Impact is monitored e.g. in terms of GDP, quality of life, purchasing power, companies' turnover and profit in several branches. Input is monitored e.g. in terms of annual budget allocation and number of full- time equivalents. Output is monitored e.g. in terms of total number of researchers in Lower Austria, R&D expenditure of companies, employment in medium/high tech manufacturing and high tech services, number of active locations of an enterprise and further more.

In a second step this BSC was broken down for single programs, the so-called "Program BSCs". Every program manager and related service provider decide about their contribution to the "Overall BSC" and the objectives for the 4 BSC levels by asking the questions: what has to be the objective of our program in order to contribute to objective x of the BSC and what we can really influence? This break-down approach is ensuring the link between program objectives and overall regional objectives, even though there is no mathematical equation like "Result of objective of the BSC = sum of results of linked objectives of program BSCs".

The Program BSC is applied by public/semi-public intermediaries in regional economic and innovation policy. All programs of Lower Austria's economic and innovation policy are covered by the BSC method.

Application of the Program BSCs is a continuous in monitoring process. Twice a year bilateral review sessions are organized with every program responsible intermediary. In these review sessions the current up-to-date achievements are discussed and compared to the target figures of the program objectives. If necessary, an amendment of the target figures can be done. Thus the Program BSC is flexible and is taking new insights into consideration, not insisting on outdated target figures agreed on few years ago and turned out as unrealistic. In the reviews challenges and highlights of the program and services results are also discussed as well as new potential topics for the program with related services. In the review session at the end of the calendar year the planning for the next year is being discussed and negotiated, but not the budget as this is fixed for the whole programming period.

LESSONS LEARNED FROM THE ANALYZED REGIONS

GOVERNANCE

Leadership and participation to enable innovation

Leadership is critical for both the design and delivery of S3. In many respects it is highly influenced by the stability of the political and policy processes in the region or country in question. This stability allows for the development of strong relationships between different levels or departments in the public sector and between the public, private and third sectors. Building on these relationships, the public sector has a key role to play in the implementation of initiatives that emerge from involvement with a variety of actors. Political leadership is the most critical ingredient in the S3 repertoire because it creates the capacity to mobilise every other ingredient. However, smart political leadership will recognise (and enable) an ethos of collaborative and distributed leadership because different skill sets are required at different stages in the S3 lifecycle. On the one hand, S3 may need different types of leadership at each stage of the implementation process — sometimes called collaborative or distributed leadership — and this requires a certain amount of flexibility from the stakeholders involved. On the other hand, there is a constant tension between the delegation of responsibilities, which might increase participation, and the centralisation of decision-making processes, which facilitates the process of making difficult choices but runs the risk of alienating stakeholders. Leadership is also linked to transparency, setting a limited number of measurable objectives, and allowing stakeholders to judge the performance of the public sector. A strong, developmental and leadership role for the public sector can be crucial for the implementation of smart specialisation. However, this is not only related to the management of funding programmes. While it may be the most visible form of public support in the S3 process, funding is most effective when integrated and bundled up with other forms of assistance — some of which may be intangible — like the convening powers and brokering capacities of regional governments and development agencies. Public authorities can play a role in bringing together stakeholders and institutions which do not usually work together, support horizontal and capacity building activities, or make early investments which the risk adverse private sector may ignore.

South Moravia is a region with a rather recent history of regional innovation policy, where the different organisations in the public and private sectors have fewer resources and less experience compared with other regions with long-lasting experience of regional innovation systems. An important step was the creation of the South Moravian Innovation Centre (JIC)[39]. Established by the regional office together with Brno City Municipality and four different universities, it has been responsible for managing innovation policy since 2009. JIC led the building of a broad-based coalition of actors which was quite challenging due in large part to historical reasons and the lack of formal sub-national competences. JIC

[39] One of the supportive structures of South Moravian region R&I, mentioned in the chapter "Ecosystem" – interest association of legal entities, focusing on the support of knowledge-intensive companies, on supporting the development of new knowledge-intensive companies and on supporting the development of mature companies with growth potential

established strong links with the public authorities that support it, with research centres, industry representatives and other institutions. These links were used to develop a broadly agreed upon S3 towards a coordinated implementation strategy with real impact on the economic fortunes of the region.

