Analysis of the Existing State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad in 2018

verze ze dne 02.11.2020

CONTENTS

SUMMARY

The research, development and innovation environment has been advancing dynamically in the Czech Republic in recent decades. Total R&D expenditures in the Czech Republic have been growing long-term, with a record CZK 102.8 bn. being spent on R&D conducted domestically in 2018. In relation to the Gross Domestic Product (GDP), R&D expenditure has risen to 1.93% and the Czech Republic has once again drawn near to the EU average. Business resources made the greatest contribution to the year-on-year increases in overall R&D expenditures in the monitored period. Businesses invested nearly CZK 60 bn. in R&D in 2018, primarily in-house R&D. According to CZSO statistics, a record CZK 35 bn. was spent from domestic public resources in 2018, which is CZK 3.8 bn. more than in 2017.

Table S.1 shows the evolution of basic RDI financial indicators and their year-on-year development including selected macroeconomic indicators. A supplementary indicator on the volume of R&D expenditures is the percentage of RDI expenditures from the state budget (SB) in the overall SB of the Czech Republic. This percentage grew by 0.39 pp between 2009 and 2018, i.e. from 2.16% to 2.55%. This attests to the growing significance of direct public support of the RDI system for implementing the Czech Republic's economic policy.

Table S.1: Research and development expenditures and year-on-year changes thereof in comparison with basic macroeconomic indicators

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
total R&D expenditures (in CZK bn.)	50.9	53.0	62.8	72.4	77.9	85.1	88.7	80.1	90.4	102.8
(in % of GDP)	1.29	1.34	1.56	1.78	1.90	1.97	1.93	1.68	1.79	1.93
percentage of state budget RDI expenditures in overall Czech budget (in %)	2.16	2.14	2.20	2.24	2.21	2.20	2.21	2.33	2.49	2.55
year-on-year change (in %)		**10/09**	**11/10**	**12/11**	**13/12**	**14/13**	**15/14**	**16/15**	**17/16**	**18/17**
total R&D expenditures		4.13	18.46	15.31	7.59	9.31	4.18	-9.65	12.83	13.68
GDP		0.82	1.80	0.65	0.94	5.26	6.54	3.75	5.86	5.58
export of goods and services		13.57	9.89	7.43	1.95	13.05	4.72	1.81	6.12	3.86

Source: CZSO – Study on R&D, National Accounts, Main Economic Indicators of the Czech Republic and State Budget Acts in 2008–2017

Note: RDI expenditures from the state budget do not include expenditures to be covered with funds from the EU budget and financial mechanisms.

Competencies in the system for public RDI support are defined by Act No. 130/2002 Coll. In 2018 a draft was drawn up for a "minor technical amendment" to this act, which was related primarily to a change in the evaluation of research organisations. The preparation of this amendment led to the need for a comprehensive change to the legal treatment of the RDI support system, such as adding regulation for innovation support.

Since 2017, a change in the system for evaluation of research organisations has been underway, consisting in a shift from the current system based on quantity to an assessment of the

quality and impact of R&D (for more see Methodology 2017+). Aside from this change in evaluation related to institutional support, a modification to the system of assessing targeted support is also underway, whereby changes to the assessment procedure for this support are gradually being implemented so as to bring the evaluation process in line with standards in countries with the most experience in such evaluation (e.g. the USA, UK, Germany and Austria).

In total the expenditure from public resources represented 0.78% of the GDP in 2018. The Czech Republic thus drew near to hitting the national target for the Europe 2020 strategy. In 2009–2018, the percentage of R&D expenditures financed from public resources ranged from 0.59–0.66% of the GDP. The maximum value was reached in 2012 and 2013 (0.66%), followed by a drop down to 0.60% in 2016. The drop-off in volume of R&D from national resources (i.e. part of the SB) was accompanied by an increase in the difference between allocated budget expenditures and those actually drawn, which is documented by a 50% growth in claims for unused expenditures from national resources from CZK 4.8 bn. (as of 1 January 2014) to CZK 7.3 bn. (as of 1 January 2019). These "additional" funds not yet used by 2018 comprise 0.12% of the GDP.

The planned expenditure for RDI from the 2019 SB is CZK 35.96 bn. and expenditures for 2020 could reach CZK 36.97 bn., which according to the most recent prediction published by the Ministry of Finance (MF) (Nov 2019) is 0.64% of the GDP in 2019 and 0.63% in 2020. The long-term proposal for SB RDI expenditures respects the 2019–2030 Innovation Strategy. The foundation is boosting public resources from the Czech Republic and above all making use of the potential of business resources. The Czech Republic is a country whose economy is driven, among other things, by industry, with manufacturing accounting for more than 25% of the GDP. This is one of the reasons it is important that R&D expenditures are covered by business sources to the tune of nearly 60%. R&D expenditures financed from business resources reached 1.12% of the GDP in 2018, having passed the 1% barrier back in 2016. In terms of business resources, the primary goal is to create the conditions so that in 2025 business expenditures form at least 1.5% of the GDP, which would mean growing them to approximately CZK 98 bn.

The vision of the newly prepared RDI 2021+ National Policy is to use effective support and a focus on RDI to contribute to the prosperity of the Czech Republic as a country whose economy is based on knowledge and the ability to innovate, which is in line with the target of the Innovation Strategy to "become a dynamic, innovative society" (one of the starting points for the forthcoming RDI 2021+ was Chapter 8 – Innovation Performance of the Czech Economy and International Comparison Thereof).

The Analysis of the State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad in 2018 arrived at the following most significant findings, which are commented on in detail in the interpretation part of the text and supplemented with graphical output.

FINANCIAL FLOWS IN RESEARCH AND DEVELOPMENT

- The gross expenditure on R&D (GERD) in the Czech Republic reached CZK 102.8 bn. in 2018, i.e. 1.93% of the GDP, and its long-term growth was caused primarily by steady growth in expenditures from business sources.
- R&D expenditures from business sources totalled nearly CZK 60 bn. (i.e. a year-on-year increase of 11.3%), those from domestic public sources reached a record CZK 35 bn. (i.e. a year-on-year increase of 11.2%), and those from foreign public sources were CZK 6.6 bn. (i.e. a year-on-year increase of 53.7%).
- Based on data from 2018, the Czech Republic has not yet reached the target set for 2020 under the Europe 2020 strategy, but it has drawn closer to it compared to 2017. Though this target in the form of investing public resources totalling 1% of the GDP in R&D annually is not currently being met, it should nevertheless be achieved through implementation of the measures submitted to the government in the document Long-Term Strategic Financing of the Research, Development and Innovation System.
- The financial indicators for 2018 indicate that the milestones laid down in the Innovation Strategy can realistically be reached under the first Pillar: Financing and Evaluation of R&D, which is boosting the funding of science (measured as a percentage of the GDP).
- Compared internationally, the Czech Republic is lagging slightly behind the European average in terms of GERD as a percentage of GDP. On the other hand, the R&D intensity (GERD as a percentage of GDP) in the Czech Republic grew by 0.55 pp: the most of all new EU Member States between 2009 and 2018.
- Business sources are used almost exclusively to finance R&D in the business sector; support of public R&D from domestic business sources is very low – for the higher education and government sector it was almost CZK 2.3 bn. in 2018. Business entities received public aid of CZK 6.1 bn.
- Domestic public financial resources went primarily into R&D carried out in the government and higher education sectors (a total of CZK 30.5 bn. in public resources).
- In the business sector, the majority (66%) of funds spent on R&D in 2018 were spent by private enterprises under foreign control; in the government sector it was the AS CR (73%) and in the higher education sector it was universities (95%).
- Private enterprises in the Czech Republic are supported directly from the SB (CZK 3.82 bn. in 2018) and indirectly in the form of items deductible from the income tax base of legal entities (CZK 2.5 bn. in 2017); long-term indirect support has been taken advantage of primarily by large enterprises.

