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Government of the Czech Republic



National Research, Development  
and Innovation Policy of the  
Czech Republic 2016–2020

**Compiled by the Section for Science, Research and Innovation of the Government of the Czech Republic on the basis of information provided by the Technology Centre CAS through a public contract**  
**“Evaluation of fulfilment of the Update of National Research, Development and Innovation Policy 2009–2015 with an Outlook for 2020.”**

SECTION FOR THE SCIENCE, RESEARCH AND INNOVATION

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## SUMMARY

The main conclusions of the evaluation of objectives and actions of the Update of National Research, Development and Innovation Policy of the Czech Republic 2009–2015 with an outlook to 2020 determined the following problematic areas:

- The system of management and financing of research, development and innovation is fragmented, insufficiently strategy-driven and its coordination mechanisms are missing or function poorly, which hampers effective cooperation between individual members of the system.
- On the whole, public research has been strengthened (its infrastructure and research capacities, increase in the quantity as well as the quality of publication results) but the system remains relatively closed (internationally as well as towards collaboration with enterprises) and there is a lack of a greater number of research bodies and teams that would generate top results on a global level.
- Production of applied research results, transfer of knowledge from public research to applications and collaboration between research organizations and enterprises are poor, which is due, inter alia, to the limited foundation basis for applied research in the Czech Republic.
- Business investments in the research and innovation activities of enterprises have been increasing but they are dominantly driven by multinational companies; the segment of research and technology-oriented small and medium-sized enterprises is relatively underdeveloped.

Of the 21 actions of the National Research, Development and Innovation Policy of the Czech Republic 2009–2015, as many as 8 actions have been implemented or are under way, 11 actions have been or are being partially implemented and 2 actions have not been or are not being implemented.

Based on these conclusions and taking into account the current international trends in the policy of research, development and innovations, the research, development and innovation policy of the Czech Republic should focus **on the following crucial areas from 2016 onwards:**

- **Improve the management of the research, development and innovation system** – clearly define powers and apply a transparent approach to the preparation of policies for research, development and innovation.
- **Introduce evaluation of research organizations and make the system of institutional funding more effective** – evaluation must become an important source of information for strategic management and the system of institutional funding must encourage research organizations to effectively fulfil their role in the research, development and innovation system.
- **Create a strong basis for applied research** – encourage some of the existing research capacities to transform into research and technology-oriented centres conducting applied research for the needs of public sector users, enterprises and other users. Commence strategic and long-term dialogue on the priorities of applied research.
- **Strengthen research and innovation activities of enterprises** – encourage enterprises to launch and develop research and innovation activities and support development of dynamic small and medium-sized enterprises.





## INTRODUCTION

All of the modern technologies without which we cannot imagine today's society are based on discoveries and inventions that resulted from the many previous generations' thirst for knowledge. The potential and the economic and social effects of a vast majority of the key discoveries of recent centuries were not known at the time of their birth and it often took several centuries to find practical application for the scientific findings. Sustaining young people's thirst for knowledge, which is an important driver of societal development, in the future is a prerequisite for the general prosperity of our society.

The main objective of the National Research, Development and Innovation Policy of the Czech Republic<sup>1</sup> ('NRDIP') is therefore to ensure development of all R&D components in the Czech Republic – fundamental research, applied R&D, each having its own irreplaceable function, and to use the coherence and synergies between them to support economic, cultural and social development of the Czech Republic.

The NRDIP is a top strategy document at a national level providing the main guidance in the field of research, development and innovation ('RDI'), embracing other related strategy documents of the Czech Republic.

The original NRDIP 2009–2015 was approved by Government Resolution No. 729 of 8 June 2009. It was updated by Government Resolution No. 714 of 27 September 2011 on the National Innovation Strategy of the Czech Republic and by Government Resolution No. 924 of 12 December 2012 on the Interim Report on the Fulfilment of the NRDIP 2009–2015. An update containing an outlook for 2020 was approved by Government Resolution No. 294 of 24 April 2013 on an Update of the NRDIP 2009–2015 with an Outlook for 2020 ('2013 NRDIP Update'). This resolution also imposed an obligation to present the updated NRDIP to the government by 31 December 2015.

<sup>1</sup> The NRDIP is defined in Section 2(3) of Act No. 130/2002 Coll., on the support of research, experimental development and innovations from public funds and on the amendment to some related acts (the Act on the Support of Research, Experimental Development and Innovations), as amended.

An updated NRDIP called National Research, Development and Innovation Policy 2016–2020 ('NRDIP 2016') was prepared on the basis of information provided by the Technology Centre ASCR through a public contract 'Evaluation of fulfilment of the Update of National Research, Development and Innovation Policy 2009–2015 with an Outlook for 2020'.

The NRDIP 2016 reacts to the current needs and development trends on a national, European and global level. It also takes into account the experience gained from implementation of the 2013 NRDIP Update, to which it is necessary to react systematically and quickly enough. The vision and the main objective of the 2013 NRDIP Update remain relevant for the NRDIP 2016 and the efforts to fulfil them will therefore continue.

**Vision of NRDIP 2016:** By 2020, the Czech Republic will become a country where high and long-term sustainable living standards of its citizens will be based on the solid foundations of competitiveness, building on the new knowledge and its application in innovations in the corporate and public sectors as the sources of future prosperity.

**Main objective of the NRDIP 2016:** To prepare quality conditions for generation of new findings, to actively work towards application of the new knowledge in innovations and to contribute to the fulfilment of the vision.

The NRDIP 2016 focuses on the key areas of needs (hence it is problem-oriented) such as management of the RDI system, public sector of RDI, collaboration between the private and public sectors of RDI, innovation in enterprises and challenges for the focus of RDI. The document sets out strategic and specific objectives and actions for their implementation. The performed analyses indicate that the key steps are the correct setting of strategic management of the RDI policy and more effective use of state budget funds, including resources from the European Structural and Investment Funds.





# 1. STRATEGIC AND LEGAL FRAMEWORK OF RDI

The current RDI policy faces new challenges linked to the dynamic changes in the traditional ways of generating added value, demographic development, climate change and social change. The research and innovation strategies of individual countries and multinational clusters react to the new challenges.

The OECD Innovation Strategy 2015<sup>1</sup> sets out five core priorities for innovation policy to which particular attention should be paid in the coming years:

- *Strengthen investment in innovation and foster business dynamism*, the effort being particularly to create conditions for development of innovative enterprises and to support access of newly created enterprises to financial resources.
- *Invest in and shape an efficient system of knowledge creation and diffusion*; this includes support for the public sector of R&D, development of cooperation between research organizations and enterprises, and stimulation of business investments in R&D.
- *Seize the benefits of the digital economy*; in this respect, investments in broadband connectivity, related infrastructure and skills for interlinking the Internet of Things, Services and People should be encouraged.
- *Foster talent and skills and optimize their use*, where emphasis should be placed on improvement of education systems and promotion of mobility of highly qualified people as this will contribute to effective transfer of experience and diffusion of knowledge.
- *Improve the governance and implementation of policies for innovation*; this is associated with improved coordination of individual policies at various levels of public administration, involvement of a wider range of actors in the creation and implementation of innovation policy, and strengthening of monitoring and evaluation as the instruments for effective management of the innovation policy.

## 1.1. RDI AT A EUROPEAN UNION LEVEL

Key new challenges for the research and innovation policy include, inter alia, the start of the so-called *new in-*

*dustrial revolution (Industry 4.0)* associated with complex digitalization and robotic automation of production processes and services. There are therefore some apparent shifts in the objectives, approaches and instruments of the European RDI policy, which are also reflected in the NRDIP 2016. The European RDI policy places new emphasis on the following areas<sup>2</sup>:

- *Applied research and encouraging enterprises* (particularly small and medium-sized ones) to heighten research and innovation activity, which should in the end strengthen Europe's economic base and its ability to flexibly react to societal needs.
- *Open and excellent science* associated with open access not only to scientific results.
- *Open innovations* and engaging various participants in research and innovation activities; in this respect, it is necessary to strengthen collaboration among research organizations, enterprises, public administration, non-profit organizations and users. At the same time, the European Commission has been endeavouring to strengthen capital investments in the development and growth of innovative enterprises.
- *Strengthening RDI aiming at increasing the energy efficiency, low-carbon technologies and digital technologies.*
- *Active development of international collaboration in RDI* with non-European countries with respect to global topics.

The European Commission's approach to RDI policy-making places a great emphasis on the application of analytical perspectives for strategic decision-making and on the role of research as a source of information in the preparation of various European policy measures (so-called scientific advice). Given the new multi-annual financial plan of the European Union for the period of 2014–2020, there has been a shift in the implementa-

1) OECD (2015): OECD Innovation Strategy 2015. An Agenda for Policy Action.

2) Council Conclusions on the European Research Area Roadmap 2015–2020, No. 8975/15, 19 May 2015.

tion of instruments supporting research and innovation towards greater concentration, specialization, comprehensive coverage of various phases of innovation activities and greater emphasis on the use of non-subsidy aid instruments. Within the European Research Area (ERA), an open labour market across the European research community is becoming an important topic; the open labour market will function as a fair and transparent environment; attention paid to gender equality issues of gender mainstreaming is a part of those efforts.

### 1.1.1. EUROPEAN STRATEGY DOCUMENTS

Fundamental European strategy documents, which formed a basis for the preparation of the 2013 NRDIP Update and remain relevant also for the NRDIP 2016 include:

- *Europe 2020 strategy*<sup>3</sup> elaborated in the area of research and innovation in the Innovation Union flagship initiative and in the concept papers aiming to complete integration of the European Research Area.
- *Horizon 2020* – the Framework Programme for Research and Innovation in the European Union<sup>4</sup>, which places greater emphasis on the support for innovation activities and is far more focused on the support for research and innovations reacting to societal challenges than the 7th Framework Programme for Research and Technological Development.
- *ERA Roadmap 2015–2020* sets out some specific recommendations to member states with respect to the focus of national research and innovation policies. The main recommendations include:
  - ▶ Strengthening the evaluation of research and innovation policies and seeking complementarities between research and innovation policy instruments at EU and national levels.
  - ▶ Improving alignment within and across the Joint Programming Process and the resulting initiatives.

- ▶ Making optimal use of public investments in research infrastructures by setting national priorities compatible with the ESFRI priorities.
- ▶ Using open, transparent and merit based recruitment practices with regard to research positions.
- ▶ Translating national equality legislation into effective action to address gender imbalances in research institutions and decision making bodies and integrating the gender dimension better in R&D policies.
- ▶ Fully implementing knowledge transfer policies at national level in order to maximize the dissemination, uptake and exploitation of scientific results.
- ▶ Promoting open access to scientific publications, sharing experience in the implementation of open access.
- ▶ Developing and implementing appropriate joint strategic approaches and actions for international R&D cooperation on the basis of member states' national priorities. In this respect, member states should define national strategies for internationalisation that would set out priorities for research collaboration with third countries.

### 1.1.2. EUROPEAN LEGISLATION

A fundamental legal change with respect to the NRDIP 2016 is the entry into force of:

- Commission Regulation (EU) No. 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty ('Regulation'), and
- Framework for State aid for research and development and innovation (2014/C 198/01) ('Framework').

In addition to changes in terminology, the new European legal regulations include an increase of the notification obligation limits, extension and specification of transparent forms of aid, simplification of the incentive effect definition, specification of the cumulated aid system and definition of eligible costs. Furthermore, non-economic activities of research organizations have been defined in detail and economic activities of research organizations carried out with public aid have been specified.

3) *EUROPE 2020: A Strategy for Smart, Sustainable and Inclusive Growth. COM(2010) 2020 final.*

4) *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Innovation Union. COM(2010) 546.*

## 1.2. NATIONAL STRATEGIC AND LEGAL FRAMEWORKS OF RDI

Objectives, approaches and instruments of the RDI policy have shifted at a national level over recent years.

Important concept papers approved since 2013 included National Reform Programmes 2014 and 2015. In reaction to the recommendation of the Council of the European Union for the Czech Republic, they emphasize the need to create a quality system for evaluation of research organizations and establish a stable system of institutional funding of research organizations where support is provided on the basis of performance.

The most important change in the area of the strategic orientation of the support for research and innovation activities in the Czech Republic is the creation of the **National Research and Innovation Strategy for Smart Specialization of the Czech Republic** ('National RIS3')<sup>5</sup>, which was approved by Government Resolution No. 1028 of 8 December 2014. The purpose of the National RIS3 is the effective targeting of funds – European, national, regional and private – to activities leading to the strengthening of research and innovation capacities and to the defined priority promising areas in order to make full use of the knowledge potential at national and regional levels and in their combination, and thereby promote a reduction in unemployment and strengthen the competitiveness of the economy. The priority areas are identified by key representatives of the business community, research and educational institutions, public administration and other partners (for details see sub-chapter 5.1).

Another shift in the RDI policy of the Czech Republic is represented by a greater emphasis on:

- *Support for applied research.* This is primarily a reaction to the risk of a gradual loss of competitiveness in the processing industry and to the need to strengthen the position of Czech enterprises (or more precisely enterprises operating in the Czech Republic) in global production chains. In this respect, the research and innovation policy places a greater emphasis on institutional embedding of the aid in support of applied research.

<sup>5</sup> RIS3 refers to the general European name of this strategy: *Research and Innovation Strategy for Smart Specialization*.

- *Concentration of support in the areas of research and innovation specialization of the Czech Republic.* The National RIS3 identifies several areas (broad economic sectors) to which the support for research and innovation activities should be directed as a matter of priority.
- *Societal impacts of research.* In connection with the effort to manage public funds responsibly and to minimize state budget deficits, there are greater requirements for the justification of increased state budget expenditures, including for RDI. This is reflected in the growing emphasis placed by support providers and research organizations on proving the social relevance of research and innovation activities supported from public funds and the benefits of those activities.

In terms of support instruments, preparation, negotiation and approval of the following operational programmes represented the most important change:

- Operational Programme Research, Development and Education ('OP RDE') under the responsibility of the Ministry of Education, Youth and Sports ('MEYS'),
- Operational Programme Enterprise and Innovation for Competitiveness ('OP EIC') under the responsibility of the Ministry of Industry and Trade ('MIT'),
- Operational Programme Prague – Growth Pole of the Czech Republic ('OP Prague') under the responsibility of Prague City Hall.

These operational programmes create the basic framework for the support for RDI from the European Structural and Investment Funds ('ESIF') in 2015–2023.<sup>6</sup>

Furthermore, two programmes supporting research for industry needs were approved, i.e. EPSILON programme for the support of applied research and experimental development implemented by the Technology Agency of the Czech Republic ('TA CR') and a programme to support research and development called TRIO under the responsibility of MIT. Both programmes refer to the need to support R&D of marketable products and to an

<sup>6</sup> The multi-annual financial plan of the European Union covers the period of 2014–2020 but the aforementioned operational programmes were approved only in 2015.

improvement in the position of Czech industry among global competitors. In addition to these programmes, implementation of other departmental programmes of support for research (new programmes of the Ministry of Culture, Ministry of Health, Ministry of Defence and Ministry of the Interior were approved) and programmes of support for international collaboration (new programmes of MEYS and TA CR) and for commercialization of R&D results (the GAMA programme implemented by TA CR) and a group of grant projects supported by the Czech Science Foundation ('CSF') continued.

Another important shift in RDI policy instruments is represented by the comprehensive international evaluation of research infrastructures carried out in 2014. The evaluation covered all important infrastructures in the Czech Republic regardless of their previous sources of funding. The Roadmap for Large Research, Experimental Development and Innovation Infrastructures in the Czech Republic was updated on the basis of the evaluation. In terms of sustainable financing of research centres supported from the Operational Programme 'Research and Development for Innovations' ('OP R&DfI') and from the Operational Programme 'Prague – Competitiveness' ('OP PC'), the launching and implementation of National Sustainability Programmes I and II were important.

In line with the European trend, there have been discussions in the Czech Republic over the past years on improving the evaluation system both at the level of individual research organizations and at the level of RDI programmes and the research and innovation policy as a whole. The IPN Methodology<sup>7</sup> project coordinated by MEYS is currently being completed; during this project, a new proposal of the methodology for evaluating research organizations, a methodology for evaluating research infrastructures and principles of evaluating RDI programmes were prepared.

Challenges of the new industrial revolution associated with the transformation of production processes and services as a result of the massive use of information technologies and robotic automation are reflected in a document entitled National Initiative Industry 4.0, which discusses technological requirements and visions, demands on applied research, standardization, safety, impacts on the labour market, education system or regulatory environment.

7) <http://metodika.reformy-msmt.cz/>

### 1.2.1. NATIONAL STRATEGY DOCUMENTS

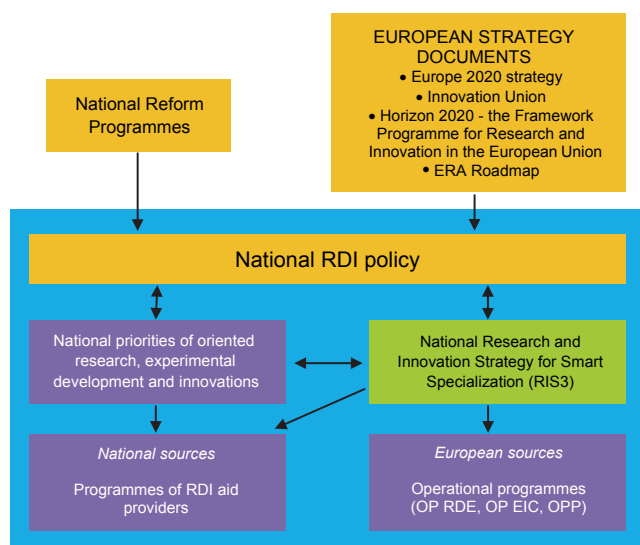
National strategy documents in the area of RDI react to the need to ensure long-term economic growth and its sustainability by creating an appropriate environment supporting RDI. According to the National Reform Programme, the main factors include improving RDI management, strengthening the quality of research and its applicability in practice, developing human resources and enhancing international collaboration. Consideration is given to the European RDI strategies specified in the previous chapter. The most important national strategy documents that formed the basis for the 2013 NRDIP Update and are still relevant include:

- *National Reform Programme*, as the basic concept paper of the national economic policy of the Czech Republic,
- *International Competitiveness Strategy and National Innovation Strategy* that are focused on the creation of conditions for performing excellent research (including a quality system of evaluation of research organizations), establishment of a quality education system and transfer of knowledge and strengthening of collaboration between public research and enterprises.
- *National priorities of oriented research, experimental development and innovations* ('NPOR') that identify priority areas of societal needs where research can considerably contribute to the improvement of key (economic, environmental, social, health, safety) aspects of the quality of life.
- *Concepts of providers and intradepartmental concepts of security research*.<sup>8</sup>

*Conclusions and recommendations from the International Audit of the RDI system*, which represent the most comprehensive evaluation of the state of the research and innovation system in the Czech Republic and its reform needs so far; they are also an important basis for preparation of the NRDIP 2016.

8) In accordance with National Security Council Resolution No. 32/2015, a concept of a provider (particularly the Ministry of the Interior) specifies the NRDIP tasks and principles to the maximum possible extent that does not hinder the ability of the security research support system to meet its main objectives. Other equal inputs into this independent concept include security policy strategy documents and supporting documents from end users which the Ministry of the Interior independently processes in order to make effective use of the funds in support of RDI. Once processed, the documents are used in the RDI policy strategy documents to the maximum possible extent.

Action plan for the development of the digital market approved by Government Resolution No. 694 of 26 August 2015 is also relevant for the NRDIP 2016; the plan's objective is to summarize relevant actions of state administration that will facilitate development of the digital market in the Czech Republic.<sup>9</sup>



**Figure 1: Scheme of relations among the key RDI documents**

### 1.2.2. NATIONAL LEGISLATION

The basic legislative framework regulating the area of RDI at the national level consists of:

- Act No. 130/2002 Coll., on the support of research, experimental development and innovation from public funds and on the amendment to some related acts (the Act on the Support of Research, Experimental Development and Innovation), as amended ('RDI Act'),
- Act No. 111/1998 Coll., on universities,
- Act No. 341/2005 Coll., on public research institutions.

The Government approved a draft law amending the RDI Act in its Resolution No. 320, dated 6 May 2015. The RDI Act was amended in connection with the

<sup>9</sup> Action plan for implementation of Industry 4.0, currently under preparation, will also be taken into consideration in the implementation of the NRDIP 2016.

transposition of European public aid legislation into Czech law (Regulation and Framework) so that its wording was in compliance with the Regulation and Framework. Given the necessity to review the existing RDI system, work is under way to prepare a new act on the support for RDI. The new legislation should help create system conditions leading to a long-term improvement of RDI quality in the Czech Republic.

### 1.2.3. INSTITUTIONAL PROVISION, COORDINATION AND MANAGEMENT OF RDI

The main institutions of the RDI system are the Research and Development Council ('R&D Council') and the Office of the Government of the Czech Republic – Section for Science, Research and Innovation ('OG CR – SRI Section'), MEYS, central and other administrative authorities responsible for R&D in the areas of their powers, organizational units of the state with their own budget allocations (CSF and TA CR) and non-governmental units of the RDI system (e.g. CAS).

#### OG CR – SRI Section

– was established on 1 March 2014 in order to effectively coordinate and manage the RDI system. The Section is led by the Deputy Prime Minister of Science, Research and Innovation, who is also the Chairman of the R&D Council and Chairman of the Government Council for Competitiveness and Economic Growth ('C&EG Council'). The R&D Council secretariat and its agenda were integrated into the SRI Section. Once it had been strengthened in terms of staff, the SRI Section started addressing the agenda of the C&EG Council and National RIS3. This merger resulted in the coordination of a wide range of topics across departments having an important role in increasing the Czech Republic's competitiveness. Due to its responsibility in the area of management and coordination of National RIS3 implementation, the position of a National RIS3 manager was established in the SRI Section.

#### The R&D Council

– is an expert advisory body of the Government for RDI. Its activities are regulated by the RDI Act. Section 35(2) specifies the activities to be performed by the R&D Council. The R&D Council's role in the system of RDI management and coordination has partially changed since the 2013 NRDIP Update, as particularly the exe-



cutive background for the R&D Council's activities has been strengthened by the establishment of the OG CR – SRI Section.

#### **MEYS**

– With the exception of the areas administered by the R&D Council, MEYS is the central administrative authority responsible for R&D. It is responsible for international collaboration of the Czech Republic in R&D, the concept of the support for large infrastructures and specific university research. It is the Managing Authority for OP RDE.

#### **MIT**

– In the area of RDI, MIT is the central government authority for industrial research and development of techniques and technologies. MIT is also the central government authority for issues of small and medium-sized enterprises and trades. It is the Managing Authority for the Operational Programme 'Enterprise and Innovations' ('OP EI') and for OP EIC.

#### **CAS**

– is a public non-university research institution comprised of a network of scientific bodies. Pursuant to Act No. 283/1992 Coll., on CAS, as amended, it is the central government authority, but for budget purposes only.

#### **Other providers in the RDI management system**

The role of other providers in the RDI management system (other administrative authorities responsible for R&D in the areas of their powers pursuant to Section 34 of the RDI Act) consists in the responsibility for preparation and implementation of RDI concepts. They are also responsible for the preparation and implementation of RDI programmes and other activities within the scope of their powers. Other providers include, inter alia, CSF and TA CR, i.e. organizational units of the state with their own budget allocations.

#### **CSF**

– is an organizational unit of the state whose mission is to provide targeted support for fundamental research exclusively from public funds. It is the only institution of this type and with this mission in the Czech Republic. Its activities are governed by the RDI Act and it is a separate accounting entity. CSF started its operations in 1993.

Within groups of grant projects, it provides financial aid for scientific projects of fundamental research both to erudite scientists and teams, and to young and beginning scientific members.

#### **TA CR**

– is an organizational unit of the state that was established in 2009 by the RDI Act. Establishment of TA CR as an implementing agency was one of the most important steps of the 2008 RDI Reform. The main task of TA CR, being an agency for implementation of the support for RDI, is to prepare and implement applied research programmes, including those for the needs of state administration, RDI tenders and public procurement.

#### **Other institutions**

##### **The C&EG Council**

– was established by Government Regulation No. 48 of 19 January 2015. It is an expert advisory body of the government for the development of competitiveness and economic growth. The C&EG Council deals with long-term and concept issues of economic growth and competitiveness of the Czech Republic. The concept of the C&EG Council is more general and it includes a wide range of interconnected topics addressed by individual committees. The objective of the C&EG Council is to connect individual topics and coordinate activities of the concerned departments. Within its activities, the C&EG Council provides the government with the knowledge base for the government's decision-making on concept issues of competitiveness and economic growth, including new sectors of cultural and creative industries and digital economy so that departmental and national attitudes and strategies are interconnected and coordinated.

#### **Platforms of the OG CR**

##### **The OG CR**

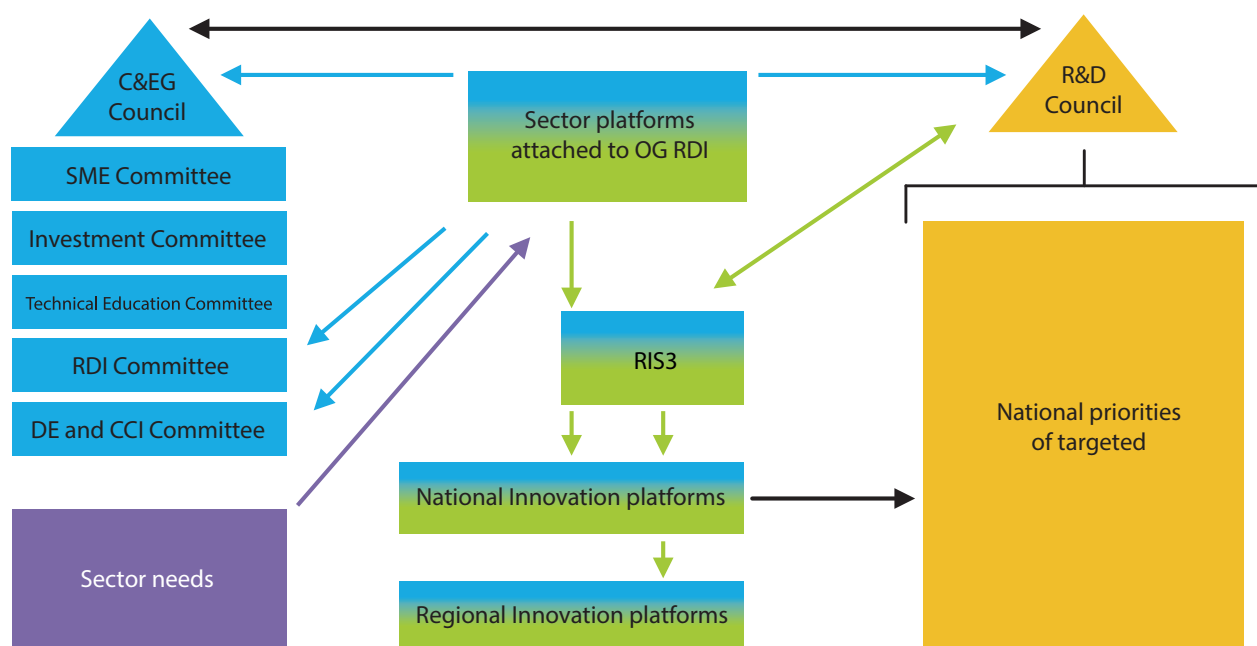
– SRI Section in the long term pursues the commencement of strategic sector dialogues with representatives of individual sectors of the national economy so that it is possible to effectively set the expenditure from the state budget and European funds to cover their material needs and to strengthen the competitiveness of the economy. Sector platforms attached to the OG CR were established

for this purpose. Their task is to identify basic problems faced by enterprises in the area of RDI and to prepare and discuss initial proposals for material needs in the area of applied research (see Annex 5). Representatives in these platforms are sector leaders with respect to private spending on RDI and at the same time producers of final products; therefore, they determine the direction for the development of the national economy sectors they represent, or they represent strategic and emerging branches. Outputs of the activities of the sector platforms are the basic materials for further discussions in the specification of the National RIS3 and in the debate on the priorities of applied research (see sub-chapter 5.1).