Reflection and learning

An important characteristic of good governance systems is the stability that makes learning possible over extended periods of time. Some of the most successful regions in Europe in this respect have been developing innovation policies since the early 1990s and have gone through several rounds of policy design and implementation. For this learning are important, particularly the role of strong networks with local and non-local representatives and a stable, yet open governance system. In countries and regions with less experience of innovation policies capacity needs to be built. In addition, the implementation of S3 needs to be closely monitored, not only in terms of outputs and outcomes of policy intervention, but also to ensure that the processes are operating effectively. Governments throughout the EU are becoming increasingly aware that the public sector can play a much more positive role in fostering innovation by promoting innovation within the public sector (by experimenting with more agile and creative forms of public administration for example) and via the public sector (by leveraging the power of purchase for example). One of the new ways in which governments at all levels are learning to learn is through the creation of Innovation Policy Labs (IPLs). Originally inspired by the likes of NESTA, the UK-based innovation agency[40], IPLs are being created all over the world as governments and their partners in business, civil society and higher education collectively strive to better understand the emergent world of open innovation and assess what it means for each partner. The world of open innovation has been fashioned by a number of factors, including:

- The pace of innovation appears to be accelerating, (1) as technological change abbreviates product and service lifecycles, (2) and as new entrants like China and India enter the global race with new business models based on frugal innovations;
- The nature of innovation could be changing, (1) as disciplines and technologies converge, (2) and as large vertically integrated firms realise that they need to open themselves up to a wider and more diverse range of knowledge sources to complement and challenge their in-house R&D labs;
- The agents of innovation are changing in the sense that users and governments are becoming major players in the era of societal challenges, where consumer-citizens are assuming the role of co-producers with traditional agents (i.e. firms) in sectors like renewable energy, food security, healthy ageing, water conservation and climate change mitigation, etc., i.e. sectors where governments also play key roles as producers, users, purchasers and regulators.

Innovation Policy Labs enable governments to 'look outside the box' in a more agile and less risk-averse fashion. This is also aided by participation in international networks such S3 Platform, which allow regions to find out how others are approaching the same challenges and possibly adopt similar approaches at home. This intelligence-gathering capacity is especially important for national and regional governments that wish to learn what works where and why in the S3 implementation process.

[40] https://www.nesta.org.uk/project/innovation-growth-lab/

The importance of stable and participative governance structures for learning over time is well illustrated by the Slovenian S3. The major initial challenge in preparing the strategy was to rebuild the innovation system following a period of disintegration resulting from uncoordinated policies, high levels of unpredictability and incoherent funding programmes that failed to support different elements of innovation across economic value chains in the past. To build coherence and predictability of funding instruments over time, a systematic and continuous consultation process among quadruple helix stakeholders has been put in place. So called Strategic Research and Innovation Partnerships[41] have been established as pillars of the S3 implementation process. The partnerships are flexible institutional structures for each of the priority areas. Certain innovation activities relate to several S3 domains or may be identified as horizontal (i.e. key enabling technologies such as ICT, photonics, robotics, etc.). Therefore, each of the Strategic partnership is established as a tailor-made structure, while some actually relate to more than just one priority area. The on-going consultation activities of the Strategic partnerships include a continuous EDP, further prioritisation and Strategic Research Agendas, joint internationalisation and performance in Global Value Chains, planning of legislative changes (such as standardisation to design efficient innovative procurement and pre-commercial measures), as well as human resource management and capacity building. Slovenian S3 offers a valuable means for strategic direction, within its nine clearly defined investment priority areas. It has led to joint approach among the three most relevant ministries, providing a stable and robust platform for consulting and responding to signals from the R&I system. The ongoing process provides a learning experience for all stakeholders, which over time can also lead to the modification and improvement of the governance mechanisms.