RESEARCH AND DEVELOPMENT FUNDING FROM THE STATE BUDGET

- Domestic public resources earmarked for conducting research, development and innovation in the Czech Republic are comprised primarily of the SB for research, development and innovation, which in 2018 reached CZK 34.8 bn.
- It is the responsibility of the Research, Development and Innovation Council (RDIC) to ensure the drafting of a proposal for SB expenditures on RDI and a medium-term outlook.
- Since 2017 this proposal has been structured into 15 budget headings: four headings can now once again provide institutional support for RDI: the Ministry of Foreign Affairs (MFA), Ministry of Labour and Social Affairs (MLSA), Ministry of the Environment (ME) and the Ministry of Transport (MT); thus the role of the founders of research institutions has been strengthened.
- Institutions carrying out R&D are financed from multiple sources, with the share of targeted categories of support predominating over institutional support in the business sector and at universities.
- The greatest volume of institutional support for long-term conceptual development of research organisations in the Czech Republic is primarily provided by the Ministry of Education, Youth and Sport (MEYS) (in 2018 funds allocated to higher education institutions amounting to approximately CZK 6.6 bn. were drawn) and the Academy of Sciences of the Czech Republic (AS CR) (CZK 3.9 bn. was drawn by AS CR institutes in 2018).
- Targeted support is provided primarily by the Grant Agency of the Czech Republic (GA CR) (utilised primarily by universities and institutes of the AS CR), the Technology Agency of the Czech Republic (TA CR) (support directed primarily at businesses and universities) and the MEYS (most support allocated to higher education institutions).
- In addition to the entities they run, targeted support from other ministries is also utilised with success by universities.
- In terms of area, targeted support in the Czech Republic goes primarily into the Industry (CZK 3.37 bn.), Medical Science (CZK 1.44 bn.), Social Sciences and Humanities (CZK 1.41 bn.) and Life Sciences (CZK 1.38 bn.) sectors.
- Since 2017, newly commenced projects have been having their data entered into the RDI information system in the structure of the OECD Fields of Research and Development, with it being necessary to convert the code list into the OECD structure in order to implement the national level of evaluation of research organisations under the 2017+ Methodology.
- Institutional support cannot currently be reliably broken down by field due to the lack of data on distribution within research organisations (particularly higher education institutions).

RDI SUPPORT IN THE CZECH REPUBLIC FROM EUROPEAN FUNDS

- Foreign public resources constitute a significant component of funding for Czech R&D; in the case of the Czech Republic these consist primarily of income from EU structural funds used for financing through individual operational programmes.
- For the 2014–2020 period, funds of EUR 2.4 bn. were earmarked for the Czech Republic for addressing key RDI problems from the ERDF, which are provided through the operational programmes Operational Programme Research, Development and Education (OP RDE) (managing authority MEYS), OP EIC (managing authority MIT) and OP Prague – Growth Pole of the Czech Republic (managing authority City of Prague).
- According to the data from the RDI IS, in 2018 public support of CZK 9.4 was drawn from OP EIC and OP RDE for RDI (this amount includes the parts from both the EU and the SB), of which 68% went to higher education institutions, 21% to AS CR institutes and 11% to businesses.
- Another instrument for supporting RDI from European funds is the EU's Horizon 2020 Research and Innovation Framework Programme (H2020), which has been running since 2014. Its budget totals over EUR 77 bn., with a budget of EUR 1.6 bn. for the EURATOM programme.
- There are differences between the framework programme and the aforementioned operational programme both in the amount of overall support that can be distributed among the applicants and in the financing rules. Applicants for funding from the H2020 programme are exposed to global competition and the environment is thus more competitive.
- According to analytic studies of the European Commission and Technology Centre of the AS CR (TC AS), the Czech Republic still numbers among the EU Member States with the lowest level of participation in this framework programme.
- Under the H2020 programme the Czech Republic has thus far obtained financial aid of EUR 277 mil. (CZK 7.3 bn.) with an overall project success rate of 14.6%, while Austria has obtained support of EUR 1.179 bn. (CZK 31.3 bn.) with an overall project success rate of 16.7%.
- Participation in ERC projects is generally considered to be an indicator of the quality of a research organisation, or even an important indicator of the quality of national research as a whole:
    - Czech research organisations have so far obtained a total of 26 ERC grants, but they lag markedly behind research organisations from the EU 15 with respect to the number of projects recommended for financing
    - significantly fewer project proposals are submitted from Czech research organisations than from the EU 15, and they have a slightly lower success rate

- 26% of proposals and 35% of supported projects from Czech research organisations are from three field panels: Physical and Analytical Chemical Sciences; Computer Science and Informatics and Ecology; Evolution and Environmental Biology
- Charles University, Masaryk University and the Biology Centre of the AS CR are behind more than half the supported projects and funds obtained from the ERC in the Czech Republic

Implementation of the National Research and Innovation Strategy for Smart Specialisation of the Czech Republic