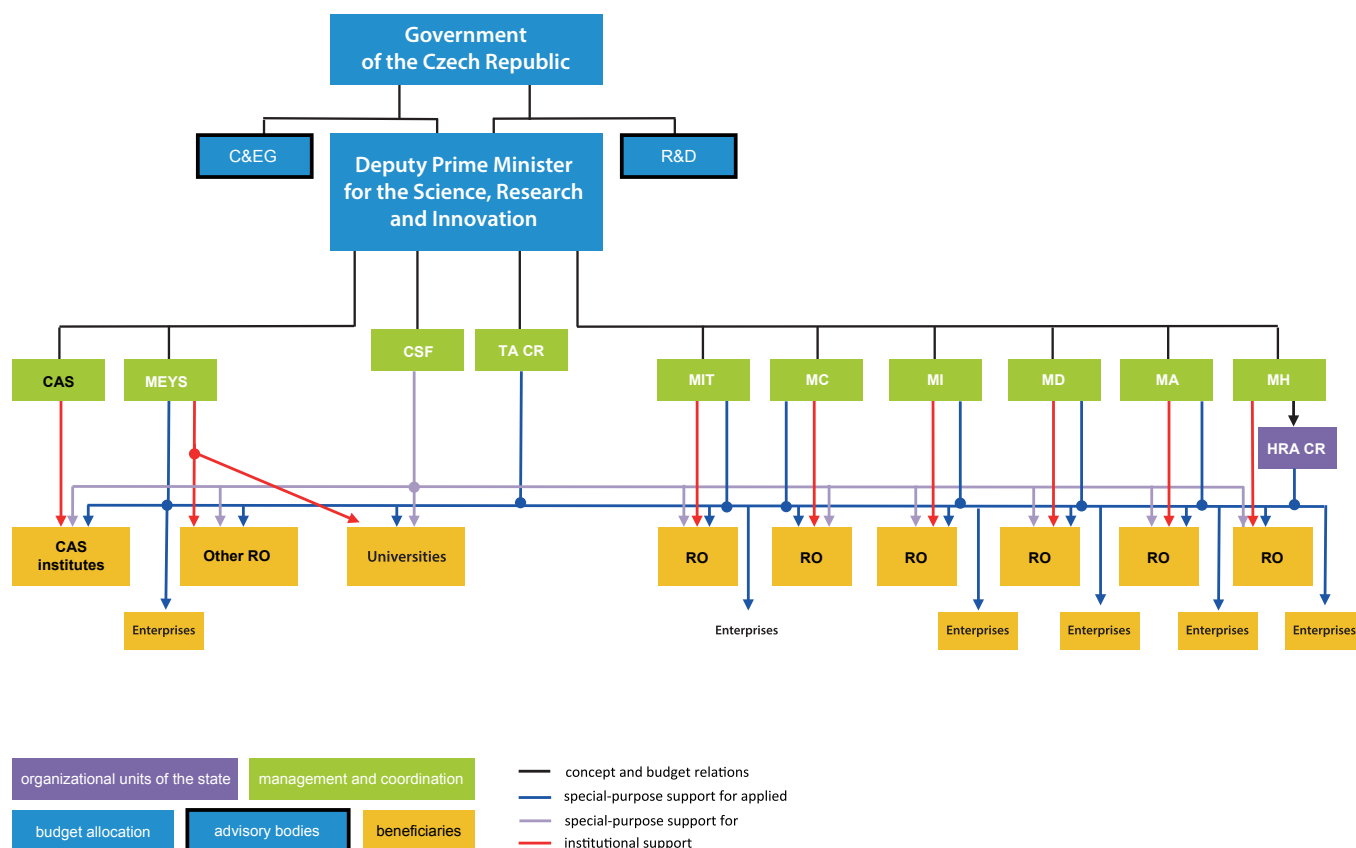
Sector platforms are linked through their staff. Their functions are linked to National Innovation Platforms within the National RIS3, which include a broader spectrum of actors as required by the European Commission. At the same time, their activities provide inputs, through the OG CR, for decision-making related to the activities of the R&D Council and the C&EG Council. As a result, three pillars (R&D Council, C&EG Council and National RIS3 structures) were created which are linked in terms of their functions, organization and staffing and which provide each other with expert supporting materials for their activities and decision-making through their working bodies and expert departments formed by the SRI Section, thereby covering complex issues of support for RDI in the Czech Republic. In all three cases, links and coordination are provided by the SRI Section and the position of the Deputy Prime Minister of Science, Research and Innovation.

The above-mentioned platforms offer important feedback with respect to the provision of public aid for RDI in the Czech Republic and provide material inputs in the form of defining long-term research topics of individual sectors and in the area of human resources. The defined and broadly discussed sector priorities (entrepreneurial discovery process) are the basis for the verticalization of the National RIS3, i.e. linking specific topics to the resources from the national budget and European funds, and for the creation of applied research priorities (see chapter 5). Verticalization is required by the European Commission as some of the operational programme calls are expected to be sector-oriented.

Figure 2 shows the mutual relations among individual coordinating bodies and key documents in the RDI system covered by the NRDIP 2016.



Scheme 1: Structure of the state administration of RDI





## 2. ASSESSMENT OF THE PROGRESS MADE IN FULFILMENT OF THE OBJECTIVES AND ACTIONS OF THE 2013 NRDIP UPDATE

An overall assessment of the implementation of the NRDIP has shown a positive shift in the level of indicators defining the national research and innovation system in the Czech Republic. Other areas have not witnessed similarly clear improvements. Although the Czech Republic has been gradually improving many indicators, it still falls behind international standards. The number of researchers in the corporate sector has been growing but it remains small with regard to the size of the country (and is considerably lower than technologically advanced countries). Research and development expenditure in the corporate sector is relatively small compared to other countries. By international standards, there is a very high share of public and foreign funding in the research and development expenditure of the corporate

sector in the Czech Republic. On the contrary, the share of the corporate sector's own resources is low.

The very low share of business sources in the R&D expenditure of the public sector has not changed in the Czech Republic in the past few years. By international standards, the Czech Republic is well below the European Union average in this respect. The area of transfer of knowledge and application of new findings in innovation remains a major weakness. No considerable changes for the better are evident in patent activities. Although the number of patent applications has been growing, the Czech Republic falls considerably behind the European Union average and particularly behind the technologically advanced countries in terms of the number of patents per size of the country.

**Table 1: Key indicators related to the 2013 NRDIP Update and their development in 2004–2013.**

Research system	2004	2006	2008	2010	2011	2012	2013	2013/04
Total number of researchers (FTE per thousand population)	1,60	2,57	2,88	2,79	2,92	3,16	3,26	204%
GERD (PPP per capita)	240,6	300,4	335,3	361,0	446,2	512,7	553,1	230%
GERD (% GDP)	1,15%	1,23%	1,24%	1,34%	1,56%	1,79%	1,92%	167%
HERD (%GDP)	0,17%	0,23%	0,23%	0,27%	0,38%	0,49%	0,52%	306%
GOVERD (%GDP)	0,26%	0,27%	0,28%	0,29%	0,31%	0,33%	0,35%	135%
BERD (%GDP)	0,72%	0,74%	0,73%	0,77%	0,86%	0,96%	1,04%	144%
Number of publications in the Web of Science database per million population	772	944	1 211	1 434	1 475	1 553	1 656	215%
Branch standardized publication citation count	0,88	0,94	1,03	1,13	1,21	1,28	1,41	160%
Share of publications co-authored by the CR and other countries	38,7%	37,8%	34,1%	34,4%	34,9%	36,1%	37,0%	96%
Knowledge diffusion and application in innovations	2004	2006	2008	2010	2011	2012	2013	2013/04
Share of publications co-authored by the public and private sectors in the total number	0,94%	1,23%	1,24%	1,18%	1,11%	1,33%	1,50%	160%
Number of patent applications according to PCT per million population	11,6	11,9	16,0	12,0	15,1	16,1		139%
Share of private sources in the university sector R&D expenditure (%)	0,6%	0,7%	0,6%	1,1%	1,0%	0,8%	2,0%	333%
Share of private sources in the government sector R&D expenditure (%)	9,0%	7,7%	5,9%	4,7%	3,4%	4,0%	3,3%	37%

Innovative enterprises	2004	2006	2008	2010	2011	2012	2013	2013/04
Number of researchers in the corporate sector (FTE per thousand population)	0,70	1,08	1,28	1,21	1,33	1,47	1,59	227%
BERD (% GVA of the industry)	1,0%	1,1%	1,0%	1,1%	1,3%	1,4%	1,5%	150%
Share of public sources in BERD	14,9%	16,4%	15,1%	15,4%	15,7%	13,7%	11,6%	78%
Share of foreign sources in BERD	3,9%	4,3%	10,5%	16,2%	18,1%	20,5%	21,2%	544%
Total risk capital investment (% GDP)	-	-	0,021%	0,015%	0,007%	0,003%	0,002%	10%
Technology balance of payments (TBP)	-0,31%	-0,17%	0,06%	-0,20%	-0,08%	-0,07%		23%

The last column of the table specifies the indicator value in relation to its value in 2004 (in %). Source: Eurostat, OECD, EVCA, WoS and others.

## 2.1. ASSESSMENT OF THE PROGRESS MADE IN FULFILMENT OF THE OBJECTIVE 'QUALITY AND PRODUCTIVE RESEARCH SYSTEM'

The research system considerably improved during the implementation of the original NRDIP for the period 2009–2015 and the 2013 NRDIP Update. Many of its parameters reached or got very close to the European level. By international standards, however, the Czech Republic **has a smaller number of globally excellent research bodies generating high-quality and long-term cited scientific works.**

### Public funding for RDI

R&D expenditure from the state budget has been increasing in the long term. In 2013, it reached 0.69% of GDP, i.e. approximately the average of the European Union. A considerable part of the funding from the European Union Structural Funds is directed to RDI via operational programmes and it forms a dominant part of the other 0.3% of GDP expenditure on RDI originating from the EU (public funding from foreign sources). In line with the objectives of the 2013 NRDIP Update, a considerable part of the public funding is distributed via RDI programmes, their specialization corresponding to the National priorities of oriented research, experimental development and innovation.

### Human resources for RDI

Objectives in the area of human resources for R&D are fulfilled successfully as the numbers of researchers, doctoral graduates and university graduates

have been increasing. The increase in the number of researchers is faster than in other countries and in terms of the number of researchers per thousand population, the Czech Republic has got close to the European Union average. Despite the great increase, the Czech Republic has not reached the level of leading countries such as Sweden and Denmark where the number of researchers per capita is approximately twice as much. The increasing number of researchers positively reflects an increase in the expenditure on R&D in research capacities. But the share of women in the total number of researchers remains relatively low even though the difference compared to the EU average is not a dramatic one.

### Performance of the research system

Productivity of the research system as well as the quality of its outputs has been increasing. In terms of the number of publications per population as well as their branch standardized citation count, the Czech Republic has been getting close to the European average. Nevertheless, the Czech Republic still lacks sufficient numbers of research bodies and teams that would generate top results on a global level. This is reflected by the relatively low share of publications from the Czech Republic among the most-cited works worldwide. The situation in the area of applied research results is absolutely unsatisfactory (details specified hereinbelow).

### International collaboration

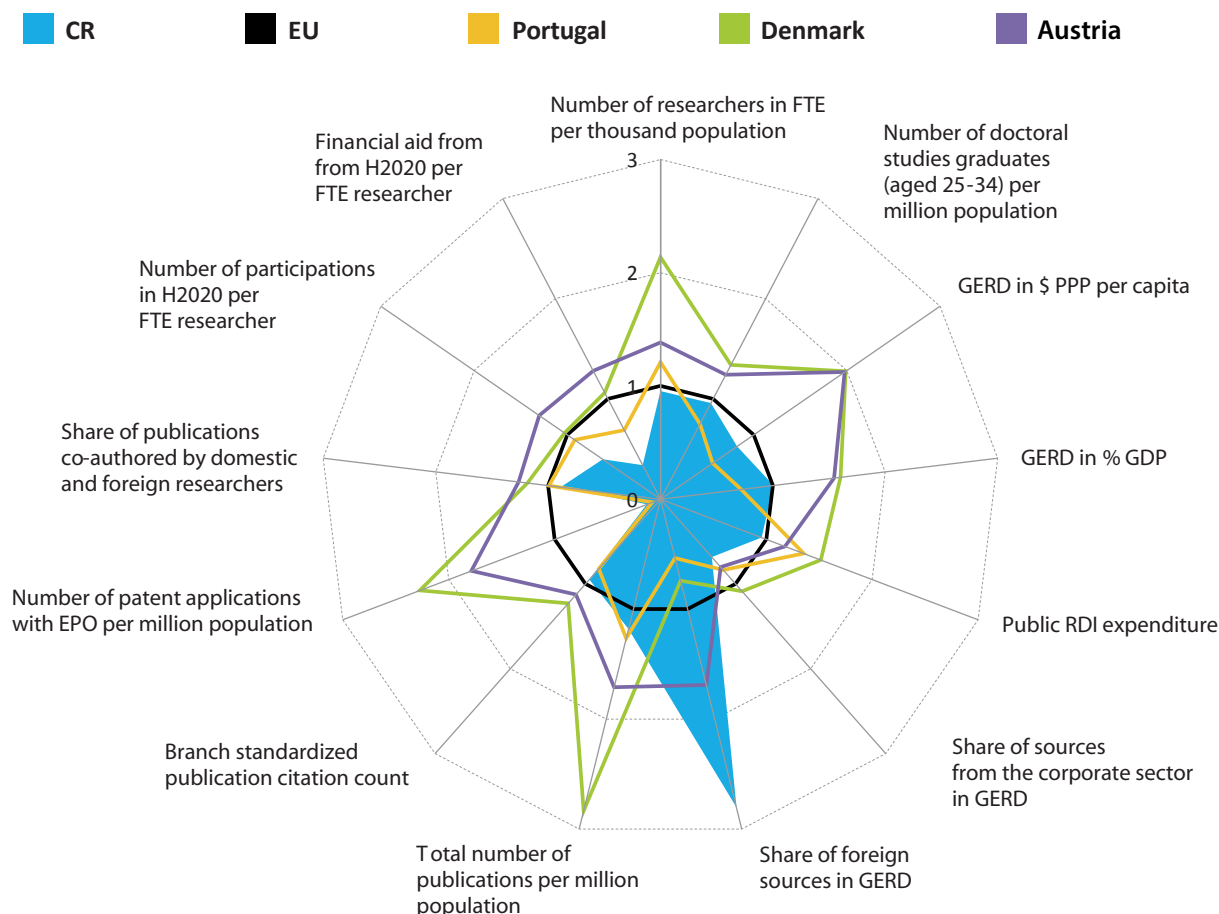
The research system remains relatively closed. Research teams from the Czech Republic generally engage in international research collaboration less frequently than foreign teams, which is clear from the low participation in general programmes of the European Union as well as from the share of publications created under international collaboration, which is smaller than the European average. Engagement of Czech teams in international R&D collaboration has not been considerably strengthened despite the implementation of actions focused on provision of system support in this area. Causes can be found particularly in the poor relations of a not insignificant number of bodies with the international research community and in the weak motivation for international collaboration, which may be associated with the fact that international collaboration is not a criterion assessed in the Methodology of Evaluation of Research Organizations and Evaluation

of Completed Programmes. The lack of an internationalization strategy causes considerable fragmentation and insufficient strategic orientation of the support for international collaboration in priority areas of the Czech Republic.

### Infrastructure for RDI

In the previous period, the R&D infrastructure and capacities have considerably improved in accordance with the objectives of the 2013 NRDIP Update. At the moment, construction of several European centres of excellence is being completed and the research capacities as well as the infrastructure quality will keep improving. Programmes were created in accordance with the objectives of the 2013 NRDIP Update and they are used to provide funding for the R&D conducted in the new centres. Although these programmes will facilitate development of the new centres, risks connected with their long-term financial sustainability persist.

Chart 1: Sub-profile of the Czech Republic – ‘Quality and productive research system’ objective



## 2.2. ASSESSMENT OF THE PROGRESS MADE IN FULFILMENT OF THE OBJECTIVE ‘EFFECTIVE KNOWLEDGE DIFFUSION AND APPLICATION IN INNOVATION’

Unlike the research system whose productivity and quality are moving towards the European level, **the area of knowledge transfer and application of new findings in innovation remains a considerable weakness of the national RDI system.**

### Relations between public research and enterprises

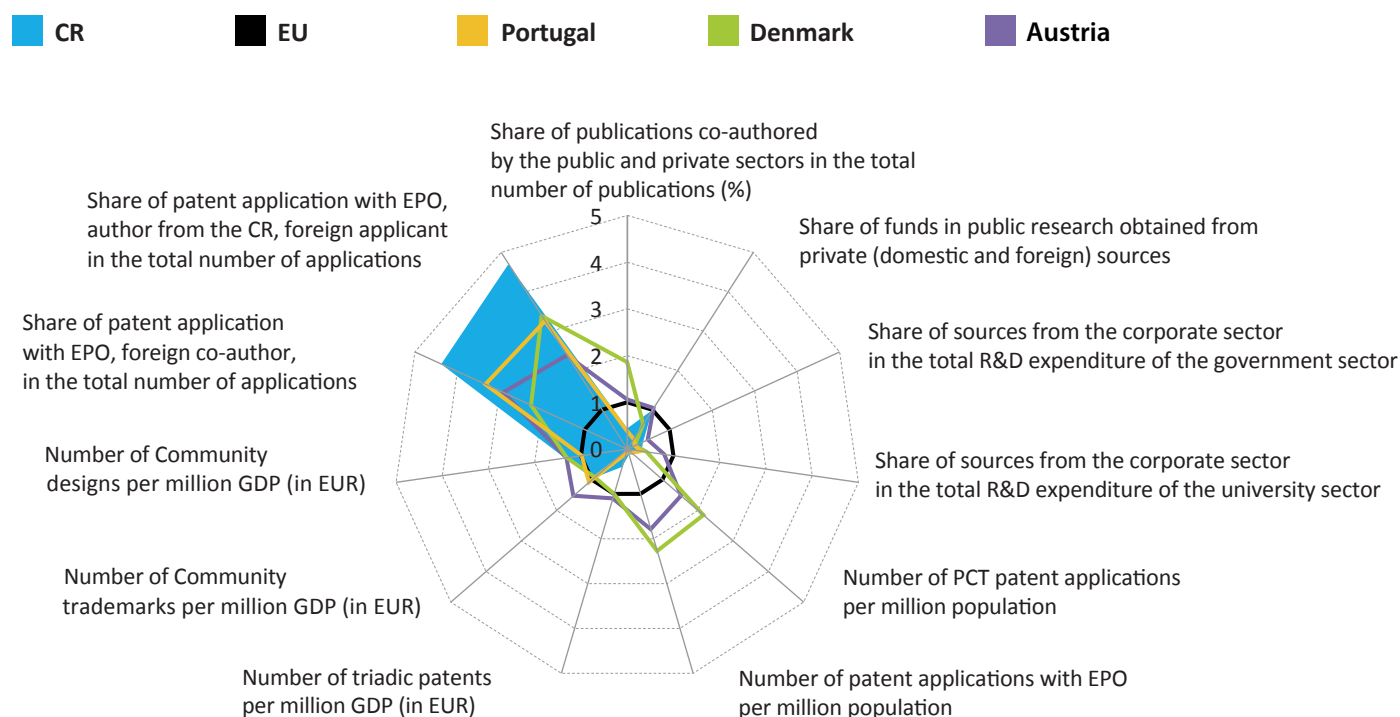
Although an improvement of relations between public research and enterprises is an objective of most strategy-concept documents focused on RDI and recently adopted in the Czech Republic (including the original NRDIP 2009–2015 and the 2013 NRDIP Update), collaboration between research organizations and enterprises remains at the low level and transfer of knowledge between public research and the application sector is not effective. The share of publications co-authored by public research and enterprises is lower than in other countries and research organizations’ revenues from their collaboration with the application sector is low by international standards. One of the causes could be the fact that techno-

logy transfer centres and systems for the commercialization of the results of R&D, which were developed in research organizations and which are to facilitate development of the relations between those institutions and enterprises are not yet sufficiently operational (or more precisely were not sufficiently operational in 2013). In this respect, the attempt to pass an amendment to the Act on Universities and Public Research Institutions facilitating the generation of funds for commercialization by research organizations has failed.

### Generation of findings apt for the use in applications

Generation of R&D findings apt for the use in applications has not improved yet. No greater volumes of findings that would be technologically relevant and could be used in strategically important innovations are generated in the Czech Republic. The established methodology of research organization evaluation rather encourages the generation of findings with no great commercial potential where there is no economic sense in the provision of international protection of intellectual property. Although the action of the 2013 NRDIP Update aimed at more intensive direct support for the applied research for industrial needs has been fulfilled, it appears that the Czech Republic still lacks a segment of research organizations

Chart 2: Sub-profile of the Czech Republic – ‘Effective knowledge diffusion and application in innovations’ objective



that would conduct applied research according to the needs of the application sector and for which the funding from private sources would be an important source of income. Unlike the research system whose productivity and quality are moving towards the European level, the area of knowledge transfer and application of new findings in innovations, i.e. the focus of the second objective of the 2013 NRDIP Update, remains a major weakness of the national research and innovation system.

### 2.3. ASSESSMENT OF THE PROGRESS MADE IN FULFILMENT OF THE OBJECTIVE 'INNOVATIVE ENTERPRISES'

Objectives concerning the strengthening of corporate research, development and innovation and improvement of the corporate sector's innovative performance in the Czech Republic have not been fulfilled.

#### Corporate research

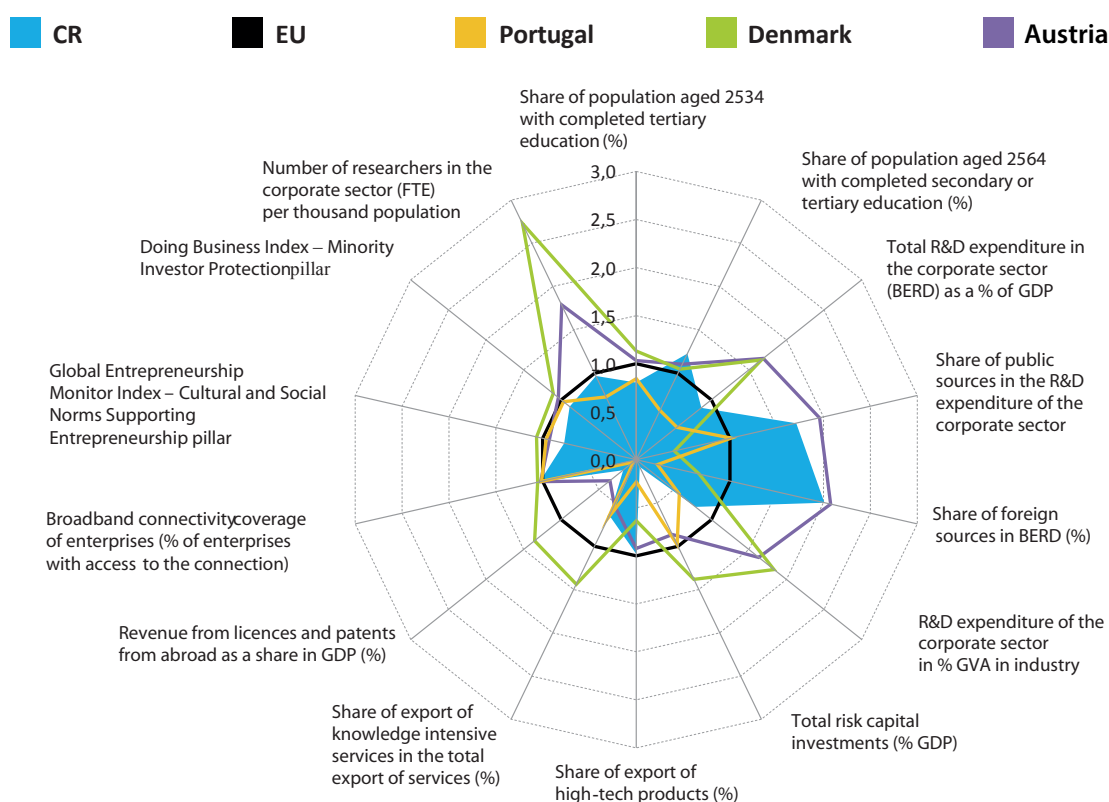
R&D expenditure in the corporate sector in the Czech Republic related to the size of the country is low by international standards. The impact of actions aimed at stimulating corporate R&D has led to a high share of

public funding rather than a considerable increase of corporate R&D expenditure. In addition, domestic enterprises have been spending less of their revenues on RDI than foreign companies operating in the Czech Republic. The below-average share of corporate R&D expenditure is actually even lower when only the expenditure of domestic companies is considered. The number of researchers in the corporate sector has been increasing but when compared with other countries the numbers related to the size of the country remain low.

#### Influence of foreign companies on corporate research

There is a very high share of sources from foreign companies in the R&D expenditure of the corporate sector in the Czech Republic. The share of sources from foreign companies has recently been rapidly increasing, which may be associated with the high share of multinational and foreign companies with high R&D expenditure. The effort to attract further foreign investment in R&D was supported by the introduction of a modified investment incentive scheme. The segment of enterprises that are not members of multinational concerns is more problematic in this respect as these enterprises spend a smaller portion of their revenues on R&D than foreign companies because the R&D ex-

Chart 3: Sub-profile of the Czech Republic – 'Innovative enterprises' objective



penditure of domestic enterprises in relation to gross value added is low compared to the situation abroad. R&D results have not become the key factor in the increase of competitiveness of enterprises and the innovative performance of domestic enterprises is not high.

#### **Use of risk capital**

Risk capital investment in early-stage innovative enterprises start-up companies is low over the long term. There are probably no new companies emerging in the Czech Republic that would meet the requirements of risk capital investors and the investors may also be discouraged by the existing business environment. The role of the state in the creation of demand for innovative solutions is inadequate. In this respect, hope can be seen in the newly prepared legal regulation of public contracts that should create conditions for effective pre-trade procurement.

#### **2.4. ASSESSMENT OF THE PROGRESS MADE IN FULFILMENT OF THE OBJECTIVE ‘STABLE, EFFICIENT AND STRATEGICALLY GOVERNED RDI SYSTEM’**

##### **Improving the efficiency of coordination in the RDI management system and providing staff capacities for the responsible authorities.**

The progress made in the fulfilment of the objective ‘Stable, efficient and strategically governed RDI system’ is not yet clear. In connection with implementation of several of the actions proposed in the 2013 NRDIP Update, coordination in the management and financing of the RDI system has been strengthened but these actions have not had a great impact so far. The non-existence of an intradepartmental strategy for the internationalization of RDI has an adverse effect on the coordination of the Czech Republic’s activities in relation to the European Research Area (‘ERA’) and hinders strategic development of international collaboration.

lization of RDI has an adverse effect on the coordination of the Czech Republic’s activities in relation to the European Research Area (‘ERA’) and hinders strategic development of international collaboration.

The legislative proposal of a new act on RDI in preparation is promising for the future as one of its variants suggests the establishment of a new Ministry of Research and Development (MRD) that would act as a central administrative authority responsible for RDI policy and assume the conceptual powers and executive tasks of some of the existing government authorities. If the said variant of the new RDI act is approved, the proposed changes in the organizational structure of the research and innovation system of the Czech Republic should have a positive effect in the form of considerably stronger coordination in the management and financing of the RDI system.

A major weakness of the national innovation system of the Czech Republic is the area of evaluation. Evaluation at the level of research organizations, special-purpose RDI support programmes and providers of public funding for RDI is at the moment carried out to a considerably limited extent. Strategies and policies focused on RDI are hardly evaluated at all. Introduction of a process and system of indicators for the evaluation of the implementation of the 2013 NRDIP Update is encouraging as they are important instruments for continuous monitoring of the progress made in fulfilment of the policy’s objectives and for strategic management of the RDI system. On the whole, however, the results of analyses, evaluations and prospective studies on the strategic management of RDI at a central level and the level of the individual providers are used only to a limited extent.



### 3. KEY AREAS OF NEED FOR THE FOCUS OF THE NRDIP 2016

On the basis of the conclusions drawn from the assessment of the progress made in fulfilment of the objectives of the 2013 NRDIP Update and in relation to the current international trends in research and innovation policies, this chapter identifies the key areas of need/problems, which the 2016 NRDIP Update should concentrate on. The key needs/problems are structured into the following five areas:

- Management of the RDI system
- Public sector of RDI
- Collaboration between the private and public sectors of RDI
- Innovation in enterprises
- Challenges for the focus of RDI

#### 3.1. MANAGEMENT OF THE RDI SYSTEM

Despite the strengthening of the RDI system management and coordination in 2014 and 2015, many problems in this area remain unsolved. Organization of the state administration and administration of RDI in accordance with the existing legislation have been continuously criticised both by the research community and by external actors and foreign evaluators (e.g. International Audit of RDI in the Czech Republic). Fragmentation and an unclear definition of the powers of individual administrative authorities continue to be their main features. The chaotic nature of the powers in RDI management is reflected in the departmentalism and general lack of cooperation between individual actors. It appears that if a really strong conceptual and management base for RDI is to be created, the established coordination units must be provided with institutional (a central administrative authority) and legislative (embedded in law) support.

The existing system of RDI management is characterized by the relatively chaotic duties and responsibilities of the individual government authorities for single factors of management and implementation of the research and innovation policy (duplication of MEYS and the R&D Council in some cases). Being the expert and advisory body of the government composed of prominent experts in fundamental research, applied research, development and innovation, the R&D Council fulfils, pursuant to the

applicable law, many executive functions associated with the execution of the state administration in the area of RDI that would belong to a central administrative authority. A change in the management system is comprehensively addressed in the new act on RDI under preparation.

Another problem persisting since 2009 is the definition of the position and role of TA CR in relation to other providers of support for RDI and ministries without a budget allocation for RDI. The definition of the role of TA CR is legally ambiguous (Section 5(2) vs. Section 36a(3)a) of the RDI Act). As a result thereof, the role of departments without a budget allocation for RDI was considerably sidelined in the preparation of programmes.

Responsibility for the support for innovations is not legally embedded and the support for industrial research is fragmented. A significant reduction in staff capacities for conceptual activities in RDI, the demise of autonomous departmental policies in this area (in the case of the Ministry of the Environment, Ministry of Transport, Ministry of Labour and Social Affairs (MLSA) etc.) and the substantially limited availability of relevant RDI results are important problems related to the still unclear role of the ministries, whose powers include responsibility for RDI but who lost a budget allocation for the support of RDI following the 2008 Reform. Together with the limitation of their role in the preparation of RDI programmes (see above), this has a negative impact in the form of the separation of R&D from other activities of the relevant departments. The shortcomings in the system of management of RDI are reflected, inter alia, in the increasing fragmentation and poor strategic orientation of the system of RDI funding. The system is very fragmented in the area of institutional financing, both in terms of the number of research organizations and in terms of the roles played in the RDI system. In addition, targeted support is not sufficiently strategy-driven and it is separated from the aid from ESIF, which places ever greater demands on the sustainability of the system of RDI financing after 2020. Finally, strategic management is weakened by the poor use of evaluations at the various levels of the RDI system as a source of information for the correct formulation of the RDI policy and for the targeting of supporting instruments. Evaluation of research organizations is

narrowed down to the evaluation of R&D results; RDI programmes are subject to rather formal evaluation and the evaluation of providers and policies only takes into account selected aspects of their activities. Little attention is paid to evaluation of possible alternatives of future development, which would allow the implementation of a pro-active (not only reactive) RDI policy.