THE CYCLE OF EDP

Discovering what a country or a region may be good at requires an investment in a concrete process of exploration. However, the experience accumulated over the past years has shown that this is only the initial step of EDP. In other words, the EDP in practice goes beyond the prioritisation phase and the subsequent related investments.

The potential of EDP: Recursive stakeholders' involvement

The EDP provision calls for an inclusive and interactive process at the different stages of the policy-making process. To successfully implement S3 priorities, it is not sufficient for public authorities and stakeholders to jointly identify investment priorities. Rather, once the process of 'discovery' has been initiated, it is crucial to keep engaging stakeholders throughout the different stages of the policy-making process. This new dimension, which could be referred to as a continuous process, is necessary to ensure trust and commitment to the strategic objectives codified in the S3, and hence the successful implementation of the strategy itself. Nonetheless, although public-private interaction is not an unknown practice across regions, the challenge is to maintain the dynamics generated during the elaboration of the national and/or regional S3 along the different stages of the policy cycle. To achieve this, it is important to map and sustain dialogue among all institutional actors involved in S3 design and implementation. This

[41] Strategic partnerships mentioned in the chapter "Organization" in Slovenian S3 governance overview

task includes dialogue with the teams/institutions that conducted the EDP exercise in view of the ESIF ex-ante conditionality, as well as actors involved in the management/implementation of the relevant Operational Programmes or other funds, down to the very individuals involved in drafting and managing calls for proposals. All these actors should have a common understanding of the EDP and should be aware of their role within the entire process. Based on the experience accumulated in regions:

- The involvement/consultation of stakeholders in the definition of policy instruments appears crucial, as it allows policy-makers to identify potential bottlenecks hence foreseeing implementation problems;
- The interaction among stakeholders involved in the monitoring of the strategy allows a continuous reflection on market opportunities, as well as a periodic re-assessment of the investment priorities previously identified.

As a result of the EDP stock-taking exercise that took place in Slovenia, a number of Strategic partnerships are established to support S3 implementation. These partnerships are planned to be open entities, where representatives from business, research, academia, NGOs[42], public sector may join or leave the group at their own initiative. However, partners are required to provide their own funding as a way to guarantee engagement and cooperation. The internal management structure of the Strategic partnerships is tailored according to the technology and market-specific characteristics of each S3 domain, with some transversal partnerships covering more than one domain. Partnerships have the objective, among others, to maintain open dialogue throughout the policy cycle (implementing the EDP as a continuous process). This approach was approved by all stakeholders, as it appeared clear that the process of identifying and focusing on investment priorities should be a continuous living and changing one. During the preparation of S3 a substantial shift occurred: a change in the perception and the mind-set of key actors, including businesses and researchers. After many networking events, promotional activities and consultations, stakeholders no longer looked at the process from afar but are now taking ownership of it and co-creating trends and policies.

MONITORING

Monitoring policies and policy strategies refers to an organized set of activities encompassing the iterative collection and elaboration of information on assessing the evolution and direction of socio-economic phenomena and the delivery of policy measures. Monitoring is a key element of the decision-making process allowing for adjusting the course of policy actions as well as a management tool for the implementation of S3. To this aim, the monitoring system needs to reflect the S3 intervention logic in all its main components and articulations.

Mechanisms for monitoring and evaluating should be integrated in the strategy and its different components from the very beginning. Monitoring refers to the need to follow progress of implementation. Evaluation refers to assessing whether and how strategic objectives are met. In order to perform evaluation, it is essential that objectives are clearly defined in a S3 in measurable terms at each level of implementation, i.e. from the strategic overall objectives to the specific objectives of each of its

[42] Non-Governmental Organizations

actions. A central task of S3 design is to identify a parsimonious yet comprehensive set of output and results indicators and to establish baselines for the result indicators and target values for all of them. The design effort a S3 implies does not come to an end when the strategy moves on to the implementation phase. S3 should evolve and adjust to changes in economic and framework conditions, as well as to emergence of new evidence during implementation through evaluation and monitoring activities.