- The National RIS3 Strategy, which aims to effectively target European funds so as to strengthen innovation activity, constitutes a prerequisite for the fulfilment of the EU regional and cohesion policy and targets for the Europe 2020 strategy.
- Based on Czech Government Resolution No. 168 of 14 March 2018, jurisdiction over implementation of the National RIS3 Strategy was transferred from the Office of the Government of the Czech Republic (OG CR) to the Ministry of Industry and Trade (MIT) effective 1 April 2018. The executive role in implementing the strategy is fulfilled by the S3 Strategy Unit of the MIT, which produced a comprehensive system for monitoring implementation of the National RIS3 Strategy for this purpose, both for EU resources as well as national and private (or regional) ones.
- In the monitored period of 1 January 2015 – 31 October 2018, the MIT has been monitoring a total of 10 659 projects approved and implemented under ESIF operational programmes and 764 projects in national support programmes through a harmonised set of primary data.
- The level of support for the horizontal objectives of the National RIS3 Strategy has been mapped out for CZK 103.87 bn., which represents approximately 49% of the overall support planned for the RIS3 strategy in operational programmes in the 2014–2020 period.
- ESIF support is mostly focused on the following RIS3 strategy targets: research, development and innovation capacity of enterprises (CZK 36.15 bn.); research institutes (CZK 12.65 bn.); international research in the Czech Republic (CZK 10.47 bn.); use of ICT in enterprises (CZK 10.44 bn.); cooperation between research organisations and businesses (CZK 8.36 bn.).
- Support for the objectives of the National RIS3 Strategy in national programmes amounts to CZK 11.44 bn. This comprises primarily support for the following: collaboration between research organisations and businesses (CZK 5.44 bn.); commercial utilisation of R&D results (CZK 2.11 bn.); and technological collaboration between businesses (CZK 2.01 bn.).
- The greatest volume of funding from operational programme projects tied to the National RIS3 Strategy according to the project realisation site is concentrated in the South Moravian Region (approximately CZK 17.6 bn.). This is followed by the Central Bohemian Region (approximately CZK 16.8 bn.) and the City of Prague (approximately CZK 16.4 bn.). By far the least support is directed to the Karlovy Vary Region (approximately CZK 1.1 bn.). In contrast to the operational programmes, the regional distribution of support under national and ministerial programmes is determined by the registered office of the applicant/beneficiary or project participant. It turns out, however, that even according to this criterion it is the City of Prague (approximately CZK 3.59 bn.), South Moravian Region

(approximately CZK 2.22 bn.) and Central Bohemian Region (CZK 1.12 bn.) that are supported most.

- In terms of the distribution of application sectors in the projects of operational programmes tied to the National RIS3 Strategy, the Digital Economy and Digital Content field is most dominant (approximately CZK 22.18 bn.) and by far the most supported application sector, followed by Mechanical Engineering-Mechatronics (approximately CZK 14.88 bn.). Support can also be considered decent for Electronics and Electrical Engineering (CZK 5.76 bn.), Pharmaceuticals, Biotechnology and Medical Devices (CZK 5.64 bn.), Automotive (CZK 4.43 bn.) and sectors focused on ensuring a healthy and good quality environment (CZK 3.22 bn.).
- In terms of knowledge domains (research specialisation of the RIS3 strategy), the most supported under operational programmes are Knowledge for the Digital Economy (CZK 12.19 bn.), Advanced Materials (CZK 6.31 bn.) and Advanced Production Technologies (CZK 4.30 bn.).
- Over the course of 2018, the National RIS3 Strategy was updated with a focus on adjusting the management structure and updating the application sectors and knowledge domains of the RIS3 strategy in the Czech Republic. An evaluation of the strategy also took place, and the conclusions of this evaluation will be taken into account in preparing the revised RIS3 strategy for the new 2021–2027 programming period.
- Details on the course of implementation of the RIS3 strategy in the Czech Republic are provided in the regular annual Implementation Reports on the National Research and Innovation Strategy for Smart Specialisation of the Czech Republic (link: https://www.mpo.cz/cz/podnikani/ris3-strategie/dokumenty/).

HUMAN RESOURCES IN RESEARCH AND DEVELOPMENT

- At the end of 2018, there were over a hundred thousand people (113 447 to be exact) working in the Czech Republic whose employment was fully or partially devoted to R&D. This was a 5.3% year-on-year increase in the number of employees in R&D.
- The majority of R&D employees are research workers (approximately 55%), followed by technical workers (approximately 30%) and other workers (15%).
- The greatest number of employees in R&D is reported by the business sector (the share of the business sector in overall R&D employment is constantly growing and is currently at 51.5%). In contrast the most research workers work in the higher education sector (25 687), closely followed by the business sector (25 275).
- Comparing the number of employees in R&D in the EU 28, the Czech Republic ranks around 11th (between Austria and Denmark). Comparing the number of research employees in the EU 28, the Czech Republic ranked 13th (between Portugal and Finland).
- Growth in the number of research workers in the business sector took place primarily in large enterprises under foreign control (4 200 people were employed in this group in 2010 and 11 600 in 2018). The second most significant group are small and medium enterprises (SMEs) (almost 6 000 in 2010 and 7 600 in 2018).
- There remains a gender imbalance of research workers in all sectors. The level of women among research workers in the Czech Republic is only about 25%. The greatest disparity between research workers (men vs women) is in the business sector (only around 13% women). In contrast, the greatest representation of women in research positions is in the government sector (39%).
- From a gender perspective, the situation is not positive even at the individual levels of an ideal academic career path. While there are more women in the number of students and master's graduates, men clearly predominate in the number of students and doctoral graduates. The difference between representation of men and women in scientific activity is even more pronounced.
- In terms of the representation of women among R&D workers and research workers, the Czech Republic ranks among the last countries in the EU 28.

Research infrastructure

- Research infrastructure is defined by Commission Regulation (EU) No. 651/2014 of 17 June 2014 as follows:
    - it comprises sites designated for the effective interconnecting of all segments of the innovation chain and interaction between entities involved in education, public research and the business sphere with a final effect in the form of goods and services with a high added value
    - it generally does not have legal personality
    - most frequently it is founded, developed and operated by research organisations
    - it can be considered an elemental component of the research, development and innovation base in the Czech Republic
    - in the Czech Republic it is financed from multiple sources from both public and business resources, both domestic and foreign, much like entities conducting research, development and innovation
    - support thereof from public resources can be divided into three groups: (i) operational programmes co-financed from the SB, (ii) target support programmes or groups of grant projects focused on building infrastructure and further development thereof, and (iii) financial instruments focused on supporting the operation of RDI infrastructure and ensuring the sustainability thereof
    - in 2005–2018, funds from the SB totalling CZK 32.7 bn. were spent in support of the research infrastructure through national grant and target support programme projects
    - a large amount of the research infrastructure in the Czech Republic constitutes potential for increasing the quality of research, development and innovation and subsequently also the competitiveness of the Czech Republic, but at the same time it places high future demands on funding and qualified human resources