#### Guidelines for the NRDIP 2016:

- **Establish a functioning system of RDI management.** The NRDIP 2016 is aimed at creating a system of RDI management with a clear definition of the roles and powers of individual bodies, functioning coordination of their activities, providing adequate staff capacities for the implementation of the RDI policy and linking the RDI policy to departmental policies. Establishment of a central administrative authority for RDI is one of the actions necessary to create a functioning system and it is included in the new act on RDI under preparation. The related definition of the powers of the individual bodies is linked to an amendment to the applicable legal regulations. It is also necessary to increase the efficiency of coordination of national and international RDI activities so that domestic and foreign public funds are used effectively and with synergy and the Czech Republic's interests in ERA are promoted successfully.
- **Establish an effective and sustainable system of research funding.** It is necessary to focus on increasing the efficiency of the system of financing of research organizations that will be adequate for the financial capacity of the state budget and at the same time to prepare a system of RDI funding (targeting and distribution of national public sources) for the period after 2020.
- **Strengthen strategic intelligence for the RDI policy.** In this respect, it is necessary to strengthen the role of the evaluation of research organizations, RDI programmes and policies and other expert analytical inputs for the strategic management of the RDI policy. In addition to the retrospective view, it is also necessary to strengthen prospective constituents of strategic intelligence that will allow timely identification of future opportunities and promising areas to be targeted by the RDI policy.

### 3.2. PUBLIC SECTOR OF RDI

The productivity of research and the quality of scientific work have been gradually increasing in the public sector of RDI over the last years and they are close to the European average. However, as indicated by the conclusions of the assessment of the progress made in fulfilment of objectives of the 2013 NRDIP Update, the Czech Republic still lacks a greater number of research bodies and teams that would generate top results on a global level and high-quality and much-cited scientific work with significant impact. This may be linked, inter alia, to the existing evaluation methodology, which does not take account the purpose for which research organizations were established. It does not encourage research teams to carry out demanding and top research and it takes no account of criteria of the research organizations' prestige in the international research environment ('esteem' indicators). It may also stem from the existing system of institutional support division as a result of which research organizations concentrate more on short-term goals (getting points for R&D results).

Despite the improved quality of research, the domestic research system remains relatively closed to international collaboration. Compared to foreign teams, research teams from the Czech Republic are less engaged in international research programmes such as framework programmes of the European Union (the current Horizon 2020 programme). The number of publications produced through international collaboration is lower in the Czech Republic than abroad. Research organizations remain relatively closed to engaging researchers from abroad. The closed nature of the research is manifested also by the relatively small number of foreign students of doctoral programmes. All of these aspects of Czech research have a negative effect on the further development of the quality of public research, the efficiency of its financing and ensuring the long-term sustainability and development of the established research capacities (not only R&DfI centres). The existing evaluation methodology may have a negative impact on this area as it does not sufficiently take into account engagement in international research and fails to motivate researchers to participate in international research programmes and research organizations to be more open.

In recent years, the equipment in R&D capacities and infrastructure has been considerably extended and upgraded through the use of funds from OP R&DfI (European centres of excellence and regional centres).





On the one hand, these centres generate considerable potential for quality research and, on the other hand, the effective use and long-term sustainability of these centres (particularly European centres of excellence) is a great risk for the future as their operation will be costly. The revenues obtained from abroad and from contractual research, to which the beneficiaries of R&DfI centre programmes committed themselves, will be an important source for ensuring sustainability.

Along with the development of research capacities in the Czech Republic, the number of researchers working in the public sector has been growing in the long term. As some research centres are put into operation one by one and as these centres may hire a not inconsiderable amount of researchers from other research organizations, a lack of quality researchers meeting high standards in terms of the quality of scientific work may become a problem in the future. The lack of researchers may also have a negative effect on the development of corporate R&D.

#### Guidelines for the NRDIP 2016:

- **Stabilize the system of financing of research organizations and increase its efficiency.** The NRDIP 2016 concentrates on the creation of a system of institutional funding that will guarantee conditions for long-term development of research organization and adequately stimulate these institutions to top research, international research collaboration and openness as well as generating findings apt for the use in innovation and collaboration with the application sector while taking account of the institutions' mission and role in the RDI system (also see chapter 3.3). The NRDIP 2016 pays attention not only to ensuring the financial sustainability ('durability') of R&DfI centres, but particularly to their sustainable development ('sustainability') and effective integration in the RDI system. It is also important to gradually reduce the share of funds the centres receive from the state budget and, on the contrary, to increase the share of funds obtained from international sources and/or from collaboration with the application sector. Ensuring effective development of the new as well as the existing research centres and infrastructures remains an important task not only in terms of establishing a system of public funding of RDI but also for the research organizations that established these centres and infrastructures and have been running them.
- **Create conditions for the development of excellent research bodies on a global level.** Following the general improvement of the quality of the research base and improvement of the R&D infrastructure, it is necessary for the NRDIP to focus not only on further improvement of the quality of R&D but also on the development of a limited number of research bodies that will be excellent on a global level, i.e. those where top internationally competitive fundamental research will be conducted and high-quality scientific work with significant impact will be produced.
- **Strengthen internationalization and openness of public research.** Research organizations need to be encouraged to provide greater openness and more intensive engagement in international research collaboration (e.g. by taking account international collaboration in the evaluation of research organizations and in the system of institutional funding). At the same time, it is necessary to open the research environment to and make it more attractive for foreign students of doctoral programmes and researchers, including open competitions for vacant managerial positions and research fellowships of domestic researchers abroad and creation of conditions for their return to the Czech Republic.
- **Ensure quality human resources for research.** As the requirements for the provision of a sufficient number of quality researchers not only in public research but also in the corporate sector have been increasing, it is necessary to improve the quality of Master's and doctoral studies and make them more attractive for both domestic and foreign students. It is also necessary to motivate pupils/students to pursue scientific and technical studies and a scientific career and to support the process of further education. Finally, it is necessary to put emphasis on raising female participation in research in relation to the objectives of the Horizon 2020 programme and objectives of the Government Strategy for Equality of Women and Men in the Czech Republic for 2014–2020. In this respect, it is necessary to adopt measures to ensure equal conditions for women and men in RDI work, including conditions for the harmonization of their private and professional lives.<sup>1</sup>

1) Specific objectives for equality of women and men in the area of education and research are also laid down in the Government Strategy for Equality of Women and Men in the Czech Republic for 2014–2020.

### 3.3. COLLABORATION BETWEEN THE PRIVATE AND PUBLIC SECTORS OF RDI

Unlike the research system whose productivity and quality are on track to match the European level, areas of applied research, knowledge transfer and application of new R&D findings still suffer from many weaknesses. The inadequately developed base of applied research, which is connected with the liquidation of the applied research base in the nineties, is a major problem of the existing RDI system. The Czech Republic still lacks a greater number of research organizations whose primary activity would be R&D for the needs of the application sector and where results with a high potential for application in innovation would be produced. This is reflected, inter alia, by the small number of international patent applications filed by research organizations and enterprises from the Czech Republic.

Another weakness is the transfer of R&D findings generated by public research into practice. Research organizations are far from open to the needs of the application sector. Although thanks to the investments from the European Union Structural Funds in 2007–2013, many technology (knowledge) transfer centres ('TTC') attached to research organizations were set up and started operating, the quality of services provided by the centres and their efficiency are not yet high. Internal systems for commercialization which should facilitate application of research results generated by research organizations and through collaboration between research organizations and the application sector have not had the expected results. Insufficient generation of findings for applications and undeveloped relations between research organizations and the application sector are related to the existing methodology of evaluation of RDI results which takes inadequate account of the collaboration between research organizations and the application sector and fails to motivate the organizations to conduct R&D in accordance with societal needs.

The limited application of open access to the published results of R&D supported from public funds is another aspect linked to the low efficiency of knowledge transfer and dissemination. Limited access hinders the transfer of new findings both within the research sector and between research organizations and potential users of the results.

Relations between innovative enterprises and research organizations are underdeveloped in the RDI system. There is a particular lack of long-term strategic partnerships, which form the heart of economic performance and prosperity of the Czech Republic. In terms of research organizations, these relations are not established and developed due to the lack of sufficient stimuli in the institutional funding system. On the part of enterprises, the cause may lie in their low absorption capacity for R&D results from the public sector, which is related to the underdeveloped R&D activities in domestic enterprises (particularly small and medium-sized ones) that require research organizations to provide a solution only at the stage close to market application.

#### Guidelines for the NRDIP 2016:

- **Re-establish the institutional base of applied research.**

To improve applied research and intensify its effects on the application sector and society, it is necessary to appropriately transform some of research capacities of the Czech Republic into quality bodies of applied research that will intensively cooperate with the application sector and generate findings with a high potential for direct application in innovation (and whose revenues from the application sector will form a substantial part of their R&D budget). Examples of centres thus established include Danish GTS institutions<sup>2</sup> with a regional remit focused on specific technological areas, or Finnish Strategic Centres for Science, Technologies and Innovations (SHOK<sup>3</sup>). In order to strengthen the quality of applied research results, it is also necessary to introduce research evaluation that will take account of the results of both fundamental and applied research, and an effective and strategy-driven system of support for applied research.

2) GTS – Advanced Technology Group ('Godkendt Teknologisk Service' – accredited providers of technological services). A network of nine independent research and technological non-profit organizations that are accredited by the responsible ministry for 3 years.

3) SHOK – Strategisen huippuosaamisen keskittymät. Six non-profit organizations operating in the key sectors of the economy.

- **Increase the efficiency of knowledge dissemination and sharing by research organizations.** In order to improve the transfer of new knowledge from the public sector into practice, it is necessary to pay attention to improving the work of TTCs set up in public research organizations and to increase their efficiency ('mobilization' of the work of TTCs and internal systems for commercialization of R&D in research organizations). The management of research organizations should introduce sufficiently motivating internal systems for the commercialization of R&D and rules for these activities in their institutions; inspiration can be drawn from the methodologies prepared under individual projects of the national EF-TRANS4. In addition, operative and effective instruments supporting R&D commercialization in research organizations should be introduced. An example is the Finnish TULI5 programme. TTCs must be encouraged to cooperate and share their experience with other TTCs in the Czech Republic and abroad. Another area requiring attention is the improvement of access to the new knowledge produced with the support from public funds. For this reason, the possibilities of and entitlements to open access to scientific publications should be evaluated as the open access will help disseminate the knowledge generated by publicly funded research.
- **Strengthen strategic collaboration between businesses and research organizations.** With respect to all instruments supporting applied RDI, it is necessary to strengthen collaboration between public research and the application sector. Emphasis should be placed particularly on the development of long-term and strategy-driven collaboration between businesses and research organizations as it will enable development of products with high added value in technological areas corresponding to the strategic focus of the Czech Republic. Finally, it is necessary to improve engagement of SMEs from the Czech Republic in international research collaboration.

4) Effective transfer of research and development knowledge and findings into practice and their subsequent application (EF-TRANS). A collection of methodologies for commercialization of research and development, particularly Methodology I – System of Commercialization.

5) Creating Business from Research – TULI. Programme to support the application of public research results and establishment of new businesses based on research and development as implemented by the Finnish agency TEKES in 1993 through 2012.

### 3.4. INNOVATION IN ENTERPRISES

Research activities of domestic enterprises (particularly SMEs) are relatively low by the standards of technologically advanced countries. As indicated by the assessment of the progress made in fulfilment of the objectives of the 2013 NRDIP Update, industrial enterprises in the Czech Republic invest a lower share of gross added value into R&D than foreign ones. In terms of the total innovation expenditure of enterprises, the share of their costs relating to the acquisition of equipment is higher and the share of the costs of their own or purchased R&D is lower by international standards, which means that R&D has not become a source of competitiveness for the domestic corporate sector.

Risk capital investment (seed and start-up capital) into early-stage innovative enterprises is low in the Czech Republic in the long term, which may be linked, inter alia, to the fact that businesses meeting the requirements of risk capital investors have not yet been established in the Czech Republic. Another cause may be the existing business environment in the Czech Republic as it may discourage investors from these activities to a certain extent (as indicated by the Doing Business<sup>6</sup> reports, this includes for example insufficient protection of the rights of minority investors and the difficult enforcement of contracts).

The existing instruments supporting corporate R&D and collaboration between enterprises and research organizations have not had a great positive impact. In terms of the R&D expenditure of the corporate sector in the Czech Republic, the share of public sources is relatively high compared to technologically advanced foreign countries, which is an indicator that enterprises have been using these instruments for the implementation of sub-actions and they have not been expanding their research activities (using their own resources). This may be caused by taking insufficient account of the needs of the application sector (or relevant societal needs) and by inefficient stimuli for the implementation of strategically important projects and development of long-term collaboration between enterprises and research organizations (extending beyond the completion of projects).

6) <http://www.doingbusiness.org/>

In the Czech Republic, an important role in corporate research is played particularly by multinational companies and branches of foreign businesses. While the presence of these businesses could be beneficial for the development of R&D activities of domestic enterprises and for the development of collaboration between businesses and research organizations, their integration in the RDI system has been limited.

In many cases, development of innovation activities of enterprises in the Czech Republic and implementation of more demanding RDI projects may be hindered by insufficiently effective internal processes. The Czech Republic does have a relatively satisfactory position in the area of digital technology exploitation in the corporate sector but the performed analyses indicate that, inter alia, domestic enterprises use information sharing systems insufficiently by international standards, which may prevent the implementation of more demanding RDI activities in the future.

As indicated by the assessment of the progress made in fulfilment of objectives of the 2013 NRDIP Update, the share of researchers working in the corporate sector is low compared to technologically advanced and industrialized countries. Requirements to ensure a sufficient number of researchers and highly qualified experts will increase in the future in connection with the development of RDI activities in the corporate sector.

#### Guidelines for the NRDIP 2016:

- **Increase the research and innovation activities of enterprises.** The NRDIP 2016 seeks to develop research and innovation activities in the domestic corporate sector (particularly in SMEs) and to apply R&D results in new products that will enable the enterprises to establish themselves in the existing or new markets and create preconditions for increasing their competitiveness. At the same time, this will increase the absorption capacity of enterprises for R&D results generated by public research. It is therefore necessary to encourage enterprises that have not been conducting R&D or purchasing R&D results to start their own R&D activities or to cooperate with research organizations. Inspiration for the development of instruments encouraging enterprises to start and develop those activities can be drawn from the earlier British Grant for Research and Development<sup>7</sup> programme.

In the light of the development of R&D, it is also necessary to encourage SMEs to participate more intensively in international research programmes and other international R&D activities (the Horizon 2020 programme, the Eureka initiative, European Technological Platforms, JTI etc.). Establishment of new businesses based on new knowledge from R&D should be encouraged and conditions for their initial development should be created, including provision of access to the financial resources necessary for these purposes. In this respect, it is necessary to encourage students to start their own businesses based on creativity, knowledge and results of R&D. In terms of the access of early-stage innovative enterprises to financial resources, it is necessary to stimulate capital investment (early stage venture capital) that would facilitate their initial development.

- **Increase the efficiency of business processes.** In the context of dynamic technological development, it is necessary to improve the preparedness of enterprises to react in time to the opportunities offered by new technologies, to changing market conditions and to existing as well as potential societal needs. It is also necessary to make use of the Czech Republic's satisfactory position in the exploitation of digital technologies in the corporate sector and its strong industrial tradition and encourage enterprises to systematically use and integrate new technologies into business processes; this will enable them to implement the most demanding RDI projects.
- **Ensure quality human resources for innovation.** In the context of increasing RDI activities in the corporate sector, the need to ensure quality human resources for corporate research and corporate positions that are demanding in terms of knowledge, particularly staff with quality technical and scientific education, will increase. The NRDIP 2016 must therefore strive to increase the quality of studies at all levels of education, including continuing education, and to increase the number of graduates meeting the conditions for those positions. Appropriate instruments must be used to support employment of fresh graduates in corporate R&D and in innovative enterprises.

*7) The Grant for Research and Development programme provided SMEs with funds for R&D of innovative products and processes. Grants were divided into four groups by product type, budget and amount of the financial participation of enterprises. In some years, the Grant for Investigating an Innovative Idea was added to the programme; it enabled SMEs to determine (with the help from advisors) whether they are adequately prepared for successful implementation of their projects, identify any obstacles and make use of external consulting to remove the obstacles.*



### 3.5. CHALLENGES FOR THE FOCUS OF RDI

As indicated by the assessment of the objectives and actions of the 2013 NRDIP Update, the results of applied research supported from public funds are applied in innovations that would strengthen competitiveness of enterprises and fulfil societal needs only to a very limited extent. Reasons include, inter alia, the lack of strategic targeting of the support for applied research, as RDI programmes whose topics are defined very broadly are launched without any direct link to user needs. Although the NPOR provides a basis for support targeting the identified societal needs, the failure to specify their implementation plan down to particular supported thematic areas is reflected in the too general focus of the RDI programmes that refer to the fulfilment of those priorities (or RDI objectives in the priority areas). The RDI objectives defined for individual priority areas in the NPOR are more general than the specific needs of the users of the RDI results. It is therefore difficult to perform an evaluation of the benefits of NPOR implementation that would be of sufficient informational value and would not lapse into a formal bureaucratic assessment.

A further reason for the general and insufficiently strategic targeting of the support for applied research is a lack of emphasis on the identification of user needs in the preparation of RDI programmes. Representatives of the potential users of RDI results (enterprises, public administration etc.) are not systematically engaged in the preparation of RDI programmes and hence the programmes cannot directly react to their explicitly expressed needs. Where a large part of applied research supported from public funds is conducted in research organizations, insufficient targeting of an RDI programme on user needs results in a situation in which it is difficult to apply the results of the supported RDI projects in innovations.

The Czech Republic lacks a systematic and continuous assessment of the trends and possible scenarios of future development that would enable timely identification of good opportunities for research and it is therefore impossible to effectively target the support for RDI not only to the current problems and user needs but also to possible future societal needs.

### Guidelines for the NRDIP 2016 Update:

- **Target the support for research according to the needs of users and societal needs.** Firstly, it is necessary to prepare a clear concept of support for applied research defining the R&D directions that should be supported in relation to the identification of societal needs and user demand (while taking account of the priorities of the National RIS3 and NPOR), and instruments and providers of the support. In this respect, it is necessary to strengthen the participation of enterprises, relevant departments, economic partners, associations and platforms in the identification of user and societal research needs. Strategically focused instruments in the support of applied research should correspond both to the current needs of businesses and society, and to the potential challenges or threats faced by society in the future. Inspiration can be drawn from the technologically focused programmes of the Finnish agency TEKES<sup>8</sup> or from the German Energy Research Programme<sup>9</sup>.
- **Strengthen a proactive RDI policy that would be based on the current trends and potential future needs and opportunities.** As the current development is associated with ever faster social and economic change, dynamic technological progress, increasing complexity and linkage of various phenomena, the RDI policy must continually monitor and evaluate possible scenarios of future development. This will enable timely identification of new needs and opportunities and effectively target the related actions of the RDI policy.

8) Tekes Programmes. Fifteen technologically focused programmes were opened under which enterprises and research organizations cooperate and undertake RDI with a significant impact on the technological area concerned.

9) 6th Energy Research Programme of the Federal Government. Program for the period of 2011–2014 with a budget of approx. EUR 3.5 billion in support of research and development of energy technologies; several federal ministries participate in the programme.



## 4. Objectives and actions<sup>1</sup> of the NRDIP 2016

### 4.1. MANAGEMENT OF THE RDI SYSTEM

#### Problems/needs:

- Ambiguous definition of the role, position and powers of government authorities (MEYS, R&D Council and other relevant actors).
- A lack of coordination of the activities of individual state administration actors, a need to strengthen staff capacities for the RDI policy.
- Considerable fragmentation and poor strategic orientation of the system of RDI financing which places real demands on the system sustainability.
- Limited use of evaluation of research organizations, RDI programmes and policies and other expert analytical inputs, including a lack of systematic monitoring and assessment of trends and potential opportunities, for strategic management of the RDI policy.

### STRATEGIC OBJECTIVE 1:

Establish a stable, effective, strategically managed and financially sustainable system of RDI.

The objective is to increase the efficiency of strategic management of the RDI policy, coordination within the system of RDI management and cooperation among all key actors contributing to the formulation and implementation of the RDI policy. A strategically managed and well-coordinated system of RDI should contribute to the long-term sustainability of RDI funding in the Czech Republic.

#### **SPECIFIC OBJECTIVE 1.1: Establish a functioning system of RDI management**

The objective is to establish a system of RDI management with a clear definition of the roles and powers of the individual bodies, functioning coordination of their activities in the system and sufficient staff capacities for the conceptual activities in RDI and linking the RDI policy with departmental policies. The system of RDI management must ensure effective coordination of national and international activities in this area so that domestic and foreign public funds for RDI are used purposefully and synergically and the Czech Republic's interests in the ERA are promoted successfully.

#### Indicators

▷ Effective system of RDI management (qualitative indicator)

- **Action 1: Establish a central administrative authority for RDI**

Establish a central administrative authority for the whole area of RDI that will be responsible for the general management of the RDI system, coordination of providers and other departments responsible for the RDI policy in their relevant scope of powers. Simultaneously, make effective use of the existing mechanisms and platforms for the coordination of the RDI policy with other activities in support of competitiveness, including activities carried out in support of innovation at a regional level (RIS3).

This action continues action 15 of the 2013 NRDIP Update

■ **Deadline: 2017**

■ **Responsibility: OG CR – SRI Section, R&D Council**

- **Action 2: Define the powers and positions of TA CR and other institutions in the system of support for RDI**

Clearly define the powers and the position of TA CR in the system of support for RDI as an agency for the implementation of the RDI policy and introduce principles for direct relation of the support provided by all providers (i.e. including CSF, TA CR and CAS) to the objectives of the RDI policy and related strategic-conceptual documents.

<sup>1)</sup> The intensity and form of participation of individual institutions in actions with a clearly defined participation will be discussed before the implementation of the action starts.



This action continues action 15 of the 2013 NRDIP Update

■ **Deadline: 2017**

■ **Responsibility: OG CR – SRI Section, R&D Council**

- ***Action 3: Ensure sufficient staff capacity of the state administration for implementation of the RDI policy***

For the effective linkage of the RDI policy with departmental policies, it is necessary to strengthen staff capacities of the ministries responsible for the research policy within their scope of powers which are not providers of support for R&D, and evaluate the need to reinforce the staff working on the RDI agenda at ministries that provide support for R&D.

This action continues actions 14 and 15 of the 2013 NRDIP Update

■ **Deadline: 2017**

■ **Responsibility: shared responsibility: MF and administrative authorities responsible for R&D within the scope of their powers**

- ***Action 4: Develop international collaboration on RDI and strengthen the position of the Czech Republic in ERA in a strategic and coordinated way***

Prepare an action plan, further to the NRDIP objectives, for internationalization of RDI that will include an action plan for the development of human resources, taking into consideration gender equalities in RDI, laying down individual steps, deadlines of implementation and responsibilities. Ensure transfer of information among all government authorities and coordination of all activities focused on the strengthening of the Czech Republic's position in ERA, including the Czech Republic's coordinated approach to and engagement in international research collaboration with non-EU countries. In the content of strengthening the Czech Republic's position, support development of the expertise for the Czech Republic's representatives for projects implemented at the European Commission level, including effective lobbying in the promotion of the interests of the Czech research in ERA and strengthening scientific diplomacy with European and non-European countries. In order to prevent discontinuity of the support for international collaboration in RDI, it is necessary to submit to the government for approval, within a very tight time frame, programmes in support of international collaboration that would ensure financing of the development of international collaboration in 2017 and beyond.

This action continues actions 10, 11, 14 and 16 of the 2013 NRDIP Update

■ **Deadline: 2016+**

■ **Responsibility: OG CR – SRI Section, MEYR, MIT, MFA, cooperation: other administrative authorities responsible for R&D within their scope of powers**

**Key milestones and responsibilities of specific objective 1.1:**

- ▶ Legal embedding of the new system (2017). Responsibility: OG CR – SRI Section, R&D Council.
- ▶ Staff reinforcement of relevant providers<sup>1</sup> and ministries (2017). Responsibility: OG CR – SRI Section, shared responsibility: MF.
- ▶ Preparation of an action plan for internationalization of RDI containing an action plan for development of human resources and gender equality in RDI (2016). Responsibility: MEYS, shared responsibility: OG CR – SRI Section and ÚV ČR – KLM.
- ▶ Launching programmes in support of international collaboration (2016). Responsibility: MEYS.

<sup>1</sup>) E.g. Ministry of the Interior in accordance with National Security Council Resolution No. 32/2015.

### **SPECIFIC OBJECTIVE 1.2: Establish a sustainable system of RDI funding**

The objective is to ensure that the system of RDI funding corresponds to the financial capacities of the state budget and to prepare an RDI funding system (focus and division of national public sources) for the period beyond 2020.

#### **Indicators**

- ▷ Financial contribution received in the Horizon 2020 programme per billion GDP (in EUR)
- ▷ Share of sources from the (domestic) corporate sector in the R&D expenditure of the government and university sectors (%)
- ▷ Share of sources from the corporate sector in GERD (%)

#### **• *Action 5: Ensure sustainability of the RDI financing system***

Set out a vision of long-term development of the RDI system with regard to the financial sustainability of the RDI system as a whole (i.e. the whole research base) with emphasis on the period after termination of the programme period 2014–2020 and a proposal of specific actions for RDI financing from public sources after 2020. In preparation of the draft R&D budget and in respect of all proposals of new or changes to the existing RDI support instruments, request specification of the method of their financing for the period until 2023 and a vision of their financing after 2023 especially when they are paid, inter alia, from ESIF resources.

This action continues action 1 of the 2013 NRDIP Update

■ **Deadline: 2018**

■ **Responsibility: OG CR – SRI Section, R&D Council, shared responsibility: MF**

#### **Key milestones and responsibilities of specific objective 1.2:**

- ▶ Preparation of a medium-term plan of the R&D state budget until 2020 and an indicative plan of RDI financing after 2020 (2018). Responsibility: OG CR – SRI Section, R&D Council.

### **SPECIFIC OBJECTIVE 1.3: Strengthen strategic intelligence for the RDI policy**

The objective is to strengthen strategic management of the RDI policy and system and make effective use of the results from evaluations of research organizations, RDI programmes and policies and other expert analytical outputs for these purposes. Another objective is to establish and introduce a system for continuous monitoring of trends and identification of future opportunities that will enable timely targeting of the RDI support to promising areas.

#### **Indicators**

- ▷ Introduction of standard procedures of RDI evaluation (qualitative indicator)

#### **• *Action 6: Use evaluation for strategic management of RDI***

Create mechanisms that will enable the use of the results of evaluations carried out at all levels for qualified development of an RDI policy. Establish responsibility for regulation of evaluation of RDI programmes and grant project groups at all phases of their implementation (ex-ante, interim and ex-post evaluations of outputs, results and effects) and strengthen the staff capacities of the relevant actors. Programme evaluation will take account of the different purposes and objectives of the individual programmes of targeted support and their role in the performance of evaluations will be defined in agreement with the providers. Evaluate the course of implementation of NRDIP actions by individual administrators at the level of the central administrative authority.

This action continues actions 18, 19 and 20 of the 2013 NRDIP Update

■ **Deadline: 2016+**

■ **Responsibility: OG CR – SRI Section, R&D Council, shared responsibility: MF, cooperation: other administrative authorities responsible for R&D within their scope of powers**

#### **• *Action 7: Strengthen the use of trend and outlook analyses in the RDI policy***

Establish a system of continuous monitoring and assessment of trends in technological, economic, social and other areas and identify potential future opportunities and needs using outlooks, which will enable timely



reaction to the changing conditions using appropriate measures of the research and innovation policies. In this context, strengthen the use of existing and newly emerging expert platforms (e.g. NIP RIS3, sector platforms) as a source of strategic information for the RDI policy.

New action.

■ **Deadline: 2016+**

■ **Responsibility: OG CR – SRI Section, shared responsibility: MIT, cooperation: other administrative authorities responsible for R&D within their scope of powers**

#### Key milestones and responsibilities of specific objective 1.3:

- ▶ Preparation of a binding guidance for evaluation of RDI programmes, laying down responsibilities for performance of the evaluation (2016), staff strengthening of relevant actors for performance of the evaluation (2017). Responsibility: OG CR – SRI Section, R&D Council, shared responsibility: MF and other administrative authorities responsible for R&D within the scope of their powers
- ▶ Pilot verification of programme evaluation using the existing programmes (2017), performance of RDI evaluation according to the binding procedure (2017+). Responsibility: according to the targeted support evaluation guideline
- ▶ Establishment of a system of continuous monitoring of trends and assessment and identification of future opportunities (2017). Responsibility: OG CR – SRI Section, shared responsibility: MIT, cooperation of other administrative authorities responsible for R&D within the scope of their powers
- ▶ Carry out an interim evaluation of the fulfilment of the actions of the National RDI policy 2016 (2018). Responsibility: OG CR – SRI Section

## 4.2. PUBLIC SECTOR OF R&D

### Problems/needs:

- The system of public research is closed (to international, cross-sectoral and interdepartmental collaboration).
- The number of research bodies excellent on a global level is relatively low.
- Risks (and therefore challenges) are effective use of the potential of new RDI centres and their inclusion in the research and innovation system
- Availability of quality human resources for research may become an obstacle to the development of public research.

## STRATEGIC OBJECTIVE 2:

Create a stable quality sector of research organizations that are ready for and open towards collaboration and knowledge sharing

The objective is to increase the efficiency and quality of R&D and openness of the public research system towards international collaboration and collaboration with the application sector.

### **SPECIFIC OBJECTIVE 2.1: Stabilize the system of financing of research organizations and increase its efficiency**

The objective is to establish a system of institutional funding that will provide conditions for strategic development of research organizations and, further to their mission and role in the RDI system, encourage research organizations to carry out top research and/or generate findings apt for the use in innovations and to collaborate with the application sector. Another objective will be ensuring of a financially sustainable development of R&D centres and their integration into the RDI system.

## Indicators

- ▷ Financial contribution received in the Horizon 2020 programme per billion GDP (in EUR)
- ▷ Total number of publications registered in the WoS database per thousand researchers
- ▷ Number of PCT applications per million population (GDP)
- ▷ Proceeds from the sale of patent licences (including national ones)

### • ***Action 8: Establish an effective system of institutional support for research and development***

Establish a system of institutional support that will stabilize the financing of research organizations and, building on the results of evaluation of research organizations (see action 10), motivate the institutions to carry out R&D in line with their mission in the RDI system. At the same time strengthen the role and responsibility of research organization founders and providers of institutional support for the fulfilment of the organizations' mission and social function in the RDI system (e.g. by introducing a mechanism of performance contracts).