The Innovation Assessment Methodology Lower Austria is a comprehensive system of different monitoring and evaluation tools for Lower Austria's innovation policy. Its aim is to gain insight into the results of innovation support services with the aim of improving delivery instruments, justify amounts spent and promote its success. One of the tools used is the Balanced Scorecard Methodology, a strategic performance management tool, developed and heavily used in the private sector. In Lower Austria it is used to define the objectives and target values for the 6 components of Lower Austria's economic strategy (including innovation) and to break them down at intermediary level as well as at programme level.

It might seem, that S3 was an approach designed specially to guide the ESIF investments in the member countries. Despite that S3 strategies are indeed funded by ESIF and the part is a substantial one in the Eastern Europe, the concept guides the investments into R&I regardless of the funding source. The concept promotes the smart selection of investment topics and a combination of various funding sources, like national, international competitive, bilateral programmes and ESIF, if available. Each country and region should aim to be as much independent from international sources as possible and maximize its national funding for R&I. The other funding sources except the national ones should be regarded only as complimentary ones, as for example, are in the Lower Austrian region. Crucially important part of R&I funding is the business sector. Many European regions already reached maximum of their capacities for funding amount and intensity, while the business investments into R&I vary severely across the EU and the World. The well-functioning R&I system should be regarded as a best stimulus for business investments into R&I. The possible donors for improvement of national R&I systems are various funding schemes from EU, World Bank and United States Agency for International Development.

GUIDELINES

Any S3 implementation guidelines should take into account the scenario versus reality question. Scenario, an ideal planned path of the implementation of a chosen S3 area in a given territory usually looks good and promising in the paper. But further success depends not only on a good plan and even not on good capacities to implement the plan – it also depends much on the R&I capacity, networks, ease of financing, market conditions, external factors and etc. The innovation is non-linear process in most of the cases. The scenario should not be read as a linear representation of innovation, in which funding instruments are accessed in successive phases. The scale going from capacity building to the market should not be interpreted as a time scale. S3 face difficulties to envisage and consider the full range of R&I support available and the possible combination of it – a proper policy mix as a tool for the implementation of the scenario. Further on the guidelines for successful governance, financing and monitoring (and evaluation) are provided based on the analyzed cases and other international experience.

Governance depends on the existing institutional settings, the distribution of roles and influence between different levels of government and different policy fields. Because of such settings there is no one good governance mechanism and no single best practice. It is common, that in the case of only national level of S3 strategy, the attention and support to this topic is found at a very high level of the government. If the country consists of more than one region, resulting in more than one active S3 (and sometimes a national S3 on top), the attention shifts to the regional government, with less direct involvement from the national level. It might result in vague distribution of responsibilities or even duplications of support actions. Another common pattern, often resulting in tension is the division of responsibilities and influence among the bodies responsible for research and innovation field. Commonly, there are two separate ministries, which divide this topic historically or politically, but usually there is a certain overlap. Ministry, responsible for research (and education) will tend to have a certain interest in further application of research, hence the technological development and innovation actions. Ministry, responsible for the economy usually deploys actions to support innovation activities, which might target the research sector. A proper attention should be given to this situation with efforts for sound coordination. S3, being a research and innovation strategy, but with possible topics in any of the policy fields (f. e. health, agriculture, etc.) might create even more tension points with other ministries/bodies. Another task for governance is to attract the participation of private sector in the implementation and steering, where applicable. These expectations make the governance of the S3 a crucial element not only for designing a proper and justified strategy, but especially for running it. The main guidelines to be observed and implemented should be:

- Establishment of task-force or inter-ministerial working group. Many regions solve the problem of distributed knowledge and governance by establishing the mechanisms of combined participation and shared responsibility. Such group can consist only of government sector (ministries, agencies, other bodies), or be supplemented by private/public sectors. The group should be responsible for steering the implementation of the strategy and supervise all matters in connection with the S3, also observing the relation with overall research and innovation policy or cohesion (regional) policy, if applicable.
- Clear attribution of responsibilities and political support to the institution responsible for the management of the Smart Specialization strategy. The mandate should be recognized regardless national or regional level. Responsibilities should reflect the available legal framework, meaning that f. e. a task-force cannot be responsible for the efficiency of funding or timely delivery of policy as there are the functions of ministries and agencies. Therefore, the responsibilities should be within the available mandate – as coordination, timely indication of issues and communication. If the responsible body is a funding institution, the mandate should change accordingly.
- A resent DG JRC[43] study revealed, that lack of skills and capabilities in regional and national administrations and some stakeholders poses serious challenges to the development of better governance arrangements and constrains the effective executions of different policy functions. It might be due to overlooking of the resources needed to deliver a proper governance function or attribution of the task to already "busy" public servants as an additional responsibility. Additional resources must support additional responsibilities. A very often failure in governance arises from failure to supply required resources.
- Accountability is also a key element of the governance function. It should be regarded as accountability for a decision making power, such as regional or national government, in some cases it

[43] Directorate-General „Joint Research Centre"

can be a Parliament (depends on the research and innovation policy framework). Accountability for general public and most importantly the stakeholders of the strategy should be regarded as well.

- A well-functioning and continuous entrepreneurial discovery process is the core of S3 and should be the key task of good governance. In many cases a specially established temporary bodies, such as strategic partnerships or platforms performs this function. It is a coordinated area with a mandate to provide recommendations and reflections regarding implementation, bottlenecks and new ideas. As it is challenging to engage private sector into the discussions, a good credibility (comes with the mandate) of such body is a necessity.
- Governance is also responsible for organization of communication function. As it might seem not to be in first line of priority functions, it is important part of general accountability and public engagement. S3 should be communicated with a publicly fit narrative, not just as a legal document with plans and indicators, but as a live strategy.

S3 covers a broad variety of financial and non-financial instruments as a tool of public intervention. An important aspect of financial instruments, found in many cases, is stability and predictability. Research (and education) part of S3 is quite inert sector and sharp changes in funding can severely damage the long-term results or motivation of stakeholders. Innovation part of the S3 is much more agile, but it also has to have a predictable policy of financial intervention from the state. The financial instruments, or measures of intervention covers a broad spectrum of actions, which can be connected with almost any kind of development, even with the improvement of legal system. A particular attention is given to promote the networking among national and international stakeholders. Some of the regions seek for a better connection with international research infrastructures as a part of their S3 empowerment. Financial instruments can work at a national level or in complementarity with the regionally specific instruments. Some of the regions go to quite a specific scale, as to the level of the city with their policy mix. Generally:

- The financial intervention should cover a sufficiently broad spectrum of actions to be regarded as a policy mix. The added value is the complementarity of the interventions and proper timing. The interventions should cover the whole TRL spectrum, but the focus (and funding) can be shifter according to the potential of the R&I system.
- It is wise to seek the complementarity with Horizon2020 (Horizon Europe from 2021) and other international funding initiatives. For example, the projects that are qualified enough and successful for the international competitive funding could be supported from national funds as showing sufficient excellence. Another factor is the complementarity in R&I topics, as projects participating in the international funding are more exposed to international networks, hence the selected topics might gain more attention and traction.
- It is safe to state that every region has financial measures focused on human resources. It might be interventions for development, attraction and retention, targeting students, talents, researchers or other required target groups. Some of the regions have measures in S3 reaching to schools, especially to promote STEM topics, which is crucial for further technological development. The development of human resources is the inevitable part of S3 and can be planned as a horizontal intervention for the whole R&I system or targeting the sectors and research areas of S3 priorities.

- Some cases are missing the financial link to non-technological innovations, which is an important part of the innovation system. Many S3 strategies, especially in the combination with key enabling technologies, has roots in the technological sciences. The part of the social and humanities sciences is represented much less and often undeservedly. Incorporation of societal issues and societal sciences in the S3 can provide important links to the engagement of society, solving of non-technological challenges and etc.