RESEARCH AND DEVELOPMENT RESULTS

- Currently over 50 000 results are produced annually, with the share of non-publication results growing by 2 pp in 2014–2018 compared to 2009–2013.
- The share of journal articles (type J results) in the overall number of publication results increased from 53.2% in 2009–2013 to 57.4% in 2014–2018.
- In 2018, 25 000 journal articles were produced, with the largest number being put out by universities in 2018 (a share in 19 500 articles), followed at some distance by state contributory organisations, organisational units of the state and public research institutions (PRI) (a share in 5 100) and institutes of the AS CR (a share in 5 100).
- The share of publications indexed on the Web of Science (WoS) and Scopus was 71% in 2018. For AS CR institutes it was over 90% of all articles they helped produce, and for universities it was 72%.
- In 2018 over 4 200 applied results were produced, with the most significant share of non-publication applied results in 2018 comprising research reports (type V; 30%), followed by prototypes and functional models (type G; 23%). The largest producer of results is once again universities (a share in 2 200 results), primarily thanks to the production of type V results – research reports. The second largest producer is business entities (a share in 1 000 results), which are most focused on producing type G results – prototype and functional models. In terms of non-publication results there are still very few patents.
- In 2014–2018 the clear-cut greatest number of results was produced in the Social Sciences and Humanities (predominantly publication results), with the second most significant group of fields in terms of overall number of results being Industry. The most significant share of non-publication results in the overall number is reported by industrial fields, but even here they do not reach 50%.
- The switch to the FORD code system will allow production of results to be monitored according to this breakdown in the future. In 2018 the greatest number of results was produced in the Natural Sciences field, followed by Engineering and Technology and Social Sciences.
- The most academic articles recorded on WoS have long been produced in the fields of Biological Sciences, Chemical Sciences, Physical Sciences and Astronomy and Clinical Medicine.
- In assessing the quality of publications, it is useful to also monitor the structure of publications in terms of the citation response of periodicals and the associated publication strategy, which can vary by field.
- In the Czech Republic the level of publication in the field groups of Natural Sciences, Engineering and Technology and Medical and Health Sciences ranged above the EU 15 average in 2018. In the case of the remaining three field groups, though the percentage of

publications produced in international cooperation is below the EU 15 average, over the last five years there has been a significant increase in the share of these field groups, which can be considered a positive phenomenon.

- Czech authors collaborate the most with authors from Germany, followed by the USA and the UK. In the case of collaboration between Czech authors and colleagues from Italy and Switzerland, the articles published have a relatively high NCI (between 3 and 4). The least prestigious publications in terms of NCI are produced in cooperation with colleagues from Slovakia. The breakdown of countries with whom colleagues from Austria collaborate is similar to the composition of countries in the Czech Republic, but the NCI of these publications is at a higher level.

Innovation performance of the Czech economy and international comparison

- In 2018, the knowledge intensity in the Czech Republic amounted to 1.9%. Thus, in assessing the EU 28 countries, the Czech Republic ranks below the EU 28 average, the Netherlands and Slovenia, but countries such as the United Kingdom, Italy and Hungary are behind the Czech Republic.
- Based on the Summary Innovation Index (SII), EU members are divided into four groups according to the innovation level of their economy. Under this indicator the Czech Republic belongs to the group of "Moderate Innovators", i.e. the third group of four. In the same group as the Czech Republic are countries such as Poland, Hungary and Italy. The Czech Republic lags significantly behind countries such as Sweden, the UK, Germany and Austria. As part of the SII indicator, the Czech Republic achieved its best position in the EU 28 (4th) in the Export of Medium & High-Tech Products indicator. The Czech Republic's worst place in the EU 28 was in the Venture Capital Investment indicator (26th).
- According to the Global Innovation Index (GII), in 2018 the Czech Republic ranked 26th (27th in 2017) out of a total of 129 economies evaluated.
- Under the GII, 13 strengths and 11 weaknesses were identified. The strengths were primarily in the field of innovation outputs and the weaknesses in the field of innovation inputs (most of all in terms of infrastructure and market sophistication).
- In the GII evaluation, the Czech Republic achieved top positions in the EU 28 in several indicators (High-tech imports, Utility model applications by origin, High-tech exports, Creative goods exports). In two indicators (High-tech exports, Creative goods exports) it was even ranked as the best of all 129 countries evaluated.

INTERPRETATION PART

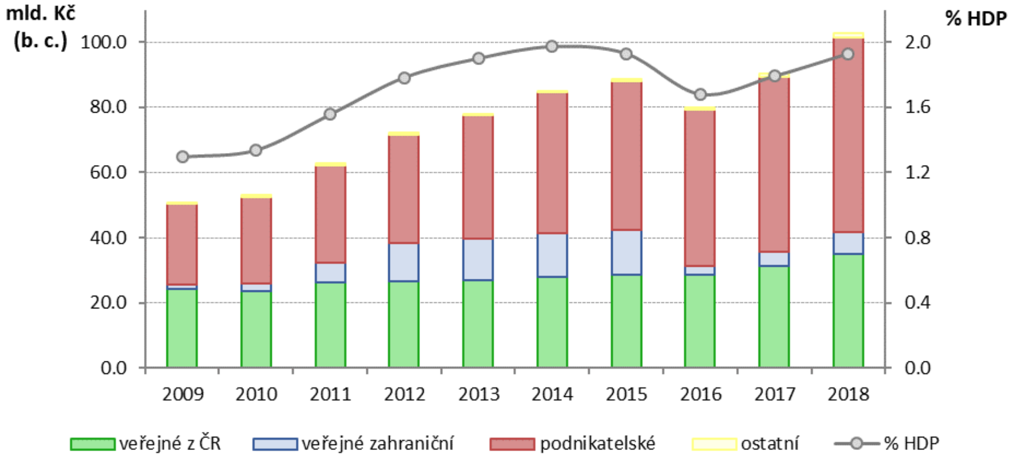
1 Financial flows in research and development

1.1 Total research and development expenditure

The **overall R&D expenditures in the Czech Republic** have been showing long-term growth (Figure 1.1). In the ten-year timeline of 2009–2018, the regular year-on-year growth was interrupted only in 2016, when there was a shortage of public resources from abroad due to the transition to the new programming period. **The absolute amount of overall expenditures first cracked a record CZK 100 bn. in 2018.** The R&D Intensity indicator (i.e. R&D expenditure as a percentage of the GDP) also had a growing trend in recent years aside from minor deviations. Though this indicator dropped off in 2016, which was caused by the expected fall-off in public resources from abroad as well as by the fact that the Czech economy was growing more rapidly than total R&D expenditures in 2015 and 2016, **after 2017 we can once again see that the rate of growth of the gross R&D expenditure is higher than GDP growth and that R&D expenditures expressed as a percentage of the GDP are at the same level as 2015.** Long-term growth of total R&D expenditures in the Czech Republic in recent years was caused primarily by steady growth in **business resources, which totalled nearly CZK 60 bn. in 2018*,*** i.e. almost 2.5 times more than in 2009. Another component of the overall expenditure that contributed to the long-term growth of gross R&D expenditures is **domestic public resources**. Though the rate of growth of these expenditures was lower, it was relatively stable compared to business sources, **in 2017 surpassing CZK 30 bn. for the first time and in 2018 even reaching CZK 35 bn. in absolute numbers.** Another no less important component of the overall R&D expenditures is **foreign public resources**, the growth of which began to be felt more significantly after 2011 in connection with drawing from EU funds in the 2007–2013 programming period (ECOP, OP RDI and OPEI). **These resources culminated in 2014 and 2015** (final drawing from OP RDI). The year-on-year decrease in gross R&D expenditures in 2016 was caused by a **fundamental drop-off in foreign public resources**, which was tied to the transition to the new programming period for drawing ESIF (for more details see Chapter 3 – Research, Development and Innovation Support in the Czech Republic from European Funds). In 2017 and 2018 we can see a gradual increase in foreign public resources (in particular due to OP RDE and OP EIC).