#### New action

■ **Deadline: 2017+**

■ **Responsibility: OG CR – SRI Section, R&D Council, cooperation: MEYS, MF and other administrative authorities responsible for R&D within the scope of their powers**

### • ***Action 9: Create conditions for the development of centres supported from OP R&DfI and large RDI infrastructures and incorporate them in the research and innovation system***

Establish an integrated and transparent system of financing of the R&DfI centres, large infrastructures and research organizations that will prevent an excessive increase in state budget requests for financing of individual significant constituents of the research system. This will include a ceiling for the financing of all research infrastructures equal to 10% of national RDI resources or 33% of ROD. At the same time, the statutes of the Council for Large Infrastructures for Research, Development

and Innovation that will fulfil the role of a committee on budgets for large research infrastructures, will be adjusted in accordance with the government's instructions. The Council for Large Infrastructures for Research, Development and Innovation will always respect the approved expenditure budget and the medium-term budget forecasts. At the same time evaluate research infrastructures (large research infrastructures and R&DfI centres) in terms of sustainability and define the role of host organizations and beneficiaries of the aid (the responsibility of the recipients of the aid). This action will contribute to the effective integration of the centres and infrastructures in the research and innovation system, diminish their reliance on state budget funds, and strengthen the responsibility of research organizations for their effective use and development.

This action continues action 4 of the 2013 NRDIP Update

■ **Deadline: 2016+**

■ **Responsibility: MEYS, OG CR – SRI Section, R&D Council**

### **Key milestones and responsibilities of specific objective 2.1:**

- ▷ Adjustment of the system of institutional funding (2017), allocation of institutional funds for R&D in line with the new system (2018+). Responsibility: OG CR – SRI Section, R&D Council, cooperation: MEYS, MF and other administrative authorities responsible for R&D within the scope of their powers
- ▷ Performance of evaluation of large infrastructures and R&DfI centres in terms of sustainability and defining the role of host organizations with recipients of the aid (2017). Responsibility: MEYS, shared responsibility: OG CR – SRI Section
- ▷ Adjustment of the statutes of the Council for Large Infrastructures for Research, Development and Innovation according to the government's instructions (2016). Responsibility: MEYS, shared responsibility: OG CR – SRI Section, R&D Council
- ▷ Establishment of an integrated system of financing of R&DfI centres, large infrastructures and research organizations (2017). Responsibility: MEYS, shared responsibility: OG CR – SRI Section, R&D Council



**SPECIFIC OBJECTIVE 2.2: Increase the quality of research and create conditions for the development of excellent research teams and bodies on a global level**

The objective is to increase the quality of public research and encourage research bodies to carry out top and internationally competitive research with significant impact on the development of science that will increase the prestige of the Czech research abroad.

**Indicators**

- ▷ Share of much-cited publications (among the 10% of the most-cited publications) in the total number
- ▷ Total number of ERC grants in relation to the sum of R&D expenditure in the government and university sectors

- **Action 10: Introduce evaluation of research organizations that will motivate an increase in the quality of research**

Building on the outputs of the IPN Methodology and experience in evaluation of CAS establishments, introduce evaluation of research bodies that will take account of the differences between research organizations according to their mission and role in the RDI system and motivate the organizations to increase the quality of research, take part in international research and carry out research utilizable in applications, and develop their collaboration with the application sector. The evaluation will therefore include criteria taking account of the various aspects of research activities (research environment, international and national collaboration, excellence in research, performance of research, research relevance for society and research impacts). The evaluation (including links to the allocation of institutional support according to the evaluation results) will encourage research organizations to improve strategic management of organizations, develop international collaboration and establish relations with the application sector.

This action continues action 17 of the 2013 NRDIP Update

■ **Deadline: 2017+**

■ **Responsibility: OG CR – SRI Section, R&D Council, shared responsibility: MEYS, cooperation: other administrative authorities responsible for R&D within their scope of powers**

- **Action 11: Development of excellent research bodies on a global level**

Discuss and consider, with regard to international experience, the possibility of developing a limited number of research bodies that will carry out excellent research on a global level and with significant impact on scientific development.<sup>2</sup>

New action

■ **Deadline: 2016+**

■ **Responsibility: MEYS, shared responsibility: OG CR – SRI Section, R&D Council, cooperation: other administrative authorities responsible for R&D within their scope of powers**

**Key milestones and responsibilities of specific objective 2.2:**

- ▶ Development of a new methodology of evaluation of research organizations taking account of their specific role and position in the research system (2016), introduction of evaluation of research organizations according to the new methodology (2017+). Responsibility: OG CR – SRI Section, R&D Council, shared responsibility: MEYS, cooperation: other administrative authorities responsible for R&D within their scope of powers
- ▶ Discussion of an appropriate mechanism of supporting excellent research bodies and discussion of the selection criteria for excellent establishments (2016/2018). Responsibility: MEYS, shared responsibility: OG CR – SRI Section, R&D Council, cooperation: other administrative authorities responsible for R&D within their scope of powers

<sup>2)</sup> Examples of the principles of selecting excellent establishments include criteria formulated in the Proposal to Establish Czech Institute of Science and Technology (CIST) Endowment Fund.

### **SPECIFIC OBJECTIVE 2.3: Increase internationalization of the research environment in the Czech Republic**

The objective is to increase engagement of domestic research teams in international R&D programmes (particularly in the Horizon 2020 programmes) and other international initiatives and open the domestic research environment to international collaboration and to foreign researchers and students of doctoral studies.

#### **Indicators**

- ▷ Share of scientific publications co-authored by domestic and foreign researchers (%)
- ▷ Share of foreign researchers in the total number of researchers (%)
- ▷ Number of participations in the Horizon 2020 programme per thousand researchers (FTE)
- ▷ Financial contribution received in the Horizon 2020 programme per billion GDP (in EUR)

- ***Action 12: Support engagement of research teams and enterprises from the Czech Republic in international RDI collaboration***

Support activities of the national information network providing information and consulting services for the engagement of Czech entities from public research and the corporate sector in international research programmes and initiatives (particularly in the Horizon 2020 programme). Support development of the quality of services provided by grant offices set up in individual research organizations.

This action continues actions 10 and 11 of the 2013 NRDIP Update

■ **2016 and onwards annually**

■ **MEYS and MIT, cooperation: other administrative authorities responsible for R&D within their scope of powers**

- ***Action 13: Encourage the inflow of quality researchers and highly qualified experts and create appropriate conditions for their professional as well as family life***

Encourage research organizations to create postdoctoral positions open for foreign graduates, improvement of the conditions for long-term working visits of quality foreign researchers (for young as well as experienced researchers in leadership positions), open, transparent and non-discriminating publication vacancies for researchers, including leading personnel. Launch a programme in support of international mobility of young (beginning) researchers and experienced researchers in senior positions and create conditions for the return of quality researchers from abroad to the Czech Republic.

New measure

■ **Deadline: 2016 and onwards annually**

■ **Responsibility: MEYS, shared responsibility: OG CR – SRI Section, cooperation: MI, MFA**

#### **Key milestones and responsibilities of specific objective 2.3:**

- ▶ Preparation of an action plan for internationalization of RDI (2016). Responsibility: MEYS, shared responsibility: OG CR – SRI Section
- ▶ Systemic provision of service support for international research collaboration (2017+). Responsibility: MEYS, shared responsibility: OG CR – SRI Section
- ▶ Launching a programme of international mobility (2017). Responsibility: MEYS, shared responsibility: OG CR – SRI Section, R&D Council



#### **SPECIFIC OBJECTIVE 2.4: Ensure quality human resources for research**

The objective is to ensure sufficient numbers of quality researchers for the public and corporate sectors and their management, improve the quality of Master's and doctoral studies and prepare high-quality graduates for employment in research and support the system of the continuing education and lifelong learning of researchers.

##### **Indicators**

- ▷ Number of doctoral graduates aged 25–34 per million population of the same age group
- ▷ Share of women in the total number of researchers (%)
- ▷ Share of foreign researchers in the total number of researchers (%)
- ***Action 14: Increase the quality of Master's and doctoral study programmes***

Promote an increase in the quality of Master's and doctoral study programmes and their focus on current and emerging technological and social trends and encourage improvement of their attractiveness for foreign students. Emphasis will be placed particularly on ensuring sufficient numbers of graduates with a quality scientific and technical education and on improving those programmes in the areas of social sciences and humanities.

##### **New measure**

- **Deadline: 2017 and onwards annually**
- **Responsibility: MEYS, cooperation: MIT, OG CR – SRI Section, R&D Council and other administrative authorities responsible for R&D within their scope of powers**

- ***Action 15: Increase the quality of human resources in R&D***

Strengthen the quality of researchers through preparation of personal development and career plans, development of continuing education and lifelong learning programmes. Develop the required skills and expertise in scientific and managerial work and team work enabling the development and deepening of collaboration with other actors in the area of RDI. Pursue the policy

of equality between women and men through adoption of a strategic plan of Priorities and Procedures in the Promotion of Gender Equality in RDI.

##### **New measure**

- **Deadline: 2016 and onwards annually**
- **Responsibility: MEYS, cooperation: OG CR – SRI Section, MLSA and other administrative authorities responsible for R&D within their scope of powers**

##### **Key milestones and responsibilities of specific objective 2.4:**

- ▶ Provision of support for postdoctoral positions (2017+). Responsibility: MEYS, cooperation: OG CR – SRI Section, R&D Council
- ▶ Adoption of a strategic plan of Priorities and Procedures in the Promotion of Gender Equality in RDI (2017+). Responsibility: MEYS, shared responsibility: OG CR – SRI Section and ÚV ČR – KLM

#### 4.3. COLLABORATION BETWEEN THE PRIVATE AND PUBLIC SECTORS

##### Problems/needs:

- The public base of applied research is not sufficiently developed in the Czech Republic.
- Knowledge transfer centres and internal systems for commercialization in research organizations are not sufficiently effective.
- Research bodies are not motivated to carry out R&D for the needs of users.
- No long-term strategic collaboration between research organizations and enterprises has been established.

### STRATEGIC OBJECTIVE 3:

Establish a system of mutually collaborating enterprises, research organizations, public administration and other actors generating new sources and knowledge for innovation.

The objective is to increase the generation of findings that can be used in the innovation of products and processes with high added value and for the needs of the public administration and that will contribute to the growth of competitiveness of enterprises and to the socioeconomic development of the Czech Republic. Another objective is to establish effective relations between public research and users of the R&D results and encourage long-term and strategy-drive collaboration between research organizations and entities from the application sector.

#### **SPECIFIC OBJECTIVE 3.1: Strengthen the institutional base of applied research**

The objective is to substantially strengthen the segment of research organizations specialized in applied research and motivate the relevant existing research body to transform themselves into research- and technology-oriented centres carrying out quality applied research according to the needs of the application sector. These establishments will collaborate intensively with the application sector and they will generate findings with a high potential for direct application in innovation.

##### Indicators

- ▷ Number of PCT applications per million population (GDP)
- ▷ Proceeds from the sale of patent licences (including national ones)
- ▷ Share of publications co-authored by the public and private sectors in the total number of publications (%)
- ▷ Share of sources from the (domestic) corporate sector in the R&D expenditure of the government and university sectors (%)
- ***Action 16: Create conditions for establishment of applied research centres***

Mechanisms and procedures will be created motivating some research bodies (including research centres supported from OP R&DfI and other programmes) to transform themselves into research- and technology-oriented centres, whose main mission will be applied research for the needs of enterprises and the society. These centres will collaborate intensively with the application sector and they will obtain a significant portion of their income from contractual research. Mechanisms will be created in the evaluation of research organizations and in the system of institutional support allocation that will encourage relevant research organizations to transform to perform R&D for the application sector.

New measure

■ **Deadline: 2020**

■ **Responsibility: OG CR – SRI Section, R&D Council, shared responsibility: MIT and MEYS, cooperation: other administrative authorities responsible for R&D within their scope of powers**





### Key milestones and responsibilities of specific objective 3.1:

- Transformation of relevant research bodies into research- and technology-oriented centres (2020). Responsibility: OG CR – SRI Section, shared responsibility: MIT and MEYS, cooperation: other administrative authorities responsible for R&D within their scope of powers

### **SPECIFIC OBJECTIVE 3.2: Increase the efficiency of knowledge dissemination and sharing by research organizations**

The objective is to increase the efficiency of commercialization systems established in research organizations and to create operative instruments supporting the generation of findings in research organizations apt for the use in applications and their application in practice.

#### Indicators

- ▷ Number of PCT applications per million population (GDP)
- ▷ Proceeds from the sale of patent licences (including national ones)
- ▷ Share of publications co-authored by the public and private sectors in the total number of publications (%)
- ▷ Share of sources from the (domestic) corporate sector in the R&D expenditure of the government and university sectors (%)
- ***Action 17: Improve conditions for the dissemination of knowledge from research organizations and encourage their collaboration with the application sector***

Increase the efficiency of knowledge (technology) transfer centres set up in research organizations and internal systems for commercialization of R&D, including establishment of mechanisms (rules) that will motivate researchers to generate findings apt for practical application and to collaborate with the application sector. Develop operative instruments in support of R&D commercialization in research organizations that will promote R&D bringing new R&D findings closer

to market application. For the purposes of establishing collaboration between the sectors, a database will be created containing facilities that can be used for the needs of R&D activities of enterprises. Evaluations will contribute to the improvement of the dissemination of knowledge from research organizations and their relations with the application sector. The evaluation will take account of the generation of findings apt for practical application and collaboration with the application sector in the context of the research organizations' mission. Possibilities for ensuring open access to scientific publications and the results of R&D financed from public sources will be evaluated, including an analysis of the costs required to ensure open access.

This action continues actions 13 and 17 of the 2013 NRDIP Update

■ **Deadline: 2017+**

■ **Responsibility: OG CR – SRI Section, R&D Council, MEYS, MIT, cooperation: other administrative authorities responsible for R&D within their scope of powers**

### Key milestones and responsibilities of specific objective 3.2:

- Consideration of options for the provision of support for the improvement of quality of TTC services (2017+) and development of instruments for commercialization in research organizations (2017). Responsibility: OG CR – SRI Section and MEYS, MIT, cooperation: other administrative authorities responsible for R&D within their scope of powers
- Creation of a database containing facilities of public research organizations that can be used for the needs of R&D activities of enterprises (2018). Responsibility: OG CR – SRI Section.

#### 4.4. INNOVATION IN ENTERPRISES

##### Problems/needs:

- Although the R&D expenditure of domestic enterprises has been increasing, it is still relatively low.
- The segment of research- and technology-oriented small and medium-sized enterprises is not sufficiently developed.
- Insufficiently effective internal business processes hinder dynamic development of innovative enterprises.
- The availability of a qualified workforce for the development of RDI activities in enterprises has been decreasing.

#### STRATEGIC OBJECTIVE 4:

Increase the innovation performance of enterprises in the Czech Republic by strengthening research activities and introducing new technologies and procedures aimed at improving the efficiency of business processes.

The objective is to strengthen the research and innovation activities of domestic enterprises (particularly small and medium-sized ones), increase the innovation performance of enterprises and make R&D and their results the most important source of enterprise competitiveness and contribute to the socioeconomic development of the Czech Republic.

##### **SPECIFIC OBJECTIVE 4.1: Strengthen the research and innovation activities of enterprises**

The objective is to motivate enterprises to heighten research activity that will enable them to increase their innovation performance and productivity and to establish their new products on existing and new markets, and to encourage enterprises which have not been carrying out R&D to launch their own R&D activities or to collaborate with research organizations. A related objective is to improve the conditions for the initial development of innovative enterprises by stimulating risk capital for early-stage innovative enterprises.

##### Indicators

- ▷ Share of sources from the corporate sector in GERD (%)
- ▷ Early-stage investments of risk capital (% GDP)

- ***Action 18: Encourage enterprises to launch and develop R&D activities***

Encourage domestic enterprises (particularly small and medium-sized ones) which have not been carrying out their own R&D activities or collaborating with research organizations (i.e. buying R&D results from public research) to launch and further develop their own R&D activities and to carry out R&D in collaboration with research organizations. The development of R&D business activities will contribute to an improvement in the enterprises' ability to absorb the results of research carried out in research organizations.

##### New action

- **Deadline: 2016+**
- **Responsibility: MIT, cooperation: OG CR – SRI Section and other administrative authorities responsible for R&D within their scope of powers**

- ***Action 19: Encourage small and medium-sized enterprises to participate in international RDI activities***

Encourage involvement of small and medium-sized enterprises in international research programmes and other international RDI activities (the Horizon 2020 programme, the Eureka initiative, European Technological Platforms etc.). Services of institutions facilitating the engagement of entities from the Czech Republic in international RDI activities will be used for this purpose. Development of international RDI activities in small





and medium-sized enterprise will make use of the presence of foreign and multinational companies active in RDI and the engagement of small and medium-sized enterprises in RDI activities with these companies operating in the Czech Republic will be promoted.

This action continues action 11 of the 2013 NRDIP Update

■ **Deadline:** 2017+

■ **Responsibility:** MIT, MEYS, **cooperation:** OG CR – SRI Section and other administrative authorities responsible for R&D within their scope of powers

- **Action 20:** *Strengthen the use of financial instruments for the development of innovation activities*

Develop and implement an instrument stimulating risk capital investments making use of public sources (National Innovation Fund). Encourage development of business activities and the establishment of new businesses based on the results of R&D and new technologies, including improvement of the business environment that will facilitate development of these activities (e.g. improvement of protection of minority owners, better enforceability of contracts etc.) and encourage researchers and students to start their own business activities making use of R&D results. Make efficient use of other forms of financial instruments, including guarantees, soft loans etc. in the development of innovation activities in small and medium-sized enterprises. Consider the option of launching a programme, including legal regulation of Pre-Commercial Procurement (PCP), which would stimulate the demand for innovative solutions by the state.

The new action partially continues action 8 of the NRDIP 2013

■ **Deadline:** 2016+

■ **Responsibility:** MIT, **shared responsibility:** MRD, **cooperation:** MF, MA, MH, MC

#### Key milestones and responsibilities of specific objective 4.1:

- ▶ Draft legal regulation of the support for PCP (2017). Responsibility: MRD, shared responsibility: MIT
- ▶ Launching of the National Innovation Fund<sup>3</sup>(2017). Responsibility: MIT, MF

3) The National Innovation Fund was approved by the government on 12 October 2015.

#### SPECIFIC OBJECTIVE 4.2: Improve the environment for the development of innovative enterprises

The objective is to increase the readiness of enterprises for dynamically changing technological and market conditions and improve their position in value chains. In this context, the aim is to strengthen the non-technical competence of small and medium-sized enterprises and to improve the availability of quality advisory services for early-stage entrepreneurs and for dynamically developing small and medium-sized enterprises.

#### Indicators

- ▶ Share of domestic added value in total exports

- **Action 21:** *Support services for the development of innovative enterprises*

Promote the development of services for the existing supporting innovation infrastructure that will facilitate the start and initial development of business and improve the efficiency of internal business processes, strategic management, protection and use of industrial property rights, introduction of new production processes, transfer of technologies and establishment on the markets of the Czech Republic and abroad. In this context, emphasis will be placed on the development of targeted expert services of business accelerators. The services will also facilitate the introduction of modern digital technologies and improvement of internal processes in enterprises that will increase the efficiency of innovative activities.

#### New actions

■ **Deadline:** 2016 and onwards annually

■ **Responsibility:** MIT, **cooperation:** MF

#### Key milestones and responsibilities of specific objective 4.2:

- ▶ Provision of support for the existing services for innovative enterprises (2016+). Responsibility: MIT, cooperation: MF

#### **SPECIFIC OBJECTIVE 4.3: Ensure quality human resources for innovation**

The objective is to increase the numbers and quality of graduates so that they are able to find employment in corporate R&D and in knowledge-demanding positions in innovative enterprises. The aim is to strengthen the practical knowledge and skills of university students in line with the requirements of research- and technology-oriented enterprises and other innovative enterprises. Introduction of mechanisms of continuing education and lifelong learning is promoted.

##### **Indicators**

- Number of doctoral graduates aged 25–34 per million population of the same age group
- Share of employment in high- and medium high-tech processing industry (%)
- Share of employment in knowledge-intensive services (%)
- ***Action 22: Prepare graduates for new challenges and the future needs of enterprises***

Establish a long-term system of forecasting the expected labour market demand in relation to the expected technological trends and potential challenges to which enterprises will have to react in a timely manner. Building on the results of these forecasts, encourage universities to adjust or create study programmes, including promotion of continuing education that will ensure the provision of experts with the required qualifications in a timely manner.

##### **New action**

- **Deadline: 2019**
- **Responsibility: MEYS, MLSA, cooperation: OG CR – SRI Section, MIT**

- ***Action 23: Promote employment of university graduates in innovation enterprises in the area of RDI***

Develop an instrument supporting horizontal mobility between the public and application sectors where collaboration between students in their final year, fresh graduates and doctoral students, and innovative enterprises will be promoted.<sup>4</sup>

<sup>4</sup>) E.g. modelled on the British post-doctoral education programme "The Engineering Doctorate".

##### **New action**

- **Deadline: 2017+**
- **Responsibility: MEYS, shared responsibility: OG CR – SRI Section, cooperation: MIT**

- ***Action 24: Increase the quality of human resources in innovative enterprises***

Strengthen the competence of employees responsible for innovation activities of enterprises through the preparation of personal development and career plans, development of continuing education and lifelong learning systems. Develop the required skills and expertise in the area of R&D work, managerial skills, team work and collaboration with other actors in the area of RDI.

##### **New action**

- **Deadline: 2016 and onwards annually**
- **Responsibility: MLSA, cooperation: OG CR – SRI Section, MIT**

#### **Key milestones and responsibilities of specific objective 4.3:**

- Establishment of a long-term system of forecasting the expected labour market demand in relation to the expected technological trends and potential challenges (2017), creation/adjustment of study programmes (2019). Responsibility: MEYS, MLSA, cooperation: OG CR – SRI Section, MIT
- Provision of support for mobility between public research and the application sector (2018). Responsibility: MEYS, shared responsibility: OG CR – SRI Section, cooperation: MIT



#### 4.5. CHALLENGES FOR THE FOCUS OF RDI

##### Problems/needs:

- There is a lack of strategic targeting of the support for applied research to user needs.
- The current and potential needs of the result users are not taken into sufficient account in the preparation of RDI programmes.

### STRATEGIC OBJECTIVE 5:

Strategically target the support for applied research to the current and potential future needs of enterprises and society

The objective is to strategically target the support for applied research, including applied research for the needs of the central state administration, to areas with a high potential for application of its results in innovation that will strengthen competitiveness of enterprises in the Czech Republic and facilitate fulfilment of the existing or possible future societal needs.

#### **SPECIFIC OBJECTIVE 5.1: Establish processes for continuous identification and assessment of the needs of applied research users and society**

The objective is to establish processes for determination of priority directions of applied research, continuous assessment of their relevance and subsequent reflection in specific programme instruments of support for applied research. In this context, the aim is to strengthen participation of enterprises, research organizations, the state administration as well as the private sector in the identification of research needs of the users of R&D results and society and in the development of instruments of targeted support for research reacting to these needs.

##### Indicators

- ▷ Intensity and quality of user engagement in the preparation of actions in support of applied research (qualitative indicator)
- **Action 25: Develop and implement processes for determination of the main directions of applied research and preparation of successor RDI programmes**

Establish an operative process making use of all the constituents of strategic intelligence (see specific objective 1.3), i.e. evaluation, consultations with expert platforms (e.g. platforms created in connection with the National RIS3), analysis of trends and prospects, for identification of the main directions of applied research (see action 28) and for preparation or adjustment of the existing RDI programmes that will support the main directions of applied research (see action 29).<sup>5</sup>

##### New action

■ **Deadline: 2016**

■ **Responsibility: OG CR – SRI Section, shared responsibility: MIT, cooperation: other administrative authorities responsible for R&D within their scope of powers**

- **Action 26: Create a platform for identification of societal challenges and a security platform**

In addition to the existing platforms for the identification of needs in relation to economic growth and competitiveness, it is necessary to develop similar mechanisms focused on the identification of priorities in the area of

<sup>5)</sup> These principles have been included in the scope of MI's powers.

societal challenges (social-science disciplines) and in the area of security (for the needs of national sources). Security management is an ongoing challenge that is significantly affected both by developments in science and technology and by the dynamics of social relations or the environment. The core of the security issues and the considerable exclusivity of the state (being the guarantor of security) require a specific approach to the development of expert inputs of the policies concerned. In addition, it is necessary to take account of the mechanisms of developing expert inputs in topics that are of both an economic and social nature (e.g. environmental issues).

#### New action

■ **Deadline: 2016**

■ **Responsibility: OG CR – SRI Section, MI, cooperation: MD and other administrative authorities responsible for R&D within their scope of powers**

- ***Action 27: Develop and implement principles in support of applied research for the needs of central government authorities and preparation of successor RDI programmes, including stabilization of the capacities in support of RDI in the state administration***

Strengthening the strategic role of central government authorities in the identification and fulfilment of their needs in the area of applied research by ensuring managing, coordinating and monitoring mechanisms, including strengthening of capacities for conceptual decision-making of the state administration in this area.<sup>6</sup>

#### New action

■ **Deadline: 2016+**

■ **Responsibility: OG CR – SRI Section, cooperation: other administrative authorities responsible for R&D within their scope of powers**

#### Key milestones and responsibilities of specific objective 5.1:

- Establishment of principles for identification of the main directions of applied research and preparation of successor RDI programmes (2016). Responsibility: OG CR – SRI Section, shared responsibility: MIT, cooperation: other administrative authorities responsible for R&D within their scope of powers

- Creation of a platform for identification of societal challenges and a security platform (2016). Responsibility: OG CR – SRI Section, MI
- Establishment of principles in support of applied research for the needs of central government authorities and preparation or adjustment of successor RDI programmes, including stabilization of capacities for the support for RDI in the state administration (2016). Responsibility: OG CR – SRI Section, cooperation: other administrative authorities responsible for R&D within their scope of powers
- Setting up a working group and preparation of supporting materials that will supplement outputs from the Entrepreneurial Discovery Process implemented within the NIP RIS3 in terms of the absorption capacity and the importance of these areas from the perspective of the national economy (GDP, export etc.) (2016). Responsibility: MIT, OG CR – SRI Section, MEYS

<sup>6</sup>) In the case of MI, in accordance with National Security Council Resolution No. 32/2015.



### **SPECIFIC OBJECTIVE 5.2: Develop a concept of support for applied research**

The objective is to establish a system of support for applied research linked to the specific needs of society and the application sector that will stimulate development of strategic and long-term collaboration between businesses, research organizations, the state administration and the civil sector at large.

#### **Indicators**

- ▷ Number of PCT applications per million population (GDP)
- ▷ Share of targeted support for R&D focused on addressing societal challenges (%)
- ***Action 28: Determine the main directions of the support for applied research***

Develop long-term priorities (5–10 years) and vertical domains of the National RIS3 into specific medium-term (3–5 years) directions of applied research, using the principles defined in action 25. These directions of applied research will take account of the potential of the Czech Republic and individual regions and will react to the identified demand of users for the results of applied research.

#### **New action**

- **Deadline: 2017**
- **Responsibility: OG CR – SRI Section, R&D Council, MIT, cooperation: other administrative authorities responsible for R&D within their scope of powers**

- ***Action 29: Develop instruments supporting the main directions of applied research***

These directions of applied research will be supported by a coordinated system of instruments (conceptual, programme ones), including determination of responsibilities of individual actors, a time schedule for the implementation of the individual instruments and specific milestones and objectives that will be evaluated in terms of their fulfilment. At the same time, areas where the support is advisable will be identified in the programmes. This will enable the use of funds and capacities to address common needs. Within all instruments in the support of applied research, long-term and stra-

tegy-driven collaboration between enterprises and research organizations will be supported as it will enable the development of products with high added value.

#### **New action**

- **Deadline: 2017+**
- **Responsibility: OG CR – SRI Section, R&D Council, MIT and other administrative authorities responsible for R&D within their scope of powers**

#### **Key milestones and responsibilities of specific objective 5.2:**

- ▶ Determination of the main directions of applied research, including societal challenges (2017). Responsibility: OG CR – SRI Section in cooperation with MIT, cooperation: other administrative authorities responsible for R&D within their scope of powers
- ▶ Development or adjustment of the existing instruments in support of the main directions of applied research (2017+). Responsibility: OG CR – SRI Section, R&D Council, MIT and other administrative authorities responsible for R&D within their scope of powers

## 5. IMPLEMENTATION

The implementation system, distribution of the roles of the individual actors and the responsibilities for fulfilment of the NRDIP 2016 actions are based on the applicable legislation, the defined powers and the created coordination structures in the area of RDI at the level of the government of the Czech Republic. While the framework required for implementation of actions specified within the objectives of the 'Management of the RDI system' and 'Public sector of RDI' already exists, or the necessary supplementation and improvement is clearly defined (e.g. establishment of a central government authority for RDI, introduction of a system of evaluation of research organizations), the system for strategic targeting of the support for applied research to user needs is only under preparation. Particular attention is therefore paid to the applied research herein below.

Given the nature of RDI activities, their complexity and the need to link individual actions, emphasis is placed on their coordination. Coordination is ensured by a central coordinator, i.e. OG CR – SRI Section, with a large base formed by the established coordinating entities operating across departments and enabling a material linkage to the agenda according to particular needs. These include the R&D Council and C&EG Council, their committees and working groups, and the link to the National RIS3 platforms.

The NRDIP 2016 contains a summary of indicators. The proposed indicator system incorporates qualitative and quantitative indicators that were relevant at the time of preparation of the NRDIP 2016 for monitoring the course and assessment of progress in fulfilment of the objectives of the strategy document. The indicators may be supplemented during the course of the implementation of the NRDIP 2016.