An intervention logic and policy mix could be constructed based on TRL as the measures often target different levels (or selection of levels). The funding of the priorities can be administered in at least three different concepts:

1. There is a general budget allocated and every priority and projects compete for the funding in the same basket.
2. The general budget is divided into the number of priority areas and funds are allocated according to the ex-ante evaluation of possible projects costs/potential. Projects compete in the priority areas baskets.
3. The general budget is divided into the number of priorities and funds are allocated according to the ex-ante evaluation of possible projects costs/potential. Projects compete in the priority baskets, making the competition happen in similar topics.

The first option is risky in case there would be a well-performing priority with the capacity for expensive projects. It might absorb the majority of funding, leaving other priorities underfinanced.

Monitoring should be aligned with the EDP. Basically, while constructing the S3, the whole examination of the current R&I status comes from the EDP process. The monitoring function will produce reports – the decision should be taken, based on legal framework and on current arrangements, to whom the report should be addressed? There are cases when the receiver of the report is a working group, a ministry, Government or even the Parliament.

- Monitoring (and evaluation) logic should be defined at the same time as the definition of the intervention logic and the identification of priorities and policy actions.
- The greatest challenge of the S3 monitoring is the systematic data collection and meaningful data aggregation at S3 priority level. In most of the cases the priority is not a sector or field of research, it's something combined. The monitoring authority should understand that it might be improbable and impossible to accurately measure the implementation of priorities in NACE activities.
- The data, signals and impressions gathered from the monitoring should be discussed with stakeholders (strategic partnerships, platforms or other body for continuous EDP). The inclusion of stakeholders in the data evaluation process, when it is important to ensure impartiality, might be challenging and should be carefully moderated. Another important aspect of the interpretation of data - a common understanding what is a successful implementation. An initial agreement among stakeholders might be required regarding this.

- As S3 employs a broad spectrum of actions, the challenging part is the complexity and limitations of methods for impact assessment of large-scale policy-mix. A methodologically sound, well-informed, valid and practical evaluation might be hard to perform. A solution is to perform the evaluations in the selected parts of S3 (based on goals, priorities).
- Monitoring should have the ways and power to affect the implementation. If the monitoring is just a tool for a discussion without real consequence possibility – it will affect the engagement of the stakeholders and compromise the monitoring function. The clear mandate is required that the evidence from the monitoring might be used to formulate the policy actions.

The possible set of indicators depends on many factors, such as the availability of data, the history of data collection and the cost of it. Also, some indicators are more preferred by certain research communities and different sets are preferred by particular sectors of businesses. The following suggestion was aggregated from the analyzed regions and should be regarded as a guideline for monitoring of S3 implementation:

Research system related indicators:

- Public R&D expenditure as percent of GDP
- Share of funds from abroad to finance the total gross domestic expenditure on R&D
- Number of researchers in public sectors (percentage of the population)
- PhD students (as well as PhDs from abroad)
- PCT patents
- Scientific publications (citation, public-private, international)
- The average time necessary to complete tenders for research equipment
- Change (in time) of the average size of a purpose grant from national resources acquired by research organizations from the region
- Number of Horizon 2020 grants
- Number of ERC or other prestigious grants employed in research organizations
- Number of licenses for research results provided
- Number (headcount) and share of foreign researchers employed in research organizations

Innovation system related indicators:

- Private R&D expenditure as percent of GDP
- Number of supported companies
- Share of funds in public sector expenditure on R&D funded by the business sector
- Share of innovation-active companies
- Number of researchers in business (percentage of the population)
- Venture capital investments
- Number of companies cooperating with knowledge institutions
- Number of Horizon 2020 grants

- Number of start-up companies using intellectual property from research organizations
- number of "*gazelles".*
- Number of foreign companies implementing R&D activities
- Number of spin-off companies
- Share of secondary school students interested in starting their own business

Indicators for evaluation of impact:

Research system related indicators:

- Universities in QS World University Rankings / Academic Ranking of World Universities

Innovation system related indicators:

- Share of innovative/green public procurement
- Value added per employee in business
- Share of value added of different sectors (e. g. life sciences)
- Share of exports of knowledge intensive services in total exports
- Share of high-tech products in exports
- Entrepreneurial activity
- Innovation Union Scoreboard / Global Innovation Index ranking
- Higher resource productivity

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