The overall R&D expenditure can be further broken down by type into current (wage and other current) and capital expenditures. Over the past 10 years, capital expenditures have totalled CZK 121.2 bn. (i.e. 16% of the total R&D expenditures for 2009–2018). The majority has consisted of current expenditures: wages (47%) and other current expenditures (37%). **In 2018, capital expenditures totalled CZK 11 bn., wage expenditures CZK 54.3 bn. and other current expenditures CZK 37.4 bn**. The amount of capital expenditures in recent years depended primarily on the amount of public resources drawn from abroad, with the highest capital expenditures being made in 2012–2015 due to the building of the European Centres of Excellence and Regional R&D Centres (an average of CZK 17.6 bn. a year). In the case of wage expenditures, the business sector saw the greatest increase, with wage expenditures having grown 164% in 2018 compared to 2009, which naturally correlates to the growing number of R&D employees in the sector in question (growth in number of FTEs of 67% between 2009 and 2018) and the growing R&D expenditures from business resources. In the public sector there was also an increase in the number of employees (FTEs), but this growth was not as marked as in the business sector. In the government sector the number of employees (FTEs) rose by 23% between 2009 and 2018, in the higher education sector by 32%; this was also accompanied by a growth in wage expenditures: 74% in the government sector and a full 139% in the higher education sector. If we compare the wage expenditures among individual sectors calculated per 1 FTE, in 2018 the highest annual wage expenditures were in the business sector (CZK 0.8 mil.), followed with a slight gap by universities (CZK 0.63 mil.) and right behind them the government sector (CZK 0.61 mil.). In the case of adjusted wage expenditures in the higher education sector, it is necessary to keep in mind that university employees often perform teaching activities, and in such cases it is likely that in total their wage expenditures could approach those in the business sector. For more detailed statistics on the development in number of employees in R&D, see Chapter 6 – Human Resources in R&D.

Figure 1.1: Gross expenditure on R&D (GERD) in the Czech Republic in 2009–2018 by source of financing (in current prices)

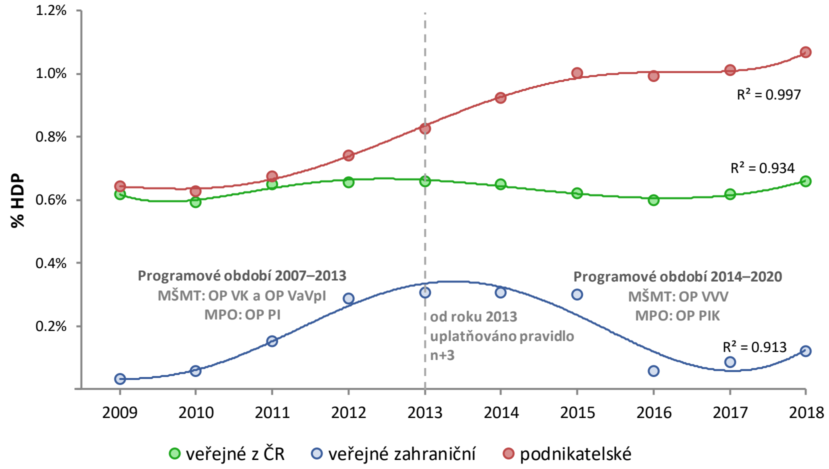


bn. CZK (c.p.) **% of GDP**

-public from Czech Rep. - foreign public - business - other - percentage of GDP

Source: CZSO, Annual Report on Research and Development

Figure 1.2: Sources of financing for gross expenditure on R&D (GERD) in current prices expressed as a percentage of GDP in 2009–2018



% of GDP
2007–2013 programming period
MEYS: ECOP and OP RDI
MIT: OPEI
n+3 rule applied since 2013
2014–2020 programming period
MEYS: OP RDE
MIT: OP EIC

-public from Czech Rep. *-foreign public* *-business*

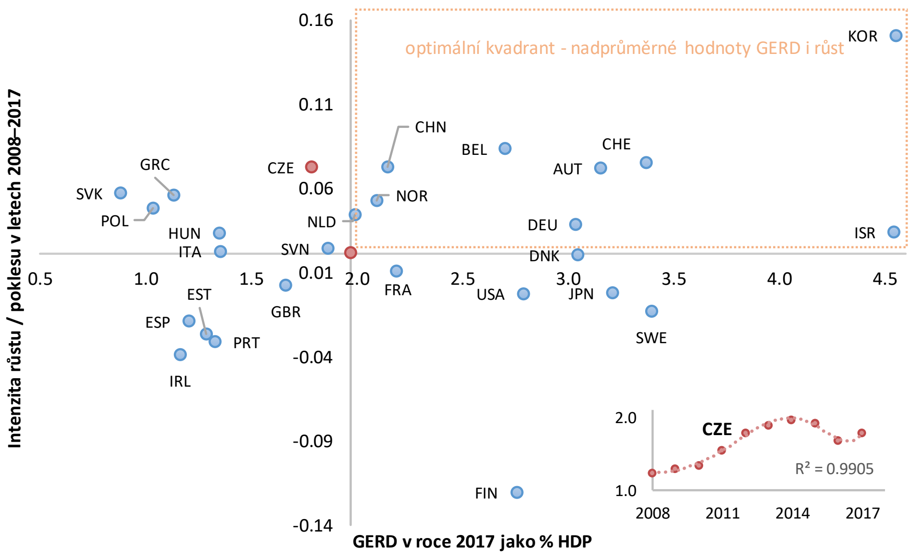
Resource: CZSO | Coefficient of determination R^2 characterises the close dependence shown by the curve.