As in most cases they are not indicators that are highly specific for the individual objectives of the NRDIP 2016, it will be necessary to determine the contribution of the implementation of a particular objective to the change in indicator value when assessing the progress because the indicator value also reflects influences other than the implementation of specific NRDIP 2016 actions.

The implementation will include annual monitoring of the indicators and their analysis in relation to the individual specific objectives of the NRDIP 2016. Given the low specificity of the indicators, it is not reasonable to compare quantitative indicator values to the expected target values at the end of the implementation of the NRDIP 2016. It will be crucial to monitor the long-term trend of those indicators and determine the contribution of the implemented NRDIP 2016 actions to their actual increase/decrease; this will be analyzed annually.



Table 2: Summary of individual actions, indicators, milestones and the authorities responsible for their fulfilment

AREA	STRATEGIC OBJECTIVE	SPECIFIC OBJECTIVE	INDICATOR	ACTION AND RESPONSIBILITY	KEY MILESTONE AND RESPONSIBILITIES
MANAGEMENT OF THE RDI SYSTEM	<b>Strategic objective 1:</b>  Establish a stable, effective, strategically managed and financially sustainable system of RDI.	<b>1.1 Establish a functioning system of RDI management</b>	<ul style="list-style-type: none"> <li>Effective system of RDI management (qualitative indicator)</li> </ul>	<p><b>Action 1:</b> Establish a central administrative authority for RDI. Responsibility: OG CR – SRI Section, R&amp;D Council</p> <p><b>Action 2:</b> Define the powers and positions of TA CR and other institutions in the system of support for RDI. Responsibility: OG CR – SRI Section, R&amp;D Council</p> <p><b>Action 3:</b> Ensure sufficient staff capacity of the state administration for implementation of the RDI policy. Responsibility: OG CR – SRI Section, shared responsibility: MF and administrative authorities responsible for R&amp;D within their scope of powers.</p> <p><b>Action 4:</b> Develop international collaboration in RDI and strengthen the position of the Czech Republic in ERA in a strategic and coordinated way. Responsibility: OG CR – SRI Section, MEYS, MIT, MFA, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</p>	<ul style="list-style-type: none"> <li>Legal embedding of the new system (2017). Responsibility: OG CR – SRI Section, R&amp;D Council.</li> <li>Staff reinforcement of relevant providers and ministries (2017). Responsibility: OG CR – SRI Section, shared responsibility: MF.</li> <li>Preparation of an action plan for internationalization of RDI containing an action plan for development of human resources and gender equality in RDI (2016). Responsibility: MEYS, shared responsibility: OG CR – SRI Section and ÚV ČR – KLM.</li> <li>Launching programmes in support of international collaboration (2017). Responsibility: MEYS.</li> </ul>
		<b>1.2 Establish a sustainable system of RDI financing</b>	<ul style="list-style-type: none"> <li>Financial contribution received in the Horizon 2020 programme per billion GDP (in EUR)</li> <li>Share of sources from the (domestic) corporate sector in the R&amp;D expenditure of the government and university sectors (%)</li> <li>Share of sources from the corporate sector in GERD (%)</li> </ul>	<p><b>Action 5:</b> Ensure sustainability of the system of RDI financing. Responsibility: OG CR – SRI Section, R&amp;D Council, shared responsibility: MF.</p>	<ul style="list-style-type: none"> <li>Preparation of a medium-term plan of the R&amp;D state budget until 2020 and an indicative plan of RDI financing after 2020 (2018). Responsibility: OG CR – SRI Section, R&amp;D Council..</li> </ul>

AREA	STRATEGIC OBJECTIVE	SPECIFIC OBJECTIVE	INDICATOR	ACTION AND RESPONSIBILITY	KEY MILESTONE AND RESPONSIBILITIES
MANAGEMENT OF THE RDI SYSTEM	<b>Strategic objective 1:</b>  Establish a stable, effective, strategically managed and financially sustainable system of RDI.	<b>1.3 Strengthen strategic intelligence for the RDI policy</b>	<ul style="list-style-type: none"> <li>• Introduction of standard procedures of RDI evaluation (qualitative indicator)</li> </ul>	<p><b>Action 6:</b> Use evaluation for strategic management of RDI. Responsibility: OG CR – SRI Section, R&amp;D Council, shared responsibility: MF, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</p> <p><b>Action 7:</b> Strengthen the use of trend and outlook analyses in the RDI policy. Responsibility: OG CR – SRI Section, shared responsibility: MIT, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</p>	<ul style="list-style-type: none"> <li>• Preparation of a binding guidance for evaluation of RDI programmes, laying down responsibilities for performance of the evaluation (2016), staff strengthening of relevant actors for performance of the evaluation (2017), performance of RDI evaluation according to the binding procedure (2017+). Responsibility: OG CR – SRI Section, R&amp;D Council, shared responsibility: MF and other administrative authorities responsible for R&amp;D within their scope of powers.</li> <li>• Pilot verification of programme evaluation using the existing programmes (2017). Responsibility: according to the targeted support evaluation guideline.</li> <li>• Establishment of a system of continuous monitoring of trends and assessment and identification of future opportunities (2017). Responsibility: OG CR – SRI Section, shared responsibility: MIT, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</li> <li>• Carry out an interim evaluation of the fulfilment of the actions of the National RDI policy 2016 (2018). Responsibility: OG CR – SRI Section.</li> </ul>



AREA	STRATEGIC OBJECTIVE	SPECIFIC OBJECTIVE	INDICATOR	ACTION AND RESPONSIBILITY	KEY MILESTONE AND RESPONSIBILITIES
PUBLIC SECTOR OF RDI	<b>Strategic objective 2:</b>  Create a stable quality sector of research organizations that are ready for and open towards collaboration and knowledge sharing.	<b>2.1 Stabilize the system of financing of research organizations and increase its efficiency</b>	<ul style="list-style-type: none"> <li>Financial contribution received in the Horizon 2020 programme per billion GDP (in EUR)</li> <li>Total number of publications registered in the WoS database per thousand researchers</li> <li>Number of PCT applications per million population (GDP)</li> <li>Proceeds from the sale of patent licences (including national ones)</li> </ul>	<p><b>Action 8:</b> Establish an effective system of institutional support for research and development. Responsibility: OG CR – SRI Section, R&amp;D Council, cooperation: MEYS, MF and other administrative authorities responsible for R&amp;D within their scope of powers.</p> <p><b>Action 9:</b> Create conditions for the development of centres supported from OP R&amp;DfI and large RDI infrastructures and incorporate them in the research and innovation system. Responsibility: MEYS, OG CR – SRI Section, R&amp;D Council..</p>	<ul style="list-style-type: none"> <li>Adjustment of the system of institutional funding (2017), allocation of institutional funds for R&amp;D in line with the new system (2018+). Responsibility: OG CR – SRI Section, R&amp;D Council, cooperation: MEYS, MF and other administrative authorities responsible for R&amp;D within their scope of powers.</li> <li>Performance of evaluation of large infrastructures and R&amp;DfI centres in terms of sustainability and defining the role of the host organizations with recipients of the aid (2017). Responsibility: MEYS, shared responsibility: OG CR – SRI Section.</li> <li>Adjustment of the statutes of the so-called Council for Large Infrastructures for Research, Development and Innovation according to the government's instructions (2016). Responsibility: MEYS, shared responsibility: OG CR – SRI Section, R&amp;D Council..</li> <li>Establishment of an integrated system of financing of the R&amp;DfI centres, large infrastructures and research organizations (2017). Responsibility: MEYS, shared responsibility: OG CR – SRI Section, R&amp;D Council.</li> </ul>
		<b>2.2 Increase the quality of research and create conditions for the development of excellent research teams and bodies on a global level</b>	<ul style="list-style-type: none"> <li>Share of much-cited publications (among the 10% of the most-cited publications) in the total number</li> <li>Total number of ERC grants in relation to the sum of R&amp;D expenditure in the government and university sectors</li> </ul>	<p><b>Action 10:</b> Introduce evaluation of research organizations that will motivate an increase in the quality of research. Responsibility: OG CR – SRI Section, R&amp;D Council, shared responsibility: MEYS, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</p> <p><b>Action 11:</b> Development of excellent research bodies on a global level. Responsibility: MEYS, shared responsibility: OG CR – SRI Section, R&amp;D Council, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</p>	<ul style="list-style-type: none"> <li>Development of a new methodology of evaluation of research organizations taking account of their specific role and position in the research system (2016), introduction of evaluation of research organizations according to the new methodology (2017+). Responsibility: OG CR – SRI Section, R&amp;D Council, shared responsibility: MEYS, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers</li> <li>Discussion of an appropriate mechanism of supporting excellent research bodies and discussion of the selection criteria for excellent establishments (2016/2018). Responsibility: MEYS, shared responsibility: OG CR – SRI Section, R&amp;D Council, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers</li> </ul>

AREA	STRATEGIC OBJECTIVE	SPECIFIC OBJECTIVE	INDICATOR	ACTION AND RESPONSIBILITY	KEY MILESTONE AND RESPONSIBILITIES
PUBLIC SECTOR OF RDI	<b>Strategic objective 2:</b>  Create a stable quality sector of research organizations that are ready for and open towards collaboration and knowledge sharing.	<b>2.3 Increase internationalization of the research environment in the Czech Republic</b>	<ul style="list-style-type: none"> <li>Share of scientific publications co-authored by domestic and foreign researchers (%)</li> <li>Share of foreign researchers in the total number of researchers (%)</li> <li>Number of participations in the Horizon 2020 programme per thousand researchers (FTE)</li> <li>Financial contribution received in the Horizon 2020 programme per billion GDP (in EUR)</li> </ul>	<b>Action 12:</b> Support engagement of research teams and enterprises from the Czech Republic in international RDI collaboration. Responsibility: MEYS and MIT, cooperation: other administrative authorities responsible for R&D within their scope of powers.  <b>Action 13:</b> Encourage the inflow of quality researchers and highly qualified experts and create appropriate conditions for their professional as well as family life. Responsibility: MEYS, shared responsibility: OG CR – SRI Section, cooperation: MI, MFA.	<ul style="list-style-type: none"> <li>Preparation of an action plan for internationalization of RDI (2016).            Responsibility: MEYS, shared responsibility: OG CR – SRI Section.</li> <li>Systemic provision of service support for international research collaboration (2017+).            Responsibility: MEYS shared responsibility: OG CR – SRI Section</li> <li>Launching a programme of international mobility (2017).            Responsibility: MEYS, shared responsibility: OG CR – SRI Section.</li> </ul>
		<b>2.4 Ensure quality human resources for research</b>	<ul style="list-style-type: none"> <li>Number of doctoral graduates aged 25–34 per million population of the same age group</li> <li>Share of women in the total number of researchers (%)</li> <li>Share of foreign researchers in the total number of researchers (%)</li> </ul>	<b>Action 14:</b> Increase the quality of Master's and doctoral study programmes. Responsibility: MEYS, cooperation: MIT, OG CR – SRI Section, R&D Council and other administrative authorities responsible for R&D within their scope of powers.  <b>Action 15:</b> Increase the quality of human resources in R&D. Responsibility: MEYS, cooperation: OG CR – SRI Section, MLSA and other administrative authorities and institutions responsible for R&D within their scope of powers.	<ul style="list-style-type: none"> <li>Provision of support for postdoctoral positions (2017+).            Responsibility: MEYS, cooperation: OG CR – SRI Section, R&amp;D Council.</li> <li>Adoption of a strategic plan of Priorities and Procedures in the Promotion of Gender Equality in RDI (2017+).            Responsibility: MEYS, shared responsibility: OG CR – SRI Section and ÚV ČR – KLM</li> </ul>
COLLABORATION BETWEEN THE PRIVATE AND PUBLIC SECTORS	<b>Strategic objective 3:</b>  Establish a system of mutually collaborating enterprises, research organizations, public administration and other actors generating new sources and knowledge for innovations.	<b>3.1 Strengthen the institutional base of applied research</b>	<ul style="list-style-type: none"> <li>Number of PCT applications per million population (GDP)</li> <li>Proceeds from the sale of patent licences (including national ones)</li> <li>Share of publications co-authored by the public and private sectors in the total number of publications (%)</li> <li>Share of sources from the (domestic) corporate sector in the R&amp;D expenditure of the government and university sectors (%)</li> </ul>	<b>Action 16:</b> Create conditions for establishment of applied research centres. Responsibility: OG CR – SRI Section, R&D Council, shared responsibility: MIT and MEYS, cooperation: other administrative authorities responsible for R&D within their scope of powers.	<ul style="list-style-type: none"> <li>Transformation of relevant research bodies into research- and technology-oriented centres (2020).            Responsibility: OG CR – SRI Section, shared responsibility: MIT and MEYS, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</li> </ul>

AREA	STRATEGIC OBJECTIVE	SPECIFIC OBJECTIVE	INDICATOR	ACTION AND RESPONSIBILITY	KEY MILESTONE AND RESPONSIBILITIES
COLLABORATION BETWEEN THE PRIVATE AND PUBLIC SECTORS	<b>Strategic objective 3:</b>  Establish a system of mutually collaborating enterprises, research organizations, public administration and other actors generating new sources and knowledge for innovations.	3.2 Increase the efficiency of knowledge dissemination and sharing by research organizations	<ul style="list-style-type: none"> <li>Number of PCT applications per million population (GDP)</li> <li>Proceeds from the sale of patent licences (including national ones)</li> <li>Share of publications co-authored by the public and private sectors in the total number of publications (%)</li> <li>Share of sources from the (domestic) corporate sector in the R&amp;D expenditure of the government and university sectors (%)</li> </ul>	<b>Action 17:</b> Improve conditions for the diffusion of knowledge from research organizations and encourage their cooperation with the application sector. Responsibility: OG CR – SRI Section, R&D Council, MEYS, MIT, cooperation: other administrative authorities responsible for R&D within their scope of powers.	<ul style="list-style-type: none"> <li>Consideration of options for the provision of support for the improvement of quality of TTC services (2017+) and development of instruments for commercialization in research organizations (2017).                Responsibility: OG CR – SRI Section and MEYS, MIT, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</li> <li>Creation of a database containing facilities of public research organizations that can be used for the needs of R&amp;D activities of enterprises (2018).                Responsibility: OG CR – SRI Section.</li> </ul>
		4.1 Strengthen the research and innovation activities of enterprises	<ul style="list-style-type: none"> <li>Share of sources from the corporate sector in GERD (%)</li> <li>Early-stage investments of risk capital (% GDP)</li> </ul>	<b>Action 18:</b> Encourage enterprises to launch and develop R&D activities. Responsibility: MIT, cooperation: OG CR – SRI Section and other administrative authorities responsible for R&D within their scope of powers.  <b>Action 19:</b> Encourage small and medium-sized enterprises to participate in international RDI activities. Responsibility: MIT, MEYS, cooperation: OG CR – SRI Section and other administrative authorities responsible for R&D within their scope of powers.  <b>Action 20:</b> Strengthen the use of financial instruments for the development of innovation activities. Responsibility: MIT, shared responsibility: MRD, cooperation: MF, MA, MH, MC.	<ul style="list-style-type: none"> <li>Draft legal regulation of the support for PCP (2017).                Responsibility: MRD, shared responsibility: MIT.</li> <li>Launching of the National Innovation Fund (2017).                Responsibility: MID, MF.</li> </ul>
INNOVATIONS IN ENTERPRISES	<b>Strategic objective 4:</b>  Increase the innovation performance of enterprises in the Czech Republic by strengthening research activities and introducing new technologies and procedures aimed at improving the efficiency of business processes.	4.2 Improve the environment for the development of innovative enterprises	<ul style="list-style-type: none"> <li>Share of domestic added value in the total export</li> </ul>	<b>Action 21:</b> Support services for the development of innovative enterprises. Responsibility: MIT, cooperation: MF	<ul style="list-style-type: none"> <li>Provision of support for the existing services for innovative enterprises (2016+).                Responsibility: MIT, cooperation: MF</li> </ul>
		4.3 Ensure quality human resources for innovations	<ul style="list-style-type: none"> <li>Number of doctoral graduates aged 25–34 per million population of the same age group</li> <li>Share of employment in high- and medium high-tech processing industry (%)</li> <li>Share of employment in knowledge-intensive services (%)</li> </ul>	<b>Action 22:</b> Prepare graduates for new challenges and the future needs of enterprises. Responsibility: MEYS, MLSA, cooperation: OG CR – SRI Section, MIT.  <b>Action 23:</b> Promote employment of university graduates in innovative enterprises in the area of RDI. Responsibility: MEYS, shared responsibility: OG CR – SRI Section, cooperation: MIT.  <b>Action 24:</b> Increase the quality of human resources in innovative enterprises. Responsibility: MLSA, cooperation: OG CR – SRI Section, MIT.	<ul style="list-style-type: none"> <li>Establishment of a long-term system of forecasting the expected labour market demand in relation to the expected technological trends and potential challenges (2017), creation/adjustment of study programmes (2019).                Responsibility: MEYS, MLSA, cooperation: OG CR – SRI Section, MIT.</li> <li>Provision of support for mobility between public research and the application sector (2018).                Responsibility: MEYS, shared responsibility: OG CR – SRI Section, cooperation: MIT.</li> </ul>

AREA	STRATEGIC OBJECTIVE	SPECIFIC OBJECTIVE	INDICATOR	ACTION AND RESPONSIBILITY	KEY MILESTONE AND RESPONSIBILITIES
CHALLENGES FOR THE FOCUS OF RDI	<b>Strategic objective 5:</b>  Strategically target the support for applied research to the current and potential future needs of enterprises and the society.	<b>5.1 Establish processes for continuous identification and assessment of the needs of applied research users and society</b>	<ul style="list-style-type: none"> <li>Intensity and quality of user engagement in the preparation of actions in support of applied research (qualitative indicator)</li> </ul>	<p><b>Action 25:</b> Develop and implement processes for determination of the main directions of applied research and preparation of successor RDI programmes. Responsibility: OG CR – SRI Section, shared responsibility: MIT, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</p> <p><b>Action 26:</b> Create a platform for identification of societal challenges and a security platform. Responsibility: OG CR – SRI Section, MI, cooperation: MD and other administrative authorities responsible for R&amp;D within their scope of powers.</p> <p><b>Action 27:</b> Develop and implement principles in support of applied research for the needs of central government authorities and preparation of successor RDI programmes, including stabilization of the capacities in support of RDI in the state administration. Responsibility: OG CR – SRI Section, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</p>	<ul style="list-style-type: none"> <li>Establishment of principles for identification of the main directions of applied research and preparation of successor RDI programmes (2016). Responsibility: OG CR – SRI Section, shared responsibility: MIT, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</li> <li>Creation of a platform for identification of societal challenges and a security platform (2016). Responsibility: OG CR – SRI Section, MI.</li> <li>Establishment of principles in support of applied research for the needs of central government authorities and preparation or adjustment of successor RDI programmes, including stabilization of capacities for the support for RDI in the state administration (2016). Responsibility: OG CR – SRI Section, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</li> <li>Setting up a working group and preparation of supporting materials that will supplement outputs from the Entrepreneurial Discovery Process implemented within the NIP RIS3 in terms of the absorption capacity and the importance of these areas from the perspective of the national economy (GDP, export etc.) (2016). Responsibility: MIT, OG CR – SRI Section, MEYS</li> </ul>
		<b>5.2 Develop a concept of support for applied research</b>	<ul style="list-style-type: none"> <li>Number of PCT applications per million population (GDP)</li> <li>Share of targeted support for R&amp;D focused on addressing societal challenges (%)</li> </ul>	<p><b>Action 28:</b> Determine the main directions of the support for applied research. Responsibility: OG CR – SRI Section, R&amp;D Council, MIT, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</p> <p><b>Action 29:</b> Develop instruments supporting the main directions of applied research. Responsibility: OG CR – SRI Section, R&amp;D Council, MIT and other administrative authorities responsible for R&amp;D within their scope of powers.</p>	<ul style="list-style-type: none"> <li>Determination of the main directions of applied research, including societal challenges (2017). Responsibility: OG CR – SRI Section in cooperation with MIT, cooperation: other administrative authorities responsible for R&amp;D within their scope of powers.</li> <li>Development or adjustment of the existing instruments in support of the main directions of applied research (2017+). Responsibility: OG CR – SRI Section, R&amp;D Council, MIT and other administrative authorities responsible for R&amp;D within their scope of powers.</li> </ul>





## 5.1. IMPLEMENTATION OF ACTIONS IN SUPPORT OF APPLIED RESEARCH TOWARDS INNOVATION

Actions to support and fulfil the priorities of applied research will be closely linked to the regular updates of the Implementation Plan of National RIS3 and NPOR and they will be taken into account in the preparation of the RDI budget for 2017–2019.

The Implementation Plan of National RIS3 will be updated for the first time by the end of the first quarter of 2016. By the end of the first half of 2016, the plan will contain specific priority areas of RDI to which a portion of funds will be targeted. The verticalization of aid from public sources means the process of targeting funds to areas and research topics with a potential to strengthen competitiveness. The topics will be determined on the basis of structured debates on platforms organized by the public administration and linking the business sector and researchers (Entrepreneurial Discovery Process). Building on this ongoing expert negotiating process, a higher volume of funds will be directed towards these priority areas and defined topics in accordance with the requirements of the European Commission. Other funds will keep supporting general research and innovation activities. As a result thereof, support for R&D will not be excluded in any of the areas whose topics will not be included in the verticalized priorities. Prioritization within the meaning of primacy of one area over another is therefore not expected. Priority topics of the first set of areas and topics will be reflected in the calls of operational programmes OP EIC, OP RDE and OP Prague or in the RDI tenders for selected programmes of TA CR in 2017. Results of the verticalization discussions and recommendations for aid providers will be specified in the Implementation Plan of National RIS3. The method of updating the Implementation Plan makes it possible to reflect changes after each year. It is possible to flexibly react to a possible demand for changes at the meetings of the RIS3 MC or its presidium.

In accordance with Government Resolution No. 569 of 31 July 2013 on the Implementation of the NPOR, an update of the NPOR is to be submitted by 30 June 2017. This activity will be connected with the gradual specification of the National RIS3 by mid-2016 as required by the European Commission. The concept of the NPOR covers the whole area of RDI (except for fundamental

non-oriented research), while the National RIS3 targets its actions at applied research related to innovation. Following the approval of the NRDIP 2016, the gradual specification of the National RIS3 in the first half of 2016 will form the basis for preparation of an update of the NPOR concerning applied research priorities with regard to the current needs of societal development no later than by mid-2017. The material on the NPOR update will therefore contain new parts concerning the priorities of applied research that will become a part of the NPOR. This work will be carried out using the above-described consultation mechanism, required as a precondition by the European Commission, with all key actors within the National Innovation Platforms of RIS3 and the R&D Council and they will continue in the preparation of a draft estimate of the state budget RDI expenditure for 2018 with an outlook to 2019–2020. In accordance with Section 2(3) of the RDI Act, Annex 5 to the NRDIP 2016 contains the initial proposal of applied research priorities that will be subject to further detailed partner discussions and specifications and become the basis for verticalization of the National RIS3 and for the widely accepted priorities of applied research as included in the NPOR.

### Definition of applied research and preparation of applied research priorities

Preparation of applied research priorities requires a more detailed specification of the term of ‘applied research’.

Pursuant to Section 2(1) of the RDI Act, applied research is defined as experimental or theoretical work carried out with the aim of acquiring new findings and skills for the development of new or significantly improved products, technologies and services.

The general objective of research is to bring progress on the basis of new findings. In the case of applied research, in contrast to fundamental research, the type of progress is obvious and the time horizon of its achievement is usually shorter than in fundamental research. Type of progress means benefits for the society as a whole<sup>1</sup>

<sup>1</sup>) E.g. improvement of the quality of life consists of health aspects (preventive as well as therapeutic ones), quality of the environment and the related environmental protection, security, transport accessibility, quality and wholesomeness of foodstuff etc.

(improvement of the quality of life, increased competitiveness of the Czech Republic, economic profit of the Czech Republic). Fulfilment of specific objectives in these areas is achieved through applied research. The above-mentioned facts indicate that it is not possible to limit applied research only to the findings in the area of industry bringing a direct economic effect even though the Czech Republic is one of the most industrial states in Europe<sup>2</sup>. Applied research focused on industrial needs is hence an important but not the sole component of applied research in the Czech Republic.

In accordance with Section 2(2)(h) and Section 3(2) (b) of the RDI Act, financial instrument in support of applied research means a programme comprising individual programme projects. Project implementation includes activities of fundamental research but only in the extent necessary for the follow-up activities of applied research.

For the purposes of the definition of the priorities of applied research and evaluation of the benefits of applied research, it is advisable to divide applied research into the following categories:

**a) Applied research focused on the needs of the economy**

The objective should be visible (and therefore quantifiable) society-wide effects, including economic ones. The economy of the Czech Republic is driven by businesses manufacturing products with high added value and investing, in this context, large volumes of funds into their own RDI. Important sectors of the national economy represent environments where scientific findings are transformed, through their application, into economic and social benefits. Sectors with high RDI expenditure have a potential to use the funds for meaningful and effective R&D in collaboration with public research entities (universities, public research institutions) using modern infrastructures built from the contributions granted from the structural funds.

In order to ensure effective management of applied research focused on industrial needs at national and regional levels through the National RIS3, i.e. targeting of (European, national and private) funds to activities leading to the strengthening of innovation capacities and to the priority defined promising areas, it was necessary to define priority needs.

The above-mentioned sector platforms were set up for that purpose. These platforms were established with regard to the importance of individual segments for the national economy and the share of private RDI expenditure of important segments in the total expenditure of the corporate sector in the Czech Republic targeted to RDI (BERD indicator). CZ NACE classification was used for a clear definition of individual segments. The goal of the sector platforms is to gradually, and in a structured manner, define the private sector demand for fulfilment of research needs by the public research sector. Annex 5 specifies the first proposals of topics important for further development of the defined sectors which can be considered key topics of applied research focused on industrial needs. This is the first step within the above-described process. The lists of the topics will serve as a basis for further discussions. The lists are open and they will be subject to verification and development within the ongoing Entrepreneurial Discovery Process in the National RIS3.

Building on these outputs, a new integrated system of applied research management will be gradually established. The system should make the maximum use of and improve the existing research base (see the scheme in Annex 8).

**b) Applied research focused on societal and departmental needs**

An interdepartmental working group was set up by a resolution adopted at the 309th meeting of the R&D Council to deal with the definition of research needs. The working group was set up on the initiative of central administrative authorities which are no longer providers of support for RDI following the 2008 Reform, and on the basis of the need for closer cooperation between the OG CR – SRI Section and these departments, which became evident in the preparation of the RDI budget for 2016 and the medium-term outlook for 2017 and 2018.

<sup>2</sup> In 2013, industrial production of the Czech Republic accounted for approx. 32% of the total GVA of the national economy. From this point of view, the Czech Republic is one of the most industrial countries of the European Union (only Romania has a higher % GVA share, namely 34.3 %). The average industrial production of EU28 accounted for 19.1 % of the total GVA.



**Goals of the working group include:**

- Preparation of budgets, including medium-term and long-term outlooks
- Establishment of public support for RDI by the central state administration and correction of deficiencies from the RDI system reform in the form of Act No. 110/2009 Coll., amending the RDI Act:
  - ▷ New approach to the solution of the system of institutional and special-purpose RDI support for applied research focused on the needs of departments – the current state results in a complex system of solutions for specific research needs, rather in terms of procedure than substance (instruments of special-purpose or institutional support, non-sensitivity to the specific departmental problems being crucial).
  - ▷ Change of the system of evaluation of research organizations – the existing system prefers the metric of fundamental research, taking no account of the needs of applied research and implementation of the concepts of central administrative authorities in the assignment of research needs.
  - ▷ Strengthening decision-making and control powers of the relevant department to define a research need and assess outputs (preparation of programmes, required types of results – e.g. certified methodology as a type of result).
- Planning departments' administrative capacities to work out a new concept of departmental applied research.

The working group will cooperate on relevant issues with the Commission for Evaluation of the Results of Research Organizations and Completed Programmes, which is one of the expert and advisory bodies of the R&D Council.

Central government authorities have sent their requirements and lists of research needs to the OG CR – SRI Section. Departments' research needs are based on the NPOR, reflect the current situation and are listed in Annex 6.

## 6. BUDGET – FORECAST OF EXPENDITURE DEVELOPMENT

Any increased state budget requirements related to implementation of the NRDIP 2016 will be resolved within the limits of the RDI support expenditure that will be determined by the government for the relevant period according to the capacity of the state budget.

One fundamental problem of the future financing of RDI in the Czech Republic will be the considerable reduction of European sources after 2020, which may cause a significant reduction of public funds, in the extreme case by approx. 0.3% of GDP. It will be possible to only partially replace the missing European sources with national public sources. It will be necessary to deal with the situation as follows:

### 1. State budget expenditure and EU funds:

The Czech Republic Government Resolution No. 380 of 25 May 2015 approved medium-term expenditure frameworks for research, experimental development and innovations in the amount of 29.00 billion CZK for 2017 and in the amount of 29.17 billion CZK for 2018.

In order to enhance certainty and long-term stability of the RDI system after termination of the ESIF programming period and to prepare the RDI budget for 2017, medium-term outlook and long-term outlook for 2021, the Deputy Prime Minister of Science, Research and Innovation in cooperation with the Minister of Education, Youth and Sports and the Ministry of Industry and Trade will prepare a draft long-term budget of RDI expenditure from national sources until 2021 as discussed by the R&D Council that will be submitted to the government by 30 April 2016 and that will take account of the following principles:

- a) Sources of targeted support for large infrastructures for research, development and innovation will amount to a maximum of 10% of the total RDI expenditure of the Czech Republic's state budget.
- b) As of 2017, the total expenditure on long-term conceptual development of research organizations, large infrastructures for RDI, National Sustainability Programme I and National Sustainability

Programme II will amount to a minimum of 14.5 billion CZK a year, the minimum target amount being equal to 15 billion CZK a year in the period 2018–2021. This amount reflects the relevant type of support for the performance of fundamental research, applied research, experimental development and innovation.

- c) As of 2017, the sum of the total expenditure on large infrastructures for RDI, National Sustainability Programme I and National Sustainability Programme II will annually amount to a maximum of 33% of the expenditure on long-term conceptual ROD approved for the year concerned. This volume will include financing of the sustainability of large infrastructures supported from ESIF in the programme period 2014–2020. Evaluation performed according to the methodology prepared by the R&D Council will be taken into account in all cases.
- d) Following the modified methodology of evaluation of research organizations as prepared by the R&D Council, budget allocations for National Sustainability Programmes I and II will be gradually reduced as of 2017 and budget allocations for the development of research organizations or large infrastructures for RDI will be proportionally increased.
- e) Evaluation of applied research will be adjusted and it will be used for the provision of institutional support; as a follow-up, the National Sustainability Programme I will be gradually transformed.
- f) A ratio of application research targeted support to fundamental research targeted support will be determined. Support for research for the needs of central government authorities will be provided for separately. Any requirements beyond the medium-term expenditure frameworks will be addressed particularly in connection with the implementation of the National RIS3.
- g) Responsibility of the support receivers for the achieved results and the usefulness of all types of research infrastructures, including targeted support for centres of competence, will be strengthened.

- h) An analysis of the risks associated with the impact of a possible failure to ensure financing of large infrastructures from ESIF sources will be prepared and, after consulting the R&D Council, submitted to the government by 30 April 2016, including a proposal of further actions to eliminate the risks.
- i) The role of host organizations with the receivers of support for large infrastructures for RDI will be determined no later than in the interim evaluation in 2017. At the same time, the above-mentioned principles of support for large infrastructures for RDI will be reflected in the statutes of the Council for Large Infrastructures for RDI and discussed with the R&D Council.

## 2. Expenditure from private sources

Private expenditure for RDI has a great potential to make up for the missing European sources after 2020.

No advantage of the potential is currently taken as the R&D funds from businesses to the public sector amount to less than 1 billion CZK. It is therefore necessary to gradually remove the limits and barriers to mutual collaboration between the private and public sectors. The following will contribute to the removal of barriers between public enterprise and public sectors:

- long-term debate with representatives of the corporate sector (sector platforms), its output being a list of research topics for the development of key sectors of the national economy,
- a new system of applied research management – pilot thematic research co-financed from the state budget, making use of the public sector capacities, including infrastructures built with the European sources,
- record keeping and evaluation of the benefits of applied research for the society as a whole, including economic benefits.

The relevant actions of the NRDIP 2016 are designated to stimulate an increase in private expenditure.

## 7. LIST OF ABBREVIATIONS

2013 NRDIP Update - Update of the National Research, Development and Innovation Policy of the Czech Republic 2009–2015 with an outlook to 2020

CAS	The Czech Academy of Sciences
HRA CR	Health Research Agency of the Czech Republic
BERD	Corporate Expenditure on Research and Development
TTO	Technology Transfer Office
CR	Czech Republic
CSO	Czech Statistical Office
E-Corda	External Common Research Data Warehouse
EDP	Entrepreneurial Discovery Process
EC	European Commission
ERA	European Research Area
ERC	European Research Council
ESIF	European Structural and Investments Funds
EU	European Union
EVCA	European Private Equity and Venture Capital Association
FTE	Full-time equivalent
CSF	Czech Science Foundation
GERD	Total Gross Domestic Expenditure on Research and Experimental Development

GOVERD	Government Expenditure on Research and Development
HC	Headcount
GDP	Gross domestic product
HERD	Expenditure on Research and Development in Higher Education Sector
RDI IS	Research, experimental development and innovation information system
MF	Ministry of Finance
PCH	Prague City Hall
MC	Ministry of Culture
MRD	Ministry of Regional Development
MD	Ministry of Defence
MIT	Ministry of Industry and Trade
SME	Small or medium-sized enterprise
MEYS	Ministry of Education, Youth and Sports
MI	Ministry of the Interior
MRD	Ministry of Research and Development
MH	Ministry of Health
MA	Ministry of Agriculture
MFA	Ministry of Foreign Affairs
National RIS3	Research and Innovation Strategy for Smart Specialization
NRDIP 2016	National Research, Development and Innovation Policy 2016–2020





NRDIP	National Research, Development and Innovation Policy of the Czech Republic 2009–2015	SRA	Strategic Research Agenda
OECD	Organization for Economic Cooperation and Development	TA CR	Technology Agency of the Czech Republic
OP EI	Operational Programme Enterprise and Innovations	OG CR – COM	Office of the Government of the Czech Republic – Minister for Human Rights, Equal Opportunities and Legislation
OP EIC	Operational Programme Enterprise and Innovations for Competitiveness	OG CR – SRI Section	Office of the Government of the Czech Republic – Section for Science, Research and Innovation
OP PC	Operational Programme Prague – Competitiveness	R&D	Research and development
OP Prague	Operational Programme Prague – Growth Pole of the Czech Republic	RDI	Research, development and innovation
OP R&DfI	Operational Programme Research and Development for Innovation	RO	Research organization
OP EC	Operational Programme Education for Competitiveness	Un	University
OP RDE	Operational Programme Research, Development and Education	WoS	Thomson Reuters Web of Science
OP	Operational Programme	RDI Act	Act No. 130/2002 Coll., on the support of research, experimental development and innovations from public funds and on the amendment to some related acts (the Act on the Support of Research, Experimental Development and Innovations), as amended.
PCP	Pre-Commercial Procurement		
PCT	Patent Cooperation Treaty		
PPP	Public Private Partnership		
C&EG Council	Council for Competitiveness and Economic Growth		
ROD	Research organization development		
R&D Council	Research and Development Council		
RIS3 MC	National RIS3 Management Committee		
RDI SB	Research, development and innovation state budget		

## Annex 1 Summary of actions and their links to specific objectives

		MANAGEMENT OF THE RDI SYSTEM			PUBLIC SECTOR OF RDI				COLLABORATION BETWEEN THE PRIVATE AND PUBLIC SECTORS OF RDI		INNOVATIONS IN ENTERPRISES			CHALLENGES FOR RDI	
		1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	4.1	4.2	4.3	5.1	5.2
ACTION		Establish a functioning system of RDI management	Establish a sustainable system of RDI financing	Strengthen strategic intelligence for the RDI policy	Stabilize the system of financing of research organizations and increase its efficiency	Increase the quality of research and create conditions for the development of excellent research teams and bodies at world level	Increase internationalization of the research environment in the Czech Republic	Ensure quality human resources for research	Strengthen the institutional base of applied research	Increase the efficiency of knowledge dissemination and sharing by research organizations	Strengthen research and innovation activities of enterprises	Improve the environment for the development of innovative enterprises	Ensure quality human resources for innovations	Establish processes for continuous identification and assessment of the needs of applied research users and society	Develop a concept of support for applied research
A 1	Establish a central administrative authority for RDI	●	●												
A 2	Define the powers and positions of TA CR and other institutions in the system of support for RDI	●	●												
A 3	Ensure sufficient staff capacity of the state administration for implementation of the RDI policy	●		●											
A 4	Develop international collaboration in RDI and strengthen the position of the Czech Republic in ERA in a strategic and coordinated way	●		●			●								
A 5	Ensure sustainability of the system of RDI financing		●		●				●		●			●	
A 6	Use evaluation for strategic management of RDI		●	●										●	
A 7	Strengthen the use of trend and outlook analyses in the RDI policy			●										●	
A 8	Establish an effective system of institutional support for R&D		●		●	●	●	●	●	●				●	
A 9	Create conditions for the development of centres supported from OP R&DfI and large RDI infrastructures and incorporate them in the research and innovation system		●		●										
A 10	Introduce evaluation of RO that will motivate an increase in the quality of research			●	●	●	●	●	●	●				●	
A 11	Development of excellent research bodies on a global level					●	●								
A 12	Support engagement of research teams and enterprises from the Czech Republic in international RDI collaboration					●	●				●				
A 13	Encourage the inflow of quality researchers and highly qualified experts and create appropriate conditions for their professional as well as family life					●	●	●							
A 14	Increase the quality of Master's and doctoral study programmes							●					●		



MANAGEMENT OF THE RDI SYSTEM				PUBLIC SECTOR OF RDI				COLLABORATION BETWEEN THE PRIVATE AND PUBLIC SECTORS OF RDI		INNOVATIONS IN ENTERPRISES			CHALLENGES FOR RDI	
ACTION	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	4.1	4.2	4.3	5.1	5.2
	Establish a functioning system of RDI management	Establish a sustainable system of RDI financing	Strengthen strategic intelligence for the RDI policy	Stabilize the system of financing of research organizations and increase its efficiency	Increase the quality of research and create conditions for the development of excellent research teams and bodies at world level	Increase internationalization of the research environment in the Czech Republic	Ensure quality human resources for research	Strengthen the institutional base of applied research	Increase the efficiency of knowledge dissemination and sharing by research organizations	Strengthen research and innovation activities of enterprises	Improve the environment for the development of innovative enterprises	Ensure quality human resources for innovations	Establish processes for continuous identification and assessment of the needs of applied research users and society	Develop a concept of support for applied research
A 15			●		●	●	●					●		
A 16								●	●	●			●	
A 17									●		●			
A 18										●	●			
A 19										●				
A 20										●	●			
A 21									●	●	●			
A 22							●					●		
A 23									●	●	●	●		
A 24												●		
A 25	●	●	●					●	●		●		●	●
A 26	●	●	●						●		●		●	●
A 27	●	●	●						●				●	●
A 28		●							●		●		●	●
A 29		●							●		●		●	●

## Annex 2 Summary of indicators for assessment of the progress made in fulfilment of the proposed objectives

INDICATOR	MANAGEMENT OF THE RDI SYSTEM			PUBLIC SECTOR OF RDI				COLLABORATION BETWEEN THE PRIVATE AND PUBLIC SECTORS OF RDI		INNOVATIONS IN ENTERPRISES			CHALLENGES FOR RDI	
	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	4.1	4.2	4.3	5.1	5.2
	Establish a functioning system of RDI management	Establish a sustainable system of RDI financing	Strengthen strategic intelligence for the RDI policy	Stabilize the system of financing of research organizations and increase its efficiency	Increase the quality of research and create conditions for the development of excellent research teams and bodies at world level	Increase internationalization of the research environment in the Czech Republic	Ensure quality human resources for research	Strengthen the institutional base of applied research	Increase the efficiency of knowledge dissemination and sharing by research organizations	Strengthen research and innovation activities of enterprises	Improve the environment for the development of innovative enterprises	Ensure quality human resources for innovations	Establish processes for continuous identification and assessment of the needs of applied research users and society	Develop a concept of support for applied research
1. Number of doctoral graduates aged 25–34 per million population of the same age group							●					●		
2. Share of women in the total number of researchers (%)							●							
3. Share of scientific publications co-authored by domestic and foreign researchers (%)						●								
4. Share of foreign researchers in the total number of researchers (%)						●	●							
5. Number of participations in the Horizon 2020 programme per thousand researchers (FTE)						●								
6. Financial contribution received in the Horizon 2020 programme per billion GDP (in EUR)		●		●		●								
7. Total number of publications registered in the WoS database per million population				●										
8. Number of PCT applications per million population (GDP)				●				●	●				●	●
9. Proceeds from the sale of patent licences (including national ones)				●				●	●					
10. Share of much-cited publications (among the 10% of the most-cited publications) in the total number					●									
11. Total number of ERC grants in relation to the sum of R&D expenditure in the government and university sectors					●									
12. Share of publications co-authored by the public and private sectors in the total number of publications (%)								●	●					

INDICATOR	MANAGEMENT OF THE RDI SYSTEM			PUBLIC SECTOR OF RDI				COLLABORATION BETWEEN THE PRIVATE AND PUBLIC SECTORS OF RDI		INNOVATIONS IN ENTERPRISES			CHALLENGES FOR RDI	
	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	4.1	4.2	4.3	5.1	5.2
	Establish a functioning system of RDI management	Establish a sustainable system of RDI financing	Strengthen strategic intelligence for the RDI policy	Stabilize the system of financing of research organizations and increase its efficiency	Increase the quality of research and create conditions for the development of excellent research teams and bodies at world level	Increase internationalization of the research environment in the Czech Republic	Ensure quality human resources for research	Strengthen the institutional base of applied research	Increase the efficiency of knowledge dissemination and sharing by research organizations	Strengthen research and innovation activities of enterprises	Improve the environment for the development of innovative enterprises	Ensure quality human resources for innovations	Establish processes for continuous identification and assessment of the needs of applied research users and society	Develop a concept of support for applied research
13. Share of sources from the (domestic) corporate sector in the R&D expenditure of the government and university sectors (%)		●						●	●					
14. Share of employment in the high- and medium high-tech processing industry (%)												●		
15. Share of employment in knowledge-intensive services (%)												●		
16. Share of sources from the corporate sector in GERD (%)		●								●				
17. Early-stage investments of risk capital (% GDP)										●				
18. Share of domestic added value in the total export (%)											●			
19. Share of the targeted support for R&D focused on addressing societal challenges (%)														●
20. Effective system of RDI management (qualitative indicator)	●													
21. Introduction of standard approaches to the evaluation of research organizations, RDI programmes, providers and policies (qualitative indicator)			●											
22. Intensity and quality of user engagement in the preparation of actions in support of applied research (qualitative indicator)													●	

## Annex 3 System of quantitative and qualitative indicators for assessment of the progress made in fulfilment of the proposed objectives

	NAME	DEFINITION AND DATA SOURCES	INITIAL VALUE (YEAR)	TARGET VALUE RATIONALE
1	Number of doctoral graduates aged 25–34 per million population of the same age group	Numerator: Number of tertiary education graduates – PhD. <i>Eurostat [hrst_fl_tegrad]</i> Denominator: Population in the 25–34 age group <i>Eurostat [demo_pjan]</i>	1 709 (2012)	The number of doctoral studies graduates at this rate was almost 1,800 in the EU in 2012. In countries such as Austria, Germany, Sweden and Denmark, their number is higher than 2,000 (approx. 1,900 in Slovenia). The number of doctoral studies graduates in the CR has been increasing almost linearly since 2004; if this trend continues, their number should increase 2,000 in 2020.
2	Share of women in the total number of researchers (%)	Numerator: Number of women in Full Time Equivalent units (FTE) – female researchers working in all sectors of research conduct <i>Eurostat [rd_p_persocc]</i> Denominator: Total number of researchers in the CR in Full Time Equivalent units (FTE) <i>Eurostat [rd_p_persocc]</i>	25 %	The share of women has been increasing in the EU and in 2012 it exceeded 30% of the total number of researchers. In the CR, the share of women has been stagnating and running in the long term at 25%. This may be caused by the significant growth of the number of researchers in the CR (the number of women in research has been increasing in absolute terms). The objective for 2020 should be to achieve 30% which corresponds approximately to the current average value in the EU.
3	Share of scientific publications co-authored by domestic and foreign researchers (%)	Numerator: Number of publications registered in the Thomson Reuters Web of Science database with at least one co-author from the CR with one co-author from abroad <i>Thomson Reuters Web of Science</i> Denominator: Number of publications registered in the Thomson Reuters Web of Science with at least one co-author from the CR <i>Thomson Reuters Web of Science</i>	42 %	The share of publications co-authored by domestic and foreign researchers in the CR has been increasing since 2009. In 2014, their share was approx. 42% which is less than the sum for EU member states but the growth dynamic has been recently higher in the CR. The target value for 2020 is in line with the trend and is approximately equal to the current value in Denmark and a little lower than in Austria (60%).
4	Share of foreign researchers in the total number of researchers (%)	Numerator: Total number of foreign researchers (natural persons, HC) in the government and university sectors <i>Eurostat [rd_p_perscitz]</i> Denominator: Total number of researchers in natural persons (HC) in the government and university sectors <i>Eurostat [rd_p_perscitz]</i>	6 % (2011)	The number of foreign researchers in the government and university sectors and their share in the total number of researchers in these sectors have been increasing. In 2011, the share was 6% (i.e. more than the EU average) and the 2005–2011 trends indicate that approx. 10% of foreign researchers could work in the CR in 2020. The trend for the EU is on average similar.
5	Number of participations in the Horizon 2020 programme per thousand researchers (FTE)	Numerator: Number of CR participations in projects financed from the Horizon 2020 programme Horizon 2020 <i>E-Corda</i> Denominator: Total number of researchers in Full Time Employment units (FTE) <i>OECD (Main Science a Technology Indicators, MSTI)</i>	- (*)	The CR's participation in framework programmes to date is low compared to other European countries. In the 7th Framework Programme, the Czech Republic had approx. 45 participations per thousand researchers, i.e. 65% of the value of the sum for EU states. The goal for 2020 is to achieve the level corresponding to the number of participations per thousand researchers in the sum for all EU member states.





	NAME	DEFINITION AND DATA SOURCES	INITIAL VALUE (YEAR)	TARGET VALUE RATIONALE
6	Financial contribution received in the Horizon 2020 programme per billion GDP (in EUR)	Numerator: Financial contribution (in euro) received by the CR in projects financed from the Horizon 2020 programme <i>E-Corda</i> Denominator: Gross domestic product <i>Eurostat</i>	- (*)	The CR's participation in framework programmes to date is low compared to other European countries and the contribution received by the CR is lower than in foreign countries. Similarly to the case above, the goal for 2020 is to achieve the level corresponding to the share of the total support from the Horizon 2020 programme in GDP in the EU.
7	Total number of publications registered in the WoS database per million population	Numerator: Number of publications registered in the Thomson Reuters Web of Science database with at least one co-author from the CR <i>Thomson Reuters Web of Science</i> Denominator: Population as of 1 January of the monitored year <i>Eurostat [demo_pjan], data for some non-EU countries may be obtained from the OECD database</i>	1 658 (2014)	The number of publications per size of the country (i.e. population) slightly exceeded the sum for all EU member states in 2014. In comparable countries such as Austria or Slovenia, however, the number of publications per size of the country is higher (by approx. 40% in 2014). The target value corresponds to the trend. As the number of publications has been increasing in the CR much faster than in the above-mentioned countries, if the trend continues, in 2020 the CR should reach the level existing then in Austria and Slovenia.
8	Number of PCT applications per million population	Numerator: Number of patent applications filed according to the Patent Cooperation Treaty (PCT) by the applicant's country and priority date (fractional method is used) <i>OECD - Patents by technology</i> Denominator: Population as of 1 January of the monitored year <i>Eurostat [demo_pjan], data for some non-EU countries may be obtained from the OECD database</i>	16 (2012)	The number of patent applications under PCT is very low in the CR. In 2012, the CR reached approximately the level of 17% of the EU value. The number of applications has been increasing but the growth rate is approximately the same as the average of the EU (and in technologically developed countries such as Austria or Denmark, the number of applications has been increasing faster). The target value for 2020 is approx. 40% of the current value for the EU, which is beyond the current trend (according to the trend, the CR might reach approx. 25 applications per million population in 2020) but in the context of development of research capacities and actions pursuant to the 2013 NRDIP Update, some 'acceleration' might occur (the last figures are from 2012).
9	Proceeds from the sale of patent licences (including national ones)	Granted patent licences (including categorization by the type of providers) in CZK. CSO – Annual licence survey (Lic 5-01)	2 726 (2014)	Total proceeds from the granted licences show an average annual increase in 2009–2014 by approx. 19%. The figure is strongly influenced by the proceeds of a single establishment that accounts for the 82% share of public research institutions in the total proceeds. The goal is a 20% average annual increase and a change of structure (higher share of public universities).
10	Share of much-cited publications (share of publications in the 10% of the most-cited publications in the total number)	Numerator: Number of publications with at least one co-author from the CR within the upper decile of the citation count <i>Thomson Reuters Web of Science</i> Denominator: Number of publications registered in the Thomson Reuters Web of Science database with at least one co-author from the CR <i>Thomson Reuters Web of Science</i>	10 % (2012)	Although the branch standardized citation count of CR publications is close to the EU average, the number of the most-cited publications is lower. But the number of the most-cited publications has been increasing faster in the CR than on the average in the EU and in most countries covered by international comparative analyses. The target value for 2020 slightly exceeds the current trend but it can be expected that with the increasing quality of the research infrastructure and RO evaluation, the quality of publications will increase faster. The target value for 2020 corresponds to the current value for the EU average.

	NAME	DEFINITION AND DATA SOURCES	INITIAL VALUE (YEAR)	TARGET VALUE RATIONALE
11	Total number of ERC grants per thousand researchers in the government and university sectors	<p>Numerator:</p> <p>Total number of ERC grants (starter, consolidator, advanced, proof of concept, synergy) in the monitored year</p> <p><i>European Research Council, ERC</i></p> <p>Denominator:</p> <p>Sum of the number of researchers in the government and university sectors in Full Time Employment units (FTE)</p> <p><i>OECD (Main Science a Technology Indicators, MSTI)</i></p>	0,17	<p>The number of ERC grants obtained by the CR is very low by European standards. A certain increase has been seen in recent years, which may indicate increasing activity and success rate of researchers from the CR.</p> <p>The goal for 2020 does considerably exceed the current trend but as the research infrastructure and motivation of research teams to conduct quality R&amp;D will gradually improve (in connection with the evaluation), the trend probably will not be linear and the target value is achievable. In addition, the goal corresponds approximately to a half of the value achieved as the sum for the whole EU in 2013.</p>
12	Share of publications co-authored by the public and private sectors in the total number of publications (%)	<p>Numerator:</p> <p>Number of publications registered in the Thomson Reuters Web of Science database with at least one co-author from the public research sector of the CR (or the country concerned) and at least one co-author from the private sector</p> <p><i>Thomson Reuters Web of Science</i></p> <p>Denominator:</p> <p>Total number of publications registered in the Thomson Reuters Web of Science database with a co-author from the CR (the country concerned)</p> <p><i>Thomson Reuters Web of Science</i></p>	1,5 %	<p>Although the publication activity of the CR is approximately identical to the EU average, the share of publications co-authored by the public and private sectors is lower. But the share of joint publications has been increasing and the trend roughly corresponds to the data for the sum of the EU.</p> <p>Despite the fact that the target value for 2020 slightly exceeds the current trend in the CR, the CR will still not achieve the current level of the average of the EU and countries such as Germany and Austria (more than 3%) and it will be considerably below the value in Sweden and Denmark (approx. 5%) in 2020.</p>
13	Share of sources from the (domestic) corporate sector in the R&D expenditure of the government and university sectors (%)	<p>Numerator:</p> <p>Sum of the sources from the corporate sectors in the R&amp;D expenditure of the government sector (GOVERD) and the university sector (HERD)</p> <p><i>Eurostat [rd_e_gerdfund]</i></p> <p>Denominator:</p> <p>Sum of the total R&amp;D expenditure in the government sector (GOVERD) and the university sector (HERD)</p> <p><i>Eurostat [rd_e_gerdfund]</i></p>	2,5 % (2013)	<p>The long-term share of sources from the corporate sector in the public research is lower in the Czech Republic than the sum for all EU member states (the share of sources from the corporate sectors was higher than 7% in the EU in 2012).</p> <p>The target for 2020 does not correspond to the trend (the share of sources from the corporate sectors is more or less invariable) but this value is equal only to the approx. 2/3 of the EU value.</p>
14	Share of employment in the high- and medium high-tech processing industry (%)	<p>Numerator:</p> <p>Percentage of total employment in high-tech and medium-tech processing industries</p> <p><i>Eurostat [htec_emp_nat2]</i></p> <p>Denominator:</p> <p>-</p>	11 %	<p>The share of employment in high-tech and medium high-tech processing industries is high in the CR and it is almost twice the sum of EU member states (data from 2013). The share of employment in these sectors has been slightly increasing. The goal for 2020 is in line with the current trend.</p>
15	Share of employment in knowledge-intensive services (%)	<p>Numerator:</p> <p>Percentage of total employment in knowledge-intensive services</p> <p><i>Eurostat [htec_emp_nat2]</i></p> <p>Denominator:</p> <p>-</p>	33 % (2013)	<p>The share of employment in knowledge-intensive services is lower in the CR than in the EU countries (in 2013, the CR reached approx. 80% of the EU value). The share of employment in knowledge-intensive services has been increasing and the growth rate is slightly higher than in some countries covered by international comparative analyses.</p> <p>The goal for 2020 slightly exceeds the current trend and it is equal approx. to the value of the sum for EU member states in 2012 (and e.g. in Germany in 2013) but it is still lower than e.g. in Sweden or Denmark.</p>



	NAME	DEFINITION AND DATA SOURCES	INITIAL VALUE (YEAR)	TARGET VALUE RATIONALE
16	Share of sources from the corporate sector in GERD (%)	Numerator: Sources from the corporate sector <i>Eurostat [rd_e_gerdfund]</i> Denominator: Total domestic expenditure on R&D <i>OECD (Main Science a Technology Indicators, MSTI)</i>	38 % (2013)	The share of sources from the corporate sector in the total R&D expenditure has been decreasing since 2005 which is related to the increase of support from the EU SF. The target value is slightly lower than the current value of the EU average (55%)
17	Early-stage investments of risk capital (% GDP)	Numerator: Risk capital investment into early-stage innovative enterprises(seed and start-up) <i>Invest Europe (formerly EVCA)</i> Denominator: Gross domestic product <i>OECD, Invest Europe1 (formerly EVCA)</i>	0,001 % (2013)	Risk capital investment into early-stage innovative enterprises is very low in the CR and figures for individual years vary considerably. The target value for 2020 corresponds to the approximate long-term value of these investments for the sum of countries monitored in the Invest Europe database.
18	Share of domestic added value in the total export (%)	Numerator: Share of domestic added value in the total export <i>OECD - Dataset: Trade in Value Added (TIVA)</i> Denominator: -	54,7 % (2011)	In the sum of EU member states in 2011, the share of domestic added value amounted to approx. 72% of the total export and to 76% in the sum for OECD countries. In the countries such as Germany, Austria, Denmark, Sweden and Slovenia, the value ranges between 65% and 75%. The goal is to reach 65% in 2020, i.e. the lower threshold of the said range.
19	Share of the targeted support for R&D focused on addressing societal challenges (%)	Numerator: Targeted support for R&D focused on addressing societal needs <i>RDI IS</i> Denominator: Total amount of relevant programmes of targeted RDI support <i>RDI IS</i>	-	Approximately one half of the relevant targeted support for RDI should be directed to the support for addressing societal challenges.
20	Effective system of RDI management (qualitative indicator)	The system of RDI management with clear definition of roles and powers of individual bodies, functional coordination of its activities and corresponding staff capacities.	-	A qualitative indicator which must be assessed in the form of an RDI system audit.
21	Introduction of standard procedures of RDI evaluation (qualitative indicator)	The existence and application of binding methodical procedures for evaluation of research organizations, RDI programmes, providers and policies.	-	A qualitative indicator which must be assessed in the form of an RDI system audit.
22	Intensity and quality of user engagement in the preparation of actions in support of applied research (qualitative indicator)	The existence, manner of functioning and results of platforms for the engagement of users in the preparation of actions in support of applied research; feedback from the user sector.	-	A qualitative indicator which must be assessed in the form of an RDI system audit.

## Annex 4 Summary of recommendations for actions of the 2013 NRDIP Update

ORIGINAL ACTION	RECOMMENDATION	RATIONALE	NEW ACTION
1	Modify – concentrate on the effective use of the state budget expenditure on RDI.	The goal is virtually unattainable and it is more important to concentrate on the effective use of the state budget expenditure on RDI and on the sustainability of the system of support for RDI from public budgets after 2020.	A 5
2	Modify – develop the NPOR into medium-term directions of applied research that will take account of the user demand for R&D results and concentrate the support on them.	Small concentration of public support for implementation of priorities, broad scope of programmes referring to the priorities and poor relations between the programmes implementing the priorities and user needs (those of enterprises and society).	A 26 A 27
3	Not to be included.	Conditions of financing the development of research capacities in Prague have been improved in OP RDE and OP Prague.	x
4	Include as a part of a more complex approached action aimed at ensuring stable financing of the research centres and infrastructures in the CR.	The risk of ensuring effective use and long-term sustainability of R&DfI centres (particularly European centres of excellence) persists. In addition to the state budget, important sources must include revenues from abroad and from the contractual research to which the recipients of R&DfI centre projects committed themselves.	A 10
5	Not to be included.	Key areas of activities are included in the existing programme support instruments. It is necessary to focus on the effective and timely implementation of OP RDE and relevant national programmes.	x
6	Not to be included.	Key areas of activities are included in the existing programme support instruments. It is necessary to focus on the effective and timely implementation of OP RDE and relevant national programmes.	x
7	Modify – develop a clear concept of support for applied research containing a definition of R&D directions whose support is expedient in relation to the identification of user demand.	The action in its original form has been implemented. But the system of support for applied research as a whole is very fragmented and not very strategically oriented towards the needs of R&D users.	A 26 A 27
8	Include as a separate action.	Conditions for PCP have not been created. It is also necessary to motivate enterprises to greater research activity allowing them to increase their innovation performance and productivity and to establish themselves with their new products on the existing or new markets.	A 19
9	Not to be included.	The action in its original form has been implemented. Moreover, a stable and quality research system jointly with the conditions for business represents a more important factor for localization of research activities of multinational companies.	x
10	Include as a part of the action focused on the strengthening of international collaboration in RDI.	The research system of the CR is relatively closed to international collaboration and to the receiving of foreign researchers. It is also necessary to strengthen scientific diplomacy and effective promotion of CR's interests in the European Research Area.	A 12
11	Include as a part of the action focused on the development of international collaboration of SMEs in RDI.	It is necessary to keep encouraging SMEs to a more intensive engagement in international R&D activities and to assist SMEs in the international transfer of technologies and their establishment on foreign markets.	A 18
12	Not to be included.	A proposal of the draft law was approved by the R&D Council in September 2015. We recommend concentrating on its completion so that it creates a stable legal environment for the implementation of the research and innovation policies of the CR.	x
13	Include as a part of a more complex approached action aimed at the development of knowledge and technology transfer and collaboration between research organizations and enterprises.	The action has not been implemented. Moreover, transfer of R&D findings from public research to practice is limited, TTC efficiency is relatively small and internal systems for commercialization have not been bringing the expected results.	A 16
14	Include as an action focused on the establishment of a stable system of research and innovation policy management.	Coordination of activities in the area of the research and innovation policies remains a weakness of the system of RDI management – powers are chaotic, departmentalism tends to prevail instead of cooperation in the implementation of the RDI policy objectives.	A 1 A 2
15	Not to be included.	A proposal of the draft law was approved by the R&D Council in September 2015. We recommend concentrating on the effective establishment of a new system of management through the legislative regulation in preparation.	x
16	Include as a part of a more complex approached action to ensure strategic and coordinated support for international collaboration in RDI.	The action has not been implemented and RDI lacks an intradepartmental strategy for international collaboration. The failure to approve a concept of international collaboration and successor RDI programmes endangers the provision of support for the development of international collaboration in 2017.	A 4



ORIGINAL ACTION	RECOMMENDATION	RATIONALE	NEW ACTION
17	Include and specify the action.	A draft new methodology of RO evaluation has been prepared in the IPN Methodology programme. It brings the evaluation of ROs closer to the international standard. Simultaneously with using the draft, it is necessary to establish a new system of RO evaluation.	O 6 O 8
18	Include and specify the action, determine providers' responsibility for the conduct of evaluation and strengthen their staff capacities for the performance of the evaluation.	Evaluation of RDI programmes is conducted rather formally and the results are not and cannot be used as a source of information for the correct establishment and targeting of supporting instruments.	O 6
19	Modify and include as a part of actions to strengthen strategic intelligence for the RDI policy.	Insufficient use of the evaluation of strategies and policies as a source of information for the correct establishment of research and innovation policies hinders strategic management of the RDI system.	O 6
20	Modify and include as a part of actions to strengthen strategic intelligence for the RDI policy.	Evaluation of providers is conducted without an explicit methodical framework and does not cover all aspects of providers' activities. This reduces the information value of evaluations for the strategic management of the RDI system.	O 6
21	Not to be included.	Application of an indicator system for evaluation of NRDIP is a necessary precondition for following the progress made in fulfilment of NRDIP objectives and changes in the RDI system caused by the policy and they should be an integral part of all strategy documents.	x

## Annex 5 Proposed research topics in the defined sectors in the area of applied research

The following list of topics is a result of the negotiations among sector platforms that took place in 2014/2015. It is an initial and non-exhaustive list that may be supplemented within the ongoing Entrepreneurial Discovery Process, which is one of the fundamental principles of RIS3.