The development of individual GERD components adjusted for GDP by source of financing in time is shown in Figure 1.2. Research and development expenditures financed from business resources as a percentage of GDP reached 1.12% in 2018, having passed 1% of the GDP back in 2016. **The growth of R&D expenditures as a percentage of the GDP is naturally a welcome trend, being the result of year-on-year growth of R&D expenditures from business sources, not of negative economic development (drop in GDP growth)**. The R&D expenditure financed from Czech public resources shows a balanced trend in 2009–2018, with the value ranging from 0.59% to 0.66%. In 2018 it reached 0.66%, i.e. the same amount as in 2012 and 2013, with the difference that at that time the economy was just pulling out of a crisis and year-on-year GDP growth was minimal (under 1%), just as the growth of public expenditures from the Czech Republic was under 2%. In 2018 the GDP grew by 5.6% and Czech public expenditures rose by a record 12%. Contributing particularly to this record growth in public expenditures was the Research, Development and Innovation Council (RDIC), which prepares the proposal for the overall RDI expenditure from the SB, as in recent years the RDIC has been endeavouring to increase SB expenditures on RDI while also streamlining the focus of these public resources. RDI expenditures from the SB are to ensure long-term stable and predictable financing of the RDI system with an accent on strengthening institutional funding, while also helping to accelerate private expenditures on RDI. In terms of business resources, the main objective is to create conditions so that business expenditures comprise 1.5% of the GDP after 2024, which according to the most recent forecasts would mean an increase of nearly CZK 90 bn. Considering the differing interpretation of EU rules on public aid, a discussion was launched at an RDIC meeting in conjunction with the Office for the Protection of Competition to harmonise the methodology for economic and non-economic activities of research organisations and research infrastructure. This harmonisation should help support future growth of private R&D expenditures. Another way to stimulate private spending on R&D is to harmonise the methodology for tax deductions. In 2018 a working group (WG) was established for R&D tax deductions; the members of this group include representatives of the RDIC, MF, General Financial Directorate (GFD), Confederation of Industry of the Czech Republic, Association of Research Organisations, and the Association of SMEs. The shared goal for R&D tax deductions is to remove the uncertainty of taxpayers using these deductions while also ensuring that the likelihood of deductions being abused does not increase, all while respecting the instrument's ultimate goal of "supporting competitiveness". As is also evident from Figure 1.2, in 2012–2015 public funding from abroad was a highly significant source of funds for R&D, in particular from EU structural funds. **In 2018, however, foreign public resources comprised a mere 0.12% of the GDP**. **Expenditures from public resources as a whole** (the SB, local budgets, foreign public resources) **constituted 0.78% of the GDP in 2018**, which means that the **Czech Republic was close to fulfilling the national target of the Europe 2020 strategy of annually investing public funds amounting to 1% of the GDP in R&D**. Moreover, the financial indicators for 2018 indicate that the milestones laid down in the 2019+ Innovation Strategy can realistically be met, namely those under the first Pillar: Financing and Evaluating R&D, which is boosting the funding of science, whereby R&D expenditures should reach 3% of the GDP by 2030.

INTERNATIONAL COMPARISON

In terms of international comparison, statistics on R&D expenditures were available for 2008–2017, but in some cases only up to 2016 (i.e. for 2007–2016), or even only up to 2015. Data are thus compared with a delay compared to the available statistics for the Czech Republic published by the CZSO in Chapter 1.2. It is evident from Figure 1.3 that **in comparison with other countries the Czech Republic is lagging slightly behind the European average in terms of gross expenditure on R&D expressed as a percentage of GDP** (i.e. R&D Intensity or Research Intensity). Between 2008 and 2017, the R&D Intensity in the Czech Republic grew the most of all new EU Member States, by 55 pp. According to a comparison with other EU Member States, the Czech Republic reported the highest value of this indicator among new Member States in 2017 (with the exception of Slovenia), and it even has a higher value than southern European countries (Portugal, Spain and Italy). The EU states that report a significantly higher R&D expenditure than the Czech Republic traditionally include Sweden, Austria and Germany. In all these countries the R&D Intensity ranges above 3% of the GDP. Also reporting a relatively high intensity of R&D expenditures in 2017 was the USA (2.8% of the GDP), and Japan (3.21% of the GDP), Switzerland (3.37% of the GDP), Israel and South Korea (over 4.5% of the GDP) were even higher. In terms of the development of R&D Intensity, a growing trend can be observed in 2008–2017 for most countries that strongly support R&D (with the exception of Sweden and Finland). Of the countries outside the EU, there is stable R&D investment growth in Asian countries, particularly South Korea and China. In China, the R&D Intensity surpassed the EU 28 average for the first time in 2013 and the gap is ever increasing, with China gradually approaching the United States in terms of R&D expenditure intensity.

Figure 1.3: Gross expenditure on R&D (GERD) in 2008–2017 in international comparison



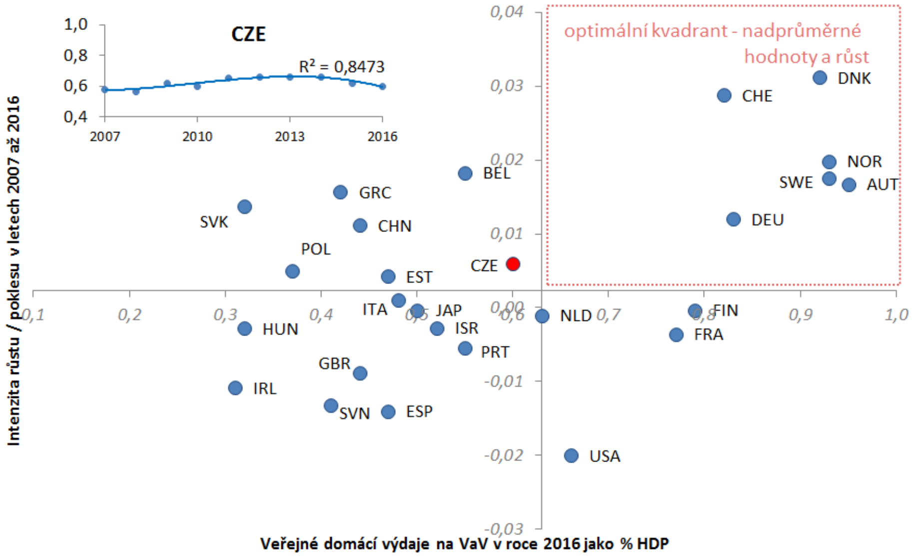
Intensity of growth/drop in 2008–2017 optimal quadrant – above-average values of GERD and growth

GERD in 2017 as a percentage of GDP

Source: OECD – Main Science and Technology Indicators | Intensity of increase/decrease in 2008–2017 is expressed as the direction of the regression line (a positive value indicates a rising trend, a negative value a falling one). The intersection of axes indicates the theoretical position of the EU 28. The section in the bottom right corner demonstrates the course of values in individual years in the Czech Republic; the coefficient of determination R^2 indicates the closeness of dependence represented by the curve.

If we perform an international comparison based on domestic public R&D expenditures (expressed relatively as a percentage of GDP, Figure 1.4), the Czech Republic approaches the European average in this indicator (the EU 28 average in 2016 was 0.63% of the GDP, the Czech value 0.6% of the GDP) and is comparable to the Netherlands, while surpassing countries such as the UK, Portugal and Japan (with R&D expenditures funded from domestic public resources at 0.50–0.55% of the GDP in 2016). The Czech Republic outperforms Poland, Slovakia and Ireland even more markedly (0.50–0.55% of the GDP), but does not reach the levels of Switzerland or France (approximately 0.8%), Norway, Sweden, Denmark or Austria (0.90–0.95% of the GDP). In the 10-year period between 2007 and 2016, a growing trend is evident for many countries, as with the Czech Republic. Nevertheless, in the UK, Netherlands and France, for example, we see a falling trend, with a noticeable drop in these countries following the financial crisis (after 2009) which was not compensated for up until 2015.

Figure 1.4: Domestic public expenditure on R&D in 2007–2016 in international comparison



Intensity of growth/drop in 2007–2016 optimal quadrant – above-average values and growth

Domestic public R&D expenditure in 2016 as a percentage of GDP

Source: OECD – Main Science and Technology Indicators | The intensity of increase/decrease in 2007–2016 is expressed as the direction of the regression line (a positive value indicates a rising trend, a negative value a falling one). The intersection of axes indicates the theoretical position of the EU 28. The section in the top left corner demonstrates the course of values in individual years in the Czech Republic; the coefficient of determination R^2 indicates the closeness of dependence represented by the curve.

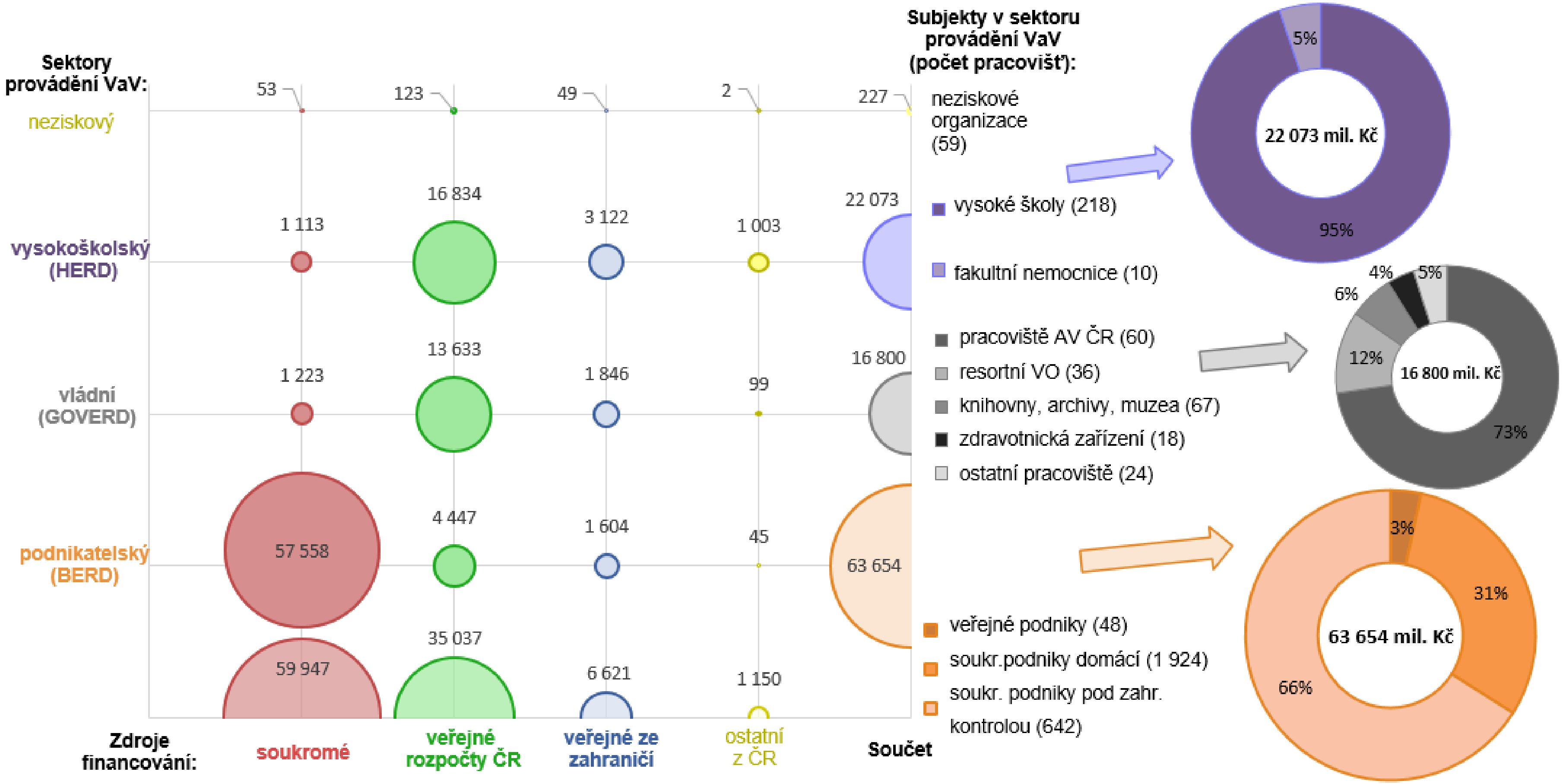
1.2 Financial flows between sectors

The relations between individual sectors and sources of funding are recorded in Figure 1.5, which shows the values for 2018. It is evident from Figure 1.5 that certain disproportions were recorded in the distribution of individual financial sources among sectors that carry out R&D. **Business sources were almost exclusively utilised in the business sector**, support of the public R&D sector from domestic business resources was very low, reaching just under CZK 2.3 bn. for the university and government sector (CZK 1.1 bn. and CZK 1.2 bn. respectively). In contrast, support from domestic public sources was directed primarily into the higher education and government sectors (CZK 16.8 bn. and CZK 13.6 bn.). The amount of support from domestic and foreign public sources for R&D carried out in the business sector totalled CZK 6.1 bn. (CZK 4.5 bn. from the Czech public budget and CZK 1.6 bn. in public resources from abroad). **The funds invested by businesses into R&D conducted in the public sector thus totals less than half the funds that businesses drew from public sources.**

The low rate of private funds spent on the public sector could indicate that collaboration between the business and private sectors in conducting R&D is not sufficient, despite the fact that such collaboration is supported from the SB. The motivation effect is evidently not being lived up to sufficiently, because the initial phase of collaboration financed from the SB has not yet sufficiently raised the business sector's confidence in the public sector, which would be expressed by a significant increase in business capital in public research. Both sectors have markedly different ideas of collaboration. The public sector endeavours to define the objectives and results of collaboration itself with regard to advancing the scientific field, while the business sector focuses more on a specific economic effect and the speed of achieving it. One cause of insufficient collaboration implied by the low level of private funds for the public sector could also be the fact that the business sector is saturated in respect of its research needs from public resources. On the other hand, it must be realised that the level of collaboration cannot be measured solely based on the share of private resources for the public sector – collaboration could also occur through participation in projects financed from public sources.

According to CZSO statistics, AS CR institutes focus primarily on basic research (CZK 10.5 bn. in 2018, i.e. 86%), compared to which institutions in the government sector in European countries such as Norway, the Netherlands and Finland are more oriented towards applied research and experimental development, which is also true of non-European countries such as the USA, South Korea and China. In the last year available for international comparison (2016), expenditures for applied research and experimental development in the Czech government sector reached 0.06% of the GDP and were four times lower than expenditures for basic research, compared to which in the aforementioned European countries these expenditures expressed as a percentage of the GDP were at least twice as high as in the Czech Republic. In the case of the higher education sector, funds focused on applied research reached 0.1% of the GDP in the Czech Republic in 2016 (in the period when drawing from OP RDI was culminating, this rate was 0.16% of the GDP on average and it then fell again to 0.1%) and represented half of the expenditures for basic research. An international comparison in the case of the university sector is rather limited as data are lacking for most of the EU 15 states and are only available for the Netherlands and the UK, for example, where the percentage of expenditures on applied research was twice that of the Czech Republic, and as much as fourfold in the case of Denmark. The ratio of R&D expenditures between applied and basic research is 1:2 in the Czech Republic (in favour of basic research), while in the aforementioned countries it is closer to 1:1 or even 2:1, thus abroad we can see a greater tendency to focus on applied research than in the Czech Republic, even in the university sector. The focus of the Czech public sector on basic research is likely also reflected in the low percentage of R&D expenditures from private sources spent in these sectors. A greater orientation towards applied research by universities and AS CR institutes could lead to greater collaboration between the business and academic spheres, which is the aim of the current NP RDI 2016–2020 (Measure 16) and the 2019+ Innovation Strategy (Pillar V – Innovation and Research Centres).

Figure 1.5: Financial flows in R&D among sectors in 2018



Sectors carrying out R&D:
non-profit
higher education (HERD)
government (GOVERD)
business (BERD)
Sources of funding: private   Czech public budgets   public from abroad   other Czech   total
Entities in the sector carrying out R&D (number of workplaces):

non-profit organisations (59)
universities (218) -> CZK 22.073 bn

university hospitals (10)

AS CR institutes (60) -> CZK 16.8 bn
ministerial research organisations (36)
libraries, archives, museums (67)
healthcare facilities (18)
other workplaces (24)

public enterprises (48) -> CZK 63.654 bn
domestic private enterprises (1 924)
private enterprises under foreign control (642)

Source: CZSO | The figure shows other sources of funding for R&D that comprise the own revenue of universities and private non-profit institutions that does not come from the SB, the business sector or from abroad. The average amount of these resources in 2013–2017 was roughly CZK 670 mil.; in 2018 they already exceeded CZK 1.1 bn. 80% of these resources are allocated in the higher education sector, comprising primarily student fees, periodical subscriptions, and publication revenue. The number of entities in the R&D sectors in parentheses list the average number of workplaces. The number of AS CR institutes is listed based on the CZSO methodology, as due to the regional breakdown the CZSO monitors data separately for multiple branches of certain institutes (Institute of Botany, Institute of History, Institute of Plasma Physics). In 2018 there were 54 separate institutes of the AS CR.

Figure 1.5 provides a detailed view of the drawing of expenditures based on research facility type in the individual sectors (pie charts on the right). The **business sector** used the greatest volume of funding for R&D that it conducted. **R&D expenditures in the business sector totalled CZK 63.6 bn.**, with 2 614 workplaces active in this sector; in contrast to the higher education sector this number nearly corresponds to the number of economic entities. In the case of universities, data are generally calculated down to individual workplaces (i.e. generally faculties). A significant amount of R&D funding was spent by private enterprises under foreign control (66%), the second most being spent by domestic private enterprises (31%), and only a negligible share coming from public enterprises (3%). **The higher education sector invested a total of CZK 22 bn. in R&D activity** (according to the CZSO methodology this sector includes university facilities and facilities at university hospitals), of which 95% was invested by universities, the remaining part falling to university hospitals. **In the government sector R&D expenditures totalled CZK 16.8 bn.,** with the largest group in terms of volume of R&D funding comprising AS CR institutes (73%). **In terms of funding volume there are thus four types of "strong" research organisations in the Czech R&D system that have invested the most in R&D in the last five years**, the largest group being private enterprises under foreign control (CZK 165.8 bn.), the second being universities (CZK 92.8 bn.), followed by private domestic companies (CZK 88 bn.) and institutes of the AS CR (CZK 61.3 bn.) in fourth place, with a relatively large gap. Private domestic companies can also make use of both direct public support and indirect support for their R&D activities (see the subchapter Direct and Indirect R&D Support in the Business Sector below).

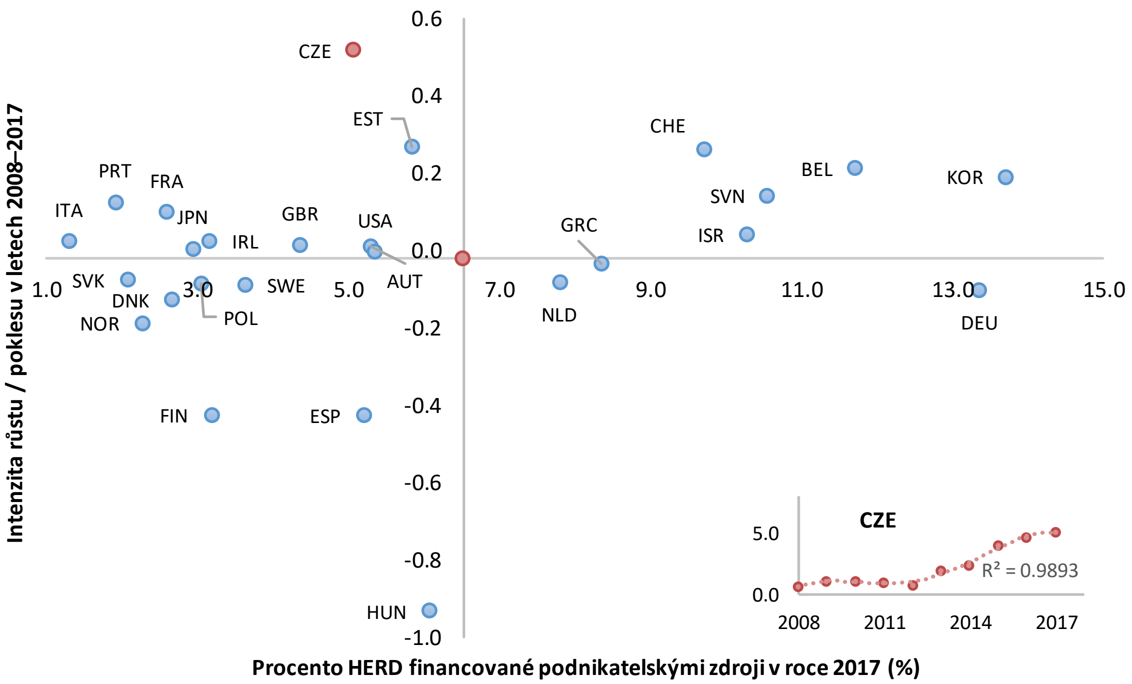
INTERNATIONAL COMPARISON

The imbalance between funds heading from businesses to public entities and funding provided to businesses from the Czech SB is also evident from an international comparison (see Figures 1.6–1.8). While support for the business sector from Czech public funds reached 9.5% of the volume of funds spent on R&D by the business sector in 2018 (7% in 2017), business sources constituted 