### SECTOR PLATFORM 'ENERGY'

Bases for the formulation of topics:

Document **'Proposed priority topics for research, development and innovations – Energy (Technology Platform 'Sustainable Energy for the Czech Republic')**

- Analysis of the opportunities and limits of energy development in the CR in various time horizons
- Technology for energy and its application in practice
  - ▷ Electricity and heat generation in nuclear sources – safety, long-term reliable economical operation, nuclear fuel cycle, radioactive cycle, fourth generation of advanced systems, SMR
  - ▷ Fossil fuel sources for generation of electricity – new operation modes including fulfilment of the requirements for classic pollutants
  - ▷ Heat/cooling generation and distribution particularly on the basis of fossil fuels – increasing the efficiency of the existing heating systems, heat accumulation, small cogeneration and microgeneration technologies, generation of cooling and trigeneration
  - ▷ Electricity and heat generation from renewable and secondary sources – biomass + wastes, hydropower, solar heat, heat pumps, power-to-gas from renewable energy sources
  - ▷ Electricity grids including electricity accumulations – prospects for the development of transmission and distribution networks, infrastructure for the development of application of hybrid and electric vehicles, cyber security
  - ▷ Energy in transport – new types of biofuels, infrastructure for plug-in and electric vehicles, hydrogen and fuel cells
  - ▷ Energy consumption and savings – energy savings in the industry, effectiveness of energy transport systems, saving technologies on the part of consumption, smart homes, smart cities and regions
- New technologies and processes with a potentially significant effect on energy

### SECTOR PLATFORM 'MACHINE TOOLS'

Bases for the formulation of topics:

Document **'Priorities of long-term applied research (fundamental sector research) for Machine Tools sector in the Czech Republic as prepared by the Technology Platform on Manufacturing Engineering Technology (TPMET).'**

- Improving accuracy – improving geometric accuracy of machine work, geometric and dimensional accuracy of the final workpiece and machined surfaces
- Improving quality – improving quality of machined surfaces, targeted positive influencing of waviness, coarseness, appearance and other characteristics of surface integrity
- Increasing production performance – increasing short-term as well as long-term production performance of machines
- Improving reliability – improving reliability of machines and all their functions, ensuring reliability of the production process or long-term maintaining of workpiece quality
- Increasing cost-efficiency – minimization of unit costs on machines, incidental times, servicing costs as well as minimization of the machine production and operation costs
- Reducing negative environmental effects – minimization of negative environmental effects of production using the machines and production of the machines, solution for energy requirements
- New measurement and management systems to increase accuracy and reliability
- Ecodesign of machines and sound usage of sources in production
- Maximization of performance and quality of the cutting process
- Virtual machining for optimization of machines and technologies
- Optimum construction of machines and their automation





- New concepts of machine tools and their drives, new technologies (Emerging Technology)
- Unconventional materials in the construction of machine tools
- New concepts of machine tools and innovation of the existing constructions
- Damping and reducing vibrations of machine tools
- Interaction between machinery and its operators and the environment

#### SECTOR PLATFORM 'AUTOMOTIVE'

Bases for the formulation of topics:

The brief version provided is based on the document **'Strategic Research Agenda (SRA) of Technology Platform 'Vehicles for Sustainable Mobility', second edition, February 2013**, whose up-to-datedness has been confirmed by the Automotive Industry Association following the platform's negotiations. The Association added specific R&D areas to SRA with individual final manufacturers and subcontractors from members of the Association (these topics may be used for further development and specification of topics).

- Drive units and fuels
  - ▷ Combustion engines with increased efficiency powered by fossil fuels, biofuels of 1st and 2nd generations, flexible combustion engines of innovative drive units powered by synthetic fuels and bio-fuels of higher generations, materials and components of alternative drive units, alternative fuels and coolants and lubricants.
- Safety
  - ▷ Elements improving active and passive safety of vehicles, vehicle optimization in terms of integrated safety, supporting measures to increase road safety
- Vehicle chassis
  - ▷ New concepts of chasses with advanced drive unites and integrated control of vehicle dynamics, active safety, comfort and noise, application of intelligent power components, light structure of bodies and frames, external and internal aerodynamics of vehicles
- Electric and electronic equipment of vehicles
  - ▷ Vehicle communication networks, adaptive and predictive control of drive unit parameters, integrated and hierarchical vehicle control systems including automation of routine processes, components of electric systems aiming to reduce their power input and costs, provision of their robustness and high operational reliability in order to increase safety, reduction of energy requirements, solving EMC and noise reduction problems, diagnostic systems to guarantee reliability of integrated control systems with new power consumers
- Intelligent transport systems, mobility and infrastructure
  - ▷ Cooperative systems for on-line information sharing among vehicles and other types of transport and between the vehicle and its surrounding, systems for making the optimum use of the data on the road network, traffic and travelling and on the possibilities to recharge electric and hybrid vehicles
  - ▷ Use of fuel cells in transport
- Virtual development
  - ▷ Research of simulation and virtual reality (VR) techniques for parametric optimization of products, for conceptual optimization of the innovations of a higher degree, VR to accelerate preparation of the production stage in the chain of production enterprises, using VR in the design of a production line, application for designing a 'Digital Plant'
- Material processing, production processes
  - ▷ Nanotechnologies for multifunctional materials, advanced metallic, plastic and composite materials, application of modern methods for material parting and joining, methods for increasing productivity, incl. Design4x, R&D optimization of production processes and increasing their flexibility and disposal methods
- Energies
  - ▷ Vehicle power management for the control of electric buses and hybrid buses
  - ▷ Infrastructure and transport systems for electromobility

## SECTOR PLATFORM 'AVIATION INDUSTRY'

Bases for the formulation of topics:

This brief version is based on the document '**Strategic Research Agenda (SRA) of the Czech Aerospace Industry (to 2025)**' whose up-to-datedness has been confirmed by the Association of Aerospace Manufacturers following the platform's negotiations. Topics from the area of air traffic management were added to the list later.

- Aerodynamics, thermomechanics, flight mechanics
  - ▷ SW for aerodynamic calculations, aerodynamic profiles, boundary layer control, effective lift mechanization, active elements of aircraft aerodynamics control, dynamic flight status analysis, flight characteristics and performances, simulation of the glazed frost impact and elimination, prediction of the internal environment in cockpits, optimum aerodynamic design of aircraft VTOL/STOL, optimization of hydrodynamics with seaplanes and flying boats, thermodynamics of suborbital aircrafts, optimization of the turbine engine flow paths, optimization of the blade parts of turbine engines, optimization of the aerodynamic design of propellers
- Aeroelasticity
  - ▷ Simulation or aeroelastic phenomena with the influence of the environment
- Noise
  - ▷ Noise prediction, means to reduce external and internal noise
- Strength and lifespan
  - ▷ Evaluation of aerostructures in terms of load capacity, fatigue and lifespan, limit states and ways of damaging aerostructures, fatigue damage, improved accuracy of the remaining lifespan prediction. Research on the impact of construction, material or technological changes on damage caused to aircraft constructions, increasing the aircraft lifespan
- Materials
  - ▷ Materials with new properties (protection from corrosion, temperature resistance, combustibility etc., new types of intelligent materials)
- Manufacturing technologies
  - ▷ New composite technologies, coupling construction components, production of integral constructions, alternative methods of assembly and installation, casting aircraft constructions components from aluminium and magnesia alloys, including computer simulations, volume and planar forming of unconventional materials, high-strength steels and non-ferrous alloys, modern surface protection of materials, effective technologies for 3D metrology
- Safety, reliability
  - ▷ Passive safety of the crew and passengers, reducing the strain on the pilot, 'antiterrorist' elements, construction safety and reliability analysis, evaluation of damage caused to aircrafts, monitoring, measuring and assessing the straining and deformation of aircraft construction parts in operation, aircrafts with reduced crew and unmanned vehicles, advanced cockpits, low-cost aircraft construction elements, effective use of the aircraft interior, transfer and sharing of large volumes of construction data between remote users, virtual reality in designing, advanced defrosting systems, protection against the effects of lightning
- Drive
  - ▷ Optimization of the design of propellers and ventilators, dynamic simulation of turbine engine regulation and control systems, modelling and optimization of thermodynamic process in combustion chambers, restartable rocket propulsion, design and optimization of high-speed transmissions, electric propulsion units, hydrogen fuel cells
- Aircraft systems
  - ▷ System integration (hydraulic system, fuel, air-conditioning system), optimization of the automated movement control (autopilot function), safe data communication, integrated electric source distribution system, improving the accuracy of low-cost inertial aircraft measuring units using GPS and magnetometers, particle filters, identification and control algorithms of dynamic systems, integrated satellite navigation receiver, automated control system, integrated stabilized aircraft optical systems



- Astronautics
  - ▷ Sensors and instruments (accelerometer, altimeter, radar, lidar, magnetometer etc.), ground testing equipment (EGSE, MGSE, OGSE), micro-computer for satellite systems, satellite board and SW systems, automatic and robotic systems, open and secure communication protocols, MEMS technologies, materials with improved properties for the use in space, structural and thermal analysis, simulation of aerothermoelastic phenomena
- Air traffic safety and seamlessness
  - ▷ Development, testing and implementation: technical systems used for the provision of air traffic services
  - ▷ Development of new technologies for the remote provision of air traffic services
  - ▷ Development of detection equipment for unmanned vehicles in the vicinity of large airports
- Unmanned airborne vehicles
  - ▷ Research on the use of drones for physical protection of critical infrastructure, perimeter guarding
  - ▷ Research on the use of drones for agriculture and forestry – fire protection, forest damage monitoring
  - ▷ Research on the use of drones for linear structures (wiring, product pipelines, borders)
  - ▷ Research on the use of multiple unmanned vehicles in a single space – it includes tactical, planning a collision avoidance, possibility to fulfil various tasks – tracking, surveillance, monitoring, patrolling, etc., using GT for multiple vehicles.
  - ▷ Research for the protection of critical infrastructure – Airports / Security, protection against illegal acts, frightening off birds and wild animals
  - ▷ Research project on the use of drones for creation of orthophotomaps

#### SECTOR PLATFORM ELECTRICAL ENGINEERING

##### Bases for the formulation of topics:

The list of basic topics was provided by the Electrical and Electronic Association of the Czech Republic. Individual topics need to be developed in detail into individual areas and it is necessary to start discussions on the topics on the basis of the Technology Readiness Level scale, from the fundamental research through commercialization and division into fundamental and application technologies.

- Automation, robotics, mechatronics, measuring
- Industry 4.0 (cyber-physical systems and a connection with ICT)
- Drives and their control
- Energy sources and electricity quality
- Smart society, intelligent buildings
- Identification systems, related services
- Electrotechnology for medical applications
- Safety and reliability of all points above

#### SECTOR PLATFORM 'METALLURGY, STEEL INDUSTRY, FOUNDRY INDUSTRY'

##### Bases for the formulation of topics:

The list of summary scientific topics was prepared by the umbrella union Hutnictví železa, a.s. Individual supporting materials of individual members were presented as annexes and they may be used for further specification of the topics.

- Development of new sophisticated products, responding to the requirements of user sectors
- New and improved steels; development of new categories of steel with combined properties (strength, formability, firmness, energy absorption, weight reduction, resistance against temperature impacts etc.)
- Optimization of the costs of production and improvement of the energy efficiency of metallurgical production
- Reduction of the material intensity of metallurgical production
- Optimization of qualitative parameters of metallurgical products, incl. improvement of the production process control and management (mechatronics)
- Development of new and improvement of the parameters of the existing ancillary materials (chemicals, oils etc.)

- New types of refractories incl. their coating for casting of new alloy types
- Sophisticated management systems
- Development of artificial intelligence and advanced systems
- New techniques and technologies for the processing and improved quality of final metallurgical products
- Advanced test, calculation and simulation methods specifically used in development
- Light alloys, cellular materials and composite materials
- Biocompatible metallurgy
- Coating and surface protection
- Powder metallurgy
- Recycling, refining and reusing critical and very valuable metals

#### SECTOR PLATFORM ‘NANOTECHNOLOGIES’

Bases for the formulation of topics:

The list of summary scientific topics was consulted and reviewed by the Nano Association of the Czech Republic.

- Textile production
  - ▷ Nanofibre barrier textiles (protection against allergens, bacteria and viruses)
  - ▷ Nanofibre materials for industrial applications (filtration)
  - ▷ Nanofibre membranes and special textiles for functional clothing
- Chemical industry
  - ▷ Nanotechnological surface protection
- Ecology
  - ▷ Zerovalent iron nanoparticles and their application in technologies of groundwater and surface water remediation

- ▷ Filter materials (polymeric nanofibre membranes) – for water and air cleaning technologies without chemicals using the membrane separation technology
- ▷ Photocatalytic paints with TiO<sub>2</sub> nanoparticles
- Energy
  - ▷ Graphene (artificial form of carbon) research and options of its application (graphene supercondenser)
  - ▷ Use of nanomaterials in battery construction (3D batteries)
- Medicine, pharmacy
  - ▷ Nanofibre structures (regenerative medicine, tissue engineering, targeted distribution of medicines in nanocapsules)
  - ▷ Micro and nanotechnological procedures for the change of physical characteristics of food supplements or medicines (increasing their effectiveness, reducing toxicity and undesired effects)
- Others
  - ▷ Nanostructured polymers, electroactive polymers, thermosetting and thermoplastic composites, polymeric composites for medicine, architecture of the mass in nanoscale, 2D and 3D nanostructures

#### SECTOR PLATFORM ‘DIGITAL ECONOMY AND INDUSTRY 4.0’

Bases for the formulation of topics:

The proposed topics were discussed with the members of the sector group for digital economy and approved by the C&EG Council’s DIGITAL ECONOMY AND CULTURAL AND CREATIVE INDUSTRIES COMMITTEE AND discussed with an MIT working group for the national initiative Industry 4.0; topics related to Industry 4.0 were added on request of the R&D Council.

- Cyber security
- Data (open data, development of new algorithms and analytic tools for the work with large volumes of data, tools for working with the Czech language in ICT etc.)

- 3D visualization and rapid prototyping (3D printing)
- Development of new digital solutions and services (e-commerce, digital content and its technological linking, Internet of Things<sup>1</sup>, development of assistive technologies, digitalization of the grid connection (transmission network, distribution networks – smart grids)
- Internet of Things and cyber-physical systems
- Vertical integration of information and knowledge systems and processes in a new industrial undertaking (from real-time management to ERP systems and systems of strategic decision-making at the top management level)
- Horizontal integration of information and knowledge systems and processes (from the contact with suppliers, engineering activity and production to the distribution network)
- Computer integration of all engineering activities in the enterprise (from ideas and specifications, design, implementation and production of products and services to data maintenance and the whole lifecycle of a product/service)
- Methods and techniques of cybernetics and artificial intelligence (agent systems, service-oriented architectures, learning and self-organized systems, machine perception systems, intelligent robotics)
- Digital skills and knowledge (education across the whole education system; lifelong learning; education of teachers in the field of modern technologies and their application, with an emphasis on the systemic and interdisciplinary approach)

<sup>1</sup> Internet of Things is related to what is called Industrie 4.0 (industry 4.0 - fourth industrial revolution) in the Federal Republic of Germany, i.e. a vision/model of economy to be achieved using a high-tech strategy for computerization and future further modernization of economy/industry. It is strategically important thing to which particular attention should be paid in the Digital Economy Development Strategy or which should form a separate part in addition to the six already proposed ones.

## SECTOR PLATFORM 'PRECISION ENGINEERING'

Bases for the formulation of topics:

The topics were formulated on the basis of a discussion with sector group members. This is the first proposal that was not prepared by an umbrella association or union but on the basis of supporting materials from individual members. This proposal is to be further discussed by relevant working bodies. 'Mechanical engineering' research topics which are divided into three extensive research areas cover the topics appropriate to the Czech economic area. These topics are conceptual, not final at the moment:

- Research and development of metallic materials
- Research and development of propulsions
- Non-metallic materials

- Metallic materials
  - ▷ Mechanical properties of materials – increasing resistance, reducing weight and guaranteeing a sufficient lifespan
  - ▷ Limits – weight, price, lifespan
  - ▷ Minimization of inner stress in metallic materials, minimization of thermal expansion
  - ▷ R&D of metallic materials (powders) for additive manufacturing, for injection technology
  - ▷ R&D in the area of prospective metallic materials and their subsequent thermal and chemical-thermal treatment
- Surface treatments
  - ▷ R&D of surface treatments in order to minimize their impact on dimensions/nanocoating
  - ▷ Surface treatments preventing surface contamination of the parts
  - ▷ Design of jets for even surface blasting
  - ▷ Limits – application price, ecology, lifespan, mechanical properties
- Technologies
  - ▷ R&D of propulsions = electric motors, hydraulic motors, transmissions, mechanical components, power and control electronics
  - ▷ Operation of precise mechanisms under great temperature changes
  - ▷ New and very precise working technologies
  - ▷ Solution for muffling the measuring precise-mechanics equipment – active feedback

- ▷ Use of quenchable high-quality stainless steel for mechanical components to be used in devices for the semiconductor industry
  - ▷ New technologies leading to the production of low-friction components
  - ▷ Use of new materials – carbon fibres – kevlar fabrics, ceramics
  - ▷ New principles, Rapid Prototyping
  - ▷ Precise machining of titanium alloys, Invar and less-common Ultem-type materials
  - ▷ SW optimization of component designing
- Plastics and composites
  - ▷ R&D of plastic and composite materials for the injection technology, additive manufacturing
  - ▷ Research on special polymers with the addition of appropriate additives
  - ▷ Research on polyamide matrices with greater chemical resistance, particularly to acids
  - ▷ Limits – price of granules, lifespan
- Adhesives and sealants
  - ▷ R&D of adhesives and sealants, connecting components without deformations

## SECTOR PLATFORM ‘RAILWAY AND RAIL TRANSPORT’

### Bases for the formulation of topics:

The topics were formulated on the basis of a discussion with sector group members. This is the first proposal that was not prepared by an umbrella association or union but on the basis of supporting materials from individual members. This proposal is to be further discussed by relevant working bodies.

- Products
  - ▷ Design and optimization of new wheel and axle designs for high speeds beyond 300 km/h
  - ▷ Effect of the chemical composition and technology of explosive consolidation on the lifespan of crossings in points
  - ▷ New diagnostic methods for the railway infrastructure and rolling stock
  - ▷ Improving technical parameters of rolling bearings
  - ▷ see the topic Emission/noise ‘Environment-friendly drives’
- Materials
  - ▷ Assessment of the use of composite blocks in terms of long-term experience in service (scaling, wheel tread degradation, gradual increase in the noise level, influence on the environment and safety)
  - ▷ Development of rail wheel and axle materials with longer lifespan and higher safety of operation, including technologies of heat treatment, research and verification of new metallic and non-metallic materials
  - ▷ Development of new structures of rubbers for sprung wheels for city and suburban railway transport
- Emissions/noise
  - ▷ Development of attenuating systems for wheels in order to reduce noise
  - ▷ Environment-friendly drives of the future in railway transport – CNG, LNG, hydrogen, fuel cells, solar energy, hybrid drives..., including solutions for armament of vehicles on the railway infrastructure
- Energy
  - ▷ see Emissions/noise ‘Environment-friendly drives’
- Control systems / electronics
  - ▷ Satellite localization applications in security products with a particular focus on ETCS, improvement of safety at regional tracks, telematic applications including diagnostics
  - ▷ Further development of ERTMS – ERTMS/ETCS and ERTMS/GSM-R (particularly adaptation and stabilization of the characteristics of both systems, focusing on the establishment of functional key online management, implementation of ETCS for the rolling stock, including integration of sophisticated solutions for automated train driving linked to traffic control systems, development of the mobile parts of ETCS according to the new specifications and finding an optimal technical and financial compromise for application on regional tracks
  - ▷ Development of detection means identifying vacancy/occupation of railway sections in accordance with the development of traction motors for engines, development of unrestricted track circuits allowing extensions of jointless rail applications





- ▷ Fully independent automation of traffic control, including linking to the rolling stock (SW, HW). Integration with other technological units in the vehicle. Development of the stationary infrastructure for automation of vehicle drive control, including online data transmission
- ▷ Development of secure radio transmission systems, the currently used 3DES standard for the EURORADIO protocol is antiquated
- Aerodynamic phenomena
  - ▷ Aerodynamics of rail vehicles, including the effect of side wind, drafting and preparation of a wind map of the CR in the TEN-T network territories and tracks considered for the construction of high-speed lines.
- Other topics
  - ▷ Solutions for improvement of safety at level crossings
- Information systems for passengers – provision of visual as well as audio information, including multimedia, to passengers and train crew. Proposal of central data administration and distribution to individual vehicles of carriers.

#### SECTOR PLATFORM 'BIOTECHNOLOGIES'

##### Bases for the formulation of topics:

The topics were formulated on the basis of a discussion with sector group members. This is the first proposal that was not prepared by an umbrella association or union but on the basis of supporting materials from individual members. This proposal is to be further discussed by relevant working bodies.

- Application of modern biological methods in agriculture (arable as well as animal farming)
- Modern vaccination methods not only against infections in human and veterinary medicine
- Diagnostics of human and veterinary diseases
- Development of new biopolymers susceptible to application in medicine and technical sectors
- Tissue and cell therapy, biological treatment

- Biotechnological development of new antimicrobial agents
- Production of recombinant molecules
- Biotechnological production of active substances of genetically unmodified cultures
- Application of modern biotechnologies in the food industry
- Biotechnological production of substances from long-term sustainable sources
- R&D of biotechnological products and services with high added value, particularly those based on application of molecular genetic approaches

#### SECTOR PLATFORM 'TRADITIONAL CULTURAL AND CREATIVE INDUSTRIES'

##### Bases for the formulation of topics:

The topics were formulated on the basis of a discussion with sector group members. This is the first proposal that was not prepared by an umbrella association or union but on the basis of supporting materials from individual members. This proposal is to be further discussed by relevant working bodies. Scientific topics in this sector follow on the scientific topics of attached CCI sectors.

There are limits to the CZ-NACE classification. It may not always correspond to the current trends as due to the development of RDI fields, e.g. nanotechnologies, biotechnologies or the very cultural and creative industries, entirely new fields may emerge.

Specific sectors are assigned to entities on the basis of the entity's prevailing activity in the year concerned but no account is taken of other related activities even though they may be almost equally important and, in an extreme case, they may cause a year-on-year transfer to another sector. The classification therefore does not formally capture the whole segment of subcontractors who are linked to the sector and who jointly represent communicating vessels.

**Design, fashion, architecture,** urbanism, landscape management, advertising industry, artistic craft, development and sale of functional SW, development and innovation activities, conceptual activities in the following fields:

- Manufacture of glass
  - ▷ Glass development in terms of safety and responsibility to the environment (lead-free glass, inner stress, protective surface treatment – nano-paint)
  - ▷ Glass surface treatment in accordance with the requirement of business trends and legislation (protective and anti-adhesive paints)
  - ▷ Integration of glass in final products (fixing tubes, telescopic suspension systems)
  - ▷ Technology linking glass and luminosity (nano-paint, light sources such as LED, oLED technologies or energy-efficient lighting tubes)
- Manufacture of porcelain
  - ▷ Coloured glazes, characteristics of glazes and influence of oxides
  - ▷ Granules development
- Textile production
  - ▷ R&D, production and use of nanofibres and nanofibre structures in textile, application of nanoparticles for special effects
  - ▷ Development of composite structures containing inorganic fibres and textile lining, intelligent textiles
  - ▷ Use of optical fibres and materials with shape memory for technical products
  - ▷ Textile sensors and sensors suitable for use in textiles
  - ▷ Modification and development of technologies for treatment of new materials, environmental aspects of new technologies
- Wood processing
  - ▷ Technologies of joints for wood-based materials
    - Mathematical simulations of wooden structure solidity
  - ▷ Development of wood-based materials highly resistant to biotic agents and fire
  - ▷ Glued laminated timber and its application in wooden structure architecture
  - ▷ Environmental aspects of wood and wood-based material processing
- Manufacture of musical instruments
  - ▷ Music acoustics and technical physics (research on the sound quality of musical instruments and their balance)
  - ▷ Modification and development of technologies for new material processing

## SECTOR PLATFORM 'NEW CULTURAL AND CREATIVE INDUSTRIES'

### Bases for the formulation of topics:

The topics were formulated on the basis of a discussion with sector group members. This is the first proposal that was not prepared by an umbrella association or union but on the basis of supporting materials from individual members. This proposal is to be further discussed by relevant working bodies. Scientific topics in this sector follow on the scientific topics of attached CCI sectors.

There are limits to the CZ-NACE classification. It may not always correspond to the current trends as due to the development of RDI fields, e.g. nanotechnologies, biotechnologies or the very cultural and creative industries, entirely new fields may emerge.

Specific sectors are assigned to entities on the basis of the entity's prevailing activity in the year concerned but no account is taken of other related activities even though they may be almost equally important and, in an extreme case, they may cause a year-on-year transfer to another sector. The classification therefore does not formally capture the whole segment of subcontractors who are linked to the sector and who jointly represent communicating vessels.

**Design, fashion, architecture,** urbanism, landscape management, advertising industry, artistic craft, development and sale of functional SW, development and innovation activities, conceptual activities in the following fields:

- Technologies as drivers of European innovations
- Nanotechnologies and design
- Use of advanced materials
- Research on the lifecycle of materials and their products
- Use of laser light in the audiovisual art
- Research on spatial sound and interactive technologies
- Immersive spaces and radical technologies in arts and their presentation

## Annex 6 Needs in the area of departmental research

The following list of research needs of individual departments is a result of negotiations of the Working Group Budget IV that was set up by the OG CR – SRI Section in September 2015. Research needs were submitted by representatives of individual departments. This is an initial and non-exhaustive list to be subject to further discussions.

### 1. MINISTRY OF TRANSPORT OF THE CZECH REPUBLIC

#### Sustainable transport

- Transport planning, qualitative and quantitative standards for transport systems, networks and transport services
- Delivery of public services in the transport of passengers, transport accessibility for persons with specific needs
- Reducing the impact of transport on public health and the environment
- Social issues, employment, education and qualification in transport
- Progressive construction and assembly technologies, increasing the efficiency of maintenance and repair works on the transport network, use of recycled and regenerated materials
- Alternative propulsions, transport energy and supply systems

#### Interoperable transport

- Legislative, regulation and normative-technical frameworks to guarantee interoperability of transport systems and services, map documentation, graphic information systems including data and information, interoperability of transport spatial data with special data from other areas
- Ensuring the correct functioning of individual parts or units or electronic systems and open communication within the system or with other systems, research on electromagnetic compatibility

#### Safe transport

- Safety of means of transport, routes and transport processes via safety features and introduction of innovative services, cyber security in transport

- Human factor in transport, effects of external influences on transport behaviour including the social context, conflict identification, handling, prevention and settlement, dealing with aggressive and inconsiderate behaviour, man-machine interactions in transport, psychology of transport disasters
- Monitoring undesirable movements and deformations of transport infrastructures

#### Economical transport

- Energy and material savings in the construction and operation of transport networks and structures, optimization of the approach to economical maintenance of the transport network
- Systems for automated control of the means of transport to ensure energy optimization of the journey, systems ensuring smooth journey of the means of public transport on the transport infrastructure
- Harmonization of fees for the use of infrastructure and innovations in the area of creation of a relatively fair market transport environment in the Czech Republic, reducing the effect of irregular traffic

#### Intelligent transport

- Detection, diagnostic, information, control and security technologies on the basis of intelligent transport systems (ITS), global navigation satellite systems (GNSS) and Earth observation systems, reliable and secure infrastructure of electronic communications for these systems
- Control and automation and robotics in transport systems

#### Spatial data in transport

- Legislative, regulation and normative-technical frameworks that will allow sharing of the obtained spatial data, development of sustainable public services dealing with spatial data in transport
- Development of platforms for the sustainable operation and dissemination of results from applications based on Earth observation data. Distillation of information from the large volume of Earth observation data; automation in acquisition of information from Earth observation data

## 2. MINISTRY OF THE ENVIRONMENT

### Sustainability of energy and material sources

- Reducing energy intensity and reducing air emissions
- Assessment of the impacts of meteorological and anthropogenic processes on emissions and air pollution with particular emphasis on ascertaining toxicological properties of fine particles and improving the accuracy of air pollution modelling
- Proposal of instruments – methodologies for implementation of strategy document actions in the area of wastes, air, climate and water protection
- Development of environmentally friendly technologies and procedures in the extraction, transport and processing of raw materials and substituting primary sources with secondary sources in relation to strategy documents in the area of wastes and circular economy
- Research and innovation in circular economy
- Development of the best available techniques and emerging techniques of industrial activities providing a higher level of environmental protection and higher cost savings
- Research in non-traditional and unconventional energy sources and their potential
- Research and development of the methods of energy storage in the Earth's crust
- Research and development of intelligent systems of generation systems, storage and distribution of renewable energy in order to minimise the effects on the nature and landscapes (local potential and consumption)

### Environment for quality life

#### Natural resources

- Providing expert documentation based on applied research results for the protection and exploitation of rock formations, soil, underground waters and mineral resources and reduction of the load caused by anthropogenic agents in the landscape (e.g. occupation, contamination, making the conditions for searching, inventory taking, use and assessment of geological conditions, natural resources and geofactors harder)
- Effects of anthropogenic influences and geofactors on environmental compartments
- Support, protection, sound and effective use of mineral resources and underground waters and use of secondary raw materials

- Providing expert documentation for soil protection in order to preserve biological, physical and chemical properties of soil on the basis of soil quality improvement and restoration of soil functions
- Expert support for planning in the area of underground and surface waters and for optimization of the landscape water regime
- Expert support (documentation, inventory taking, monitoring, data analysis and new finding synthesis) for medium- and long-term assessment of the condition and the influence of changes on environmental compartments, natural resources and landscape
- Sustainable provision of non-productive and productive soil functions
- Expert support for planning in the area of water

### Research focused on nature values associated with the provision of knowledge and expert documentation for the effective protection of nature, particularly for:

- protection of biodiversity of communities, species and genetic variability of individuals
- fulfilment of the CR's commitments ensuing from international agreements and treaties
- ensuring implementation of the Natural 2000 network, or implementation of Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, and Directive 2009/147/EC on the conservation of wild birds
- reducing the negative impact of invasive species, or more precisely implementation of Regulation (EU) No. 1143/2014 of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species, and Council Regulation (EC) No. 708/2007 concerning use of alien and locally absent species in aquaculture
- fulfilment of the National Action Plan to reduce the use of pesticides, long-term increasing of efficiency of the special territorial protection of nature and landscape, particularly methods and procedures for the favourable conservation status of protected ecosystems and their compartments, habitats of species and populations of species, and to obtain and assess information on their condition and development in terms of fulfilment of the objectives of special territorial protection of nature and landscape.

### Global changes (and adaptation to climate changes)

- Scenarios and climate changes, identification and monitoring of their effects
- Analysis of the future effects of climate changes on ecosystems, habitats and individual species, method of evaluation of their sensitivity and vulnerability and the related ecological and social risks
- Planning, preparation and implementation of adaptation measures; synergy and antagonism of measures
- Monitoring and evaluation of effectiveness of adaptations and evaluations – environmental aspect; economic analysis and evaluation of adaptation measure benefits include the aspect of maintaining the scope or minimizing the loss of ecosystem services
- Evaluation of the influence and forecast of natural hazards and anthropogenic risks and possibilities of their prevention in relation to the climate dynamics
- Research on biogeochemical water-rock-air interactions and modelling critical loads and development scenarios
- Research on migration, accumulation and release of elements and compounds in an anthropogenically affected environment and their natural geochemical cycles and in rock and soil environments
- Methodological research on and identification of sophisticated indicators of environmental compartment quality
- CO<sub>2</sub> storage in rock structures in order to reduce the influence of climate changes
- Economic analyses of climate change effects – quantification of the financial effect in case of inactivity and adaptation costs (the so-called cost & benefit analyses)

### Sustainable development of landscape and human settlements

- Retaining natural features (functions) of the landscape (environmental stability, landscape water regime, soil-formation processes, biodiversity, permeability of landscape features to animal movement)
- Restoration and preservation of ecosystems providing ecosystem services as an integral part of the ways of using landscapes
- Forecast of the effects of various influences and their combinations on the function use of landscapes
- Establishment of a long-term functioning system for assessment of the condition of environmental and landscape compartments

- Increasing the efficiency of forecasting the effects of natural phenomena and processes, making use of nature's potential and assessment of their impact on environmental compartments, landscape and society
- Provision of expert documentation for effective protection of species, implementation of the Natura 2000 network and fulfilment of liabilities ensuring from international agreements and treaties, as well as preparation of scientific documentation for implementation of Regulation of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species, and fulfilment of the National Action Plan to reduce the use of pesticides
- Provision of new methods, procedures and solutions in order to increase resistance of towns and municipalities to the effects of crisis situations (catastrophes) of anthropogenic and natural origin
- Analysis of the influence of anthropogenic phenomena and processes on the ecological stability of landscapes; options of conserving and restoring natural features (functions) of the landscape – ecological stability, landscape water regime, soil-formation processes, biodiversity, permeability of landscape features to animal movement)
- Methodology for determining quantitative and qualitative parameters of ecosystem and ecological network stability and the conditions of their sustainability
- Assessment and valuation of ecosystem services
- Restoration and preservation of ecosystems providing ecosystem services as an integral part of the ways of using landscape
- Influence of natural and/or semi-natural ecosystems and elements in settlements on ecological and social functions of the settlement environments (a spectrum of ecosystem services – microclimate, flow conditions of water, health of population), complex evaluation of the functional condition of greenery in settlements for the needs of strategic planning
- Sustainable model of functional use of landscape
- Long-term sustainable model for monitoring and evaluating the condition of landscape and its compartments (a system of indicators, data sources, information systems). Improving the efficiency of forecasts concerning the influence of natural phenomena and processes, use of nature's potential on the assessment of their impact on landscape, society and quality of environmental compartments



### Environmentally friendly society

- Establishment of a system of suitable presentation of environmental knowledge
- Research on inconsistencies between attitudes and behaviour in the area of environmental protection in various age groups (including adults) – identification of barriers and education, training and awareness-raising options of overcoming the barriers
- Development and verification of methods of quantitative economic evaluation of environmental protection policies on enterprises and households
- Voluntary instruments in support of environmental innovations
- Preparation of uncomplicated environmental legislation

### Social and cultural challenges

#### Governance and administration

- Establishment of a system of policy evaluation according to sustainable development principles
- Proposal for the use of ICT instruments to increase effectiveness of predictions regarding the influence of natural phenomena and processes, for the use of nature's potential and evaluation of their impact on landscape, society and quality of environmental compartments
- Optimization of the use of ICT instruments to monitor environmental compartments, to support performance of environmental administrative activities and evaluation of environmental policy effects in order to reduce the costs and administrative load caused by legislative regulation
- Development of instruments and methods for effective application of economic, administrative, legislative or voluntary instruments in the area of environmental protection and minimization of the costs necessary in order to reach the objectives of environmental conceptual documents
- Development of innovative methods in the area of structured and non-structured environmental data mining for the purposes of their multiple use, comparison and dependency analyses
- Development of innovative methods and procedures based on progressive digital technologies, new data sources (e.g. from distant observation of the Earth) and their combining with available data, in order to create standardized mechanisms in support of the creation, evaluation and reporting of the environment

### Development and application of human potential

- Preparation of draft updated teaching models for lifelong learning in the area of environment
- Increasing the efficiency of instruments of environmental training, education and awareness
- Exploring the potential of a circular economy for the creation of new jobs under the CR's conditions

### Secure society

- Development of instruments and technologies for identification, monitoring, prediction, prevention and mitigation of the risk of emergency situations (catastrophes) of anthropogenic and natural origin and monitoring their effects
- Protection against the adverse effects of extreme meteorological phenomena (floods, drought, heat waves, extreme wind) and exogeodynamic phenomena (erosion, sedimentation, retention, slope instability, acidification of water, soil and rock environment) and proposals to mitigate their effects
- Protection of the environment against adverse effects of emergency situations (catastrophes), prevention, mitigation and adaptation instruments

Establishment of methodologies and instruments to identify, evaluate and prevent anthropogenic risks

## 3. MINISTRY OF JUSTICE

### A. Evaluation research – evaluation of the effects of implementation of adopted rules and measures in the area of criminal policy (repression and prevention)

- Effectiveness of programmes of drug user treatment in prisons
- Effectiveness of the treatment of convicted persons (including employment) in relation to relapsing into criminal activity
- Comprehensive effectiveness of probation programmes
- Practical effects of the act on crime victims on the change of crime victims' position
- Effectiveness of the sanction policy in relation to the trends of criminality development and criminal legislation development
- Effects of the employment of convicted persons serving a sentence on the reduction of recidivism



- Evaluation of the effects of legal persons' criminal liability and interaction between individual and collective approach to criminal liability
- Evaluation of the process of launching the electronic monitoring system (EMS) in the Czech Republic
- Development of an evaluation instrument to measure effectiveness of criminal sanctions

## **B. Specific problems**

### **Juvenile offenders**

- Possibilities for and limits to resocialization of juvenile and young convicted persons serving a sentence through treatment and internal differentiation
- Causes and conditions of primary criminal recidivism of minors
- Effects of the types of sanctions imposed on juvenile offenders and their combination on relapsing into criminal activity or client failure

### **Monitoring**

- Continuous annual monitoring of changes in the development of organized crime in the Czech Republic
- Regular monitoring and publication of annual analytical commented overviews of registered criminality development, with particular focus on selected and current forms of criminality

### **Recidivism**

- Analysis of the time aspect between final conviction and committing a new crime
- Analysis of the present condition of recidivism monitoring in the CR in relation to the use of recidivism data in the formulation and implementation of the sanction policy (including unification of the recidivism definitions in use)
- Identification, analysis and categorization of the reasons for client failures (including their importance) within fulfilment of all alternative sanctions imposed
- Criminal history/career and recidivism of serious crime perpetrators
- Selected preconditions of reintegration: recidivism comparison according to the type of release, a convicted person's residence and the extent of preparation for their release

## **Specific types of criminality**

- Identification and criminological characteristics of the types and trends of crimes committed via the internet
- Criminological analysis of hate crime (crimes motivated by racial, ethnic or similar hatred)
- Possibility of measuring secondary drug criminality
- Improvement of the strategy for protection of information systems in the department of the Ministry of Justice against cyber threats

## **Others**

- Protective therapy of offenders in the Czech Republic, its legal regulation and practical implementation as a way of protecting society against dangerous offenders
- Acts of self-harm and suicidal behaviour while serving a sentence – causes and prevention
- Influence of migration on the structure of criminal activity and prison population
- Development of a proposal for systemic linkages among criminality prevention, sanction policy and postpenitentiary care
- Research on crime victims focused on the experience of the population of the Czech Republic with selected types of crimes in the monitored period
- Research on seniors as a risk group of potential crime victims and their specifics as perpetrators
- Increasing the standard of physical protection of buildings within the judicial part of the justice department.

## **C. International comparison**

- Analysis of imposing measures of security detention in the Czech Republic; comparison of legal regulations and their effects with other countries in the Central European region, particularly with respect to the European criminal law and case law of the of the European Court of Human Rights
- Comparison of prison systems around the world, particularly in European countries, to find models that may be used in the Czech Republic

#### 4. Ministry of Foreign Affairs

Research needs of the MFA include expert examination of the following main directions of foreign policy:

- Issues of the power situation in the world, political and economic arrangement of the world, relations between actors of international relations, main factors and trends influencing the world order etc.
- Effective use of membership in key international organizations or sui generis entities, particularly in the EU, NATO, UN, OSCE etc., in order to achieve security, prosperity and sustainable development of the Czech Republic
- Preventing and suppressing securing threats using the instruments of multilateral and bilateral diplomacy
- Issues of the root causes (or push-factors) of migration in the source countries of migrations and opportunities for the foreign policy to contribute to effective management of migration flows and migration policy
- Issues related to energy security and energy as a factor in international relations
- Issues related to the development of key international legal instruments and institutions (e.g. the International Criminal Court, key international treaties etc.)

Cross-cutting issue in relation to which the research objectives are formulated on the basis of the agreement with the Ministry of Industry and Trade is the economic diplomacy.

In the priority areas of the Foreign Policy Concept, detailed in departmental strategy documents, applied research is focused on the following main areas:

- Foreign development cooperation and humanitarian aid
- Promotion of human rights and transformation cooperation
- Reputation of the Czech Republic abroad (public diplomacy, cultural diplomacy, the so-called branding)

As concerns territorial focus, research needs reflect the following priorities of the Concept:

- Central Europe, with particular regard to Germany, Slovakia, Poland, Austria, Hungary and V4 cooperation
- Strategic dialogue with Germany, strategic partnership with France, relations with the Great Britain

- South-East Europe (i.e. states of the so-called Western Balkans – Serbia, Montenegro, Bosnia and Herzegovina, Albania, Macedonia and Kosovo, plus Turkey)
- Eastern Europe, with particular regard to the countries of the so-called Eastern Partnership (Ukraine, Moldova, Georgia, Belarus, Armenia, Azerbaijan), policy of the Eastern Partnership and relations with Russia
- Strategic dialogue with the USA, strategic partnership with Israel
- Key relations in the region of the Middle East and North Africa: Israel, the Gulf States, Iran, Syria, Egypt
- Key relations in Asia and Pacific: particularly PRC, Republic of Korea, Japan and India
- Key relations in the Latin America: particularly Mexico, Brazil and Pacific Alliance states
- Key relations in the Sub-Saharan Africa: particularly RSA, Ethiopia and Nigeria

National priorities: priority areas of Social and Cultural Challenges; Governance and Administration – Area, as well as Secure Society and Protection Against Criminality.

#### 5. Ministry of Regional Development

R&D in regional policy, tourism, territorial planning and housing policy

- R&D leading to more effective links to the European legislation within National Coordination Bodies

#### 6. Ministry of Labour and Social Affairs

##### Research on family policy:

- Socio-economic family situation
- Demographic family situation
- Value attitudes and preferences of families
- Childcare
- Equal opportunities, gender issues
- Quality of life of the senior population

##### Research on social policy:

- social works
- social services
- social housing and social inclusion



#### Research on occupational health and safety

- Documents and methods for evaluation of the socio-economic aspects of work
- Scientific documents and methods for evaluation of the health risk of exposure to chemical pollutants and nanoparticles
- Studying the effects of exposure to selected factors of the working environment and working conditions (physical, physiological and psychological factors)
- Studying the effects of mental and psychosocial stress at work
- Selected occupational diseases, their diagnostic and medical examination criteria
- Education and training
- OHS management

#### Research on employment

- Employment and continuing professional education in the field of the labour market
- Employment and support for the handicapped
- Social benefit systems of the state social assistance, assistance in poverty, benefits for the handicapped and care allowances

#### Research in social-insurance systems

- Pension system and pension insurance
- Sickness insurance, premium for social security and accident insurance
- Employees' incapacity for work
- Medical examiner's service
- Demographic development of the relevant population groups
- Monitoring changes in foreign pension systems

#### Research on new societal challenges

- Social changes in European and Czech societies as a result of internal and external structural shifts

#### Research on internal departmental processes

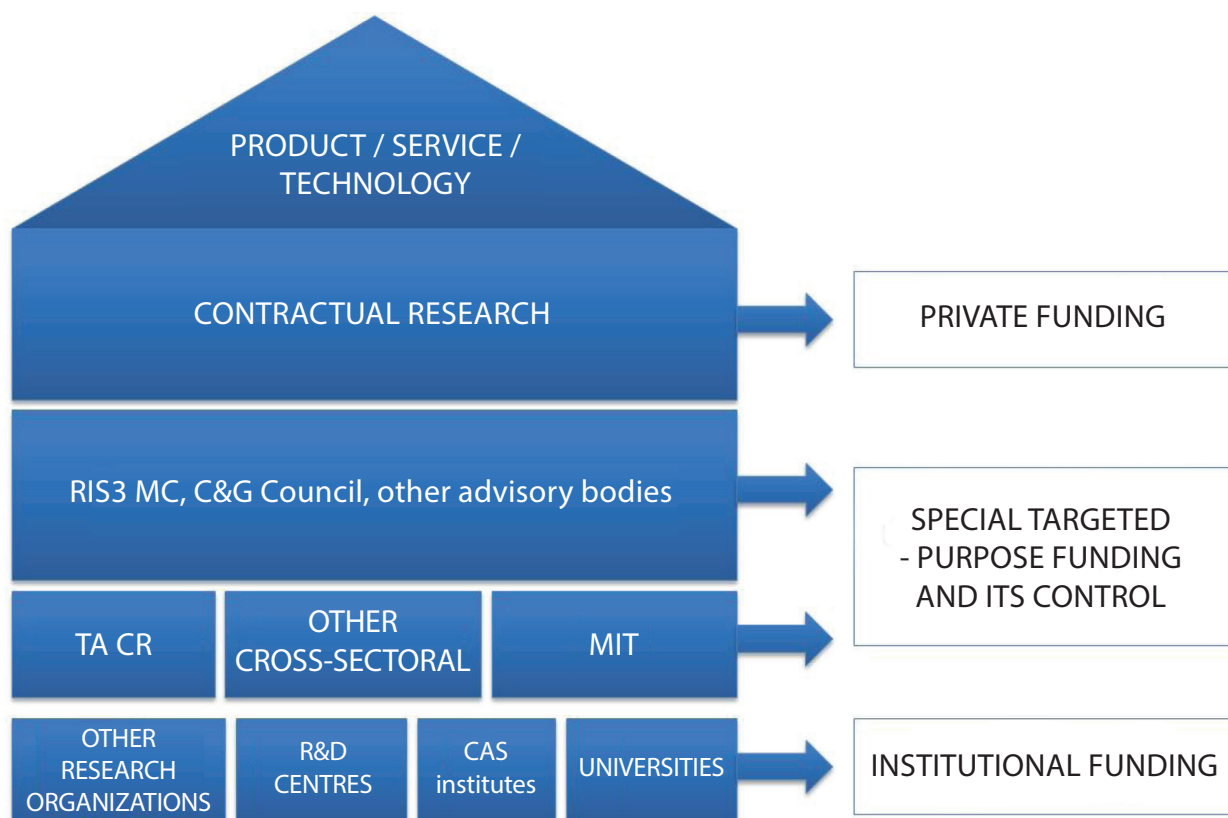
- Increasing the effectiveness of the performance of the state administration

## Annex 7 Links between the strategic objectives of the NRDIP 2016 and the strategic objectives of the National RIS3

NRDIP 2016			NATIONAL RIS3
STRATEGIC OBJECTIVES OF NRDIP 2016	SPECIFIC OBJECTIVES		STRATEGIC OBJECTIVES
Establish a stable, effective, strategically managed and financially sustainable system of research and innovations	1.1	Establish a functioning system of RDI management	D3- Improving the quality of R&D staff: SO1- Increasing the level of strategic and operative management E1- The development of e-Government
	1.2	Establish a sustainable system of RDI financing	
	1.3	Strengthen strategic intelligence for the RDI policy	
Create a stable quality sector of research organizations that are ready for and open towards collaboration and knowledge sharing	2.1	Stabilize the system of financing of research organizations and increase its efficiency	B1- Improving the quality and problem-orientation of research
	2.2	Increase the quality of research and create conditions for the development of excellent research teams and bodies on a global level	D 3, SO2- Introducing an effective system of human resources management at research institutes and universities
	2.3	Increase internationalization of the research environment in the Czech Republic	D3, SO3- Increasing the attractiveness of the research career and improving the quality of the preparation of future researchers
	2.4	Ensure quality human resources for research	
Establish a system of mutually collaborating enterprises, research organizations, the public administration and other actors generating new sources and knowledge for innovations	3.1	Strengthen the institutional base of applied research	C1- Increasing the relevance of research
	3.2	Increase the efficiency of knowledge dissemination and sharing by research organizations	F2- Promoting and better utilizing cooperation of local actors in addressing problems
Increase the innovation performance of enterprises in the Czech Republic by strengthening research activities and introducing new technologies and procedures aimed at improving the efficiency of business processes	4.1	Strengthen research and innovation activities of enterprises	A1- Increasing the innovation demand in companies
	4.2	Improve the environment for the development of innovative enterprises	A2- Increasing the level of enterprise in society A3-Increasing the internationalization of SMEs
	4.3	Ensure quality human resources for innovations	E2-The development of eBusiness and ICT in enterprise D2- Improving the quality of school graduates
Strategically target the support for applied research to the current and potential future needs of enterprises and society	5.1	Establish processes for continuous identification and assessment of the needs of applied research users and society	F1- Promoting open partnership cooperation while addressing social challenges and systematically utilizing successfully proven models
	5.2	Develop a concept of support for applied research	

Note: In relation to the National RIS3 strategic objective D3- 'Improving the quality of the preparation of future researchers', specific objectives are stated as this strategic objective is reflected in two strategic objectives of the NRDIP 2016 with different focus.

## Annex 8 Scheme of the system of support for applied research



The scheme clearly indicates that the whole system must be perceived in the context of relations between its individual parts; it is impossible to separate the academic world from industry. They are an interconnected whole where institutional and special-purpose funding is linked to the sector priorities which are considered both in the budget and in the evaluation system. The target effect in the form of new technologies, products and services will result from the linkage of capacities and sources of the corporate sector and the public sector, i.e. particularly the oriented research of CAS, university research and education financed in the form of both targeted and institutional funding.

## Annex 9 System of research, development and innovation in the Czech Republic

*The text below represents CAS's view of the RDI system in the Czech Republic* and it was inserted on the basis of CAS's comments on the NRDIP 2016.

### FUNDAMENTAL RESEARCH

Fundamental research, driven by a thirst for knowledge, is important not only because it generates new knowledge but also because it teaches young people to independently address open problems, i.e. a skill which many young people bring to their future jobs. This cultural-educational aspect of fundamental research is of exception importance.

There are very few fields that are characterized as pure fundamental research without foreseeable social applications. However, even in these fields (e.g. particle physics), instruments and technologies required for the research often have economic effects, recently for example the web development in the European Organization for Nuclear Research (CERN) in 1990.

It is ever clearer that social disciplines and humanities, usually considered disciplines where pure fundamental research is conducted, play an important role in the addressing current problems. Sociology, psychology, Orientalism and economics ever more overlap other sciences and are of considerable social benefit. An ever more substantial part of their research activities has the character of applied research that is important e.g. for effective state administration.

Major actors of fundamental research are public universities and institutes of the Czech Academy of Sciences but important fundamental research is conducted also at some state institutions established particularly by the Ministry of Health.

Organization and financing of fundamental research from the public funds of the state budget are the responsibilities of the state.

### APPLIED RESEARCH

Applied research plays an important role not only in industry but also in healthcare, the agricultural-food sector and culture. A specific role is played by applied research for the needs of the state, including the needs

of the military and security sectors. Financing of the military and security R&D should be separated from the financing of civil research.

Major actors in applied research are institutions from the corporate sector for which research is a necessary part of their business. The corporate sector therefore finances a major part of applied research for its own needs. An important role in this field is played by organizations such as the Association of Research Organizations (AVO) and the Council of Applied Research Organizations (AR Council). The state cannot replace the applied research activities of enterprises and determine the subject of research conducted by enterprises. Nevertheless, it plays an important threefold role in this area.

The state will support applied research in the corporate sector in accordance with

- Commission Regulation (EU) No. 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty ('Regulation') and
- Framework for State aid for research and development and innovation (2014/C 198/01), ('Framework'),

i.e. where its aid will not disturb the free market or in those sectors where the market has failed. Identification of those circumstances is the responsibility of the state.

The state will support and finance research in strategically important directions characterized by the long-term nature of research and great uncertainty about results where no initiative of the corporate sector can be expected but which simultaneously promise to bring about a great economic effect. Identification of those directions is the joint responsibility of the state and corporate sector.

The state will assist in the creation of specialized institutions focusing on applied research and development of technologies directly relating to the needs of our enterprises. These institutions may have various forms, legal status and they may be co-financed by the state. Willingness and ability of the corporate sector to contribute to the financing will be essential to the success of these organizations.





## RELATIONSHIP BETWEEN FUNDAMENTAL AND APPLIED RESEARCH

No really top applied research resulting in the development of groundbreaking innovations can exist without quality fundamental research in a wide range of fields. It is ever clearer that the boundary between fundamental and applied research is blurring fast and there is therefore no point in drawing a sharp distinction between them. A real boundary exists only between research and development.

The substantial difference between fundamental and applied research, as defined in Act No. 130/2002 Coll., does not lie in the methods (in both cases, it is theoretical or experimental work carried out with the aim of acquiring new findings and skills) but primarily in the motivation to gain new findings. (This difference is reflected in the special-purpose funding where the objectives of fundamental research projects are determined according to the 'bottom-up' method while the objectives of applied research are determined according to the 'top-down' method.) It is therefore impossible to set boundaries between fundamental and applied research on the basis of the form of results, i.e. publication (fundamental research) vs. non-publication (applied research), as virtually all revolutionary discoveries and inventions included, in their initial stage, research resulting in generally available publications. A more important aspect is the time horizon in which the research may result in the development of practical applications on which it is focused. The longer the time required for application of research results in practice and the greater the uncertainty whether the research will produce the expected results, a greater role in the research co-financing should be played by the state.

## INNOVATION

Innovation is primarily a matter of enterprises that need to know what should be innovated and why. The state may effectively assist in this area by using a number of instruments specified in Section 4 of the Regulation providing for the aid for research and development and innovation but it cannot replace the innovation activities of enterprises. The state may set up an organization that will professionally support research towards innovations as well as the innovations themselves. There are many such organizations in the world that are financed from public funds, e.g. Tekes in Finland.

## MAJOR ACTORS IN RESEARCH AND DEVELOPMENT, THEIR ROLES AND RELATIONS

Major sectors of organizations conducting research in the Czech Republic are:

- **Public and state universities**

They are established by law. Funds for R&D and education are granted by MEYS. Their mission in R&D is to conduct fundamental as well as applied research in a wide range of fields. The research is closely linked to teaching. Contents of study programmes and research orientation are fully within the remit of universities but the state or the corporate sector may initiate establishment of study programmes that would be needed for the development of a certain field.

- **Institutes of the Czech Academy of Sciences**

They are established by the Czech Academy of Sciences, an organizational unit of the state which also provides institutional funding of R&D. They conduct fundamental as well as applied research in a wide range of fields, while concentrating their capacities on long-term projects. This research is largely complementary to the university research. Universities and institutes of the Czech Academy of Sciences collaborate very closely. In many fields or research topics, this collaboration is a prerequisite for the Czech establishments to assert themselves in the intensive international competition. The state will support close collaboration between universities and institutes of the Czech Academy of Sciences, drawing on the example of the linking of the Max Planck Society or Leibniz Association institutes with German universities.

- **Departmental public research institutions and contributory organizations**

Both forms, i.e. public research institutions as well as contributory organizations established by the relevant ministries, play an important role in applied research particularly in the health, agricultural-food and security sectors and to a lesser extent also in culture. They include teaching hospitals which are linked to faculties of medicine of public universities. These institutions should conduct research focused on the needs of the relevant department by which they were established. Departmental public research institutions are associated in the Council of Public Research Institutions of Applied Research.

- **Corporate sector institutions**

This sector includes both public business entities and domestic private enterprises and foreign-controlled enterprises. The latter employ an absolute majority of R&D employees and researchers in the corporate sector and account for approx. 56% of the corporate sector expenditure on R&D while domestic private enterprises account for 38%. The corporate sector as a whole accounts for approx. 55% of all R&D employees and 51% of all researchers in the Czech Republic. It is focused almost exclusively on applied research and development directly linked to the production programme of enterprises. Fundamental research expenditure accounts for only 3% of the corporate expenditure on R&D. These entities include many domestic private enterprises which have the character of a research organization as defined in the Framework. Some of the enterprises, together with other entities, form the Association of Research Organizations.

#### **RELATIONSHIP BETWEEN THE CORPORATE SECTOR AND RESEARCH ORGANIZATIONS**

The research collaboration of the corporate sector with universities and institutes of the Czech Academy of Sciences is based mainly on collaboration on joint projects financed from the public funds by the Technology Agency of the Czech Republic or the Ministry of Industry and Trade. Contractual research commissioned by industrial enterprises to be conducted by universities, institutes of the Czech Academy of Sciences and research organizations of the corporate sectors is very poorly developed.

#### **INSTITUTIONAL AND TARGETED FUNDING**

A correct ratio between institutional and targeted funding of R&D is essential for the successful development of this sector. Institutional funding of research organizations plays different roles in individual sectors of R&D. In the case of institutions established by the state (public universities, public research institutions, contributory organizations), institutional support should be a dominant part of their revenues, i.e. a part allowing the institution management to decide on their scientific programme. Over-dependence on targeted funding, which is characteristic of the current state, leads to fragmentation of research and means wasted

intellectual capacity of quality scientists. It is therefore ineffective. Institutional support should be limited to those research organizations which provably act on behalf of the public interest.

#### **ROLE OF THE PROVIDERS OF FUNDS FOR RESEARCH AND DEVELOPMENT**

Support providers play the key role in ensuring the effective functioning of the R&D system. As a result of the ill-conceived reform of this sector in 2008, the number of providers of institutional as well as targeted support for R&D was reduced and today MEYS provides institutional support to six departmental public research institutions that were established by the Ministry of the Environment, Ministry of Labour and Social Affairs and Ministry of Transport. It is necessary to change this and return the responsibility for institutions they established to the relevant departments. It is not necessary to limit the number of providers of R&D expenditure. On the contrary, only the founders of R&D institutions can effectively control and evaluate the institutions they established, as the law obliged them to do.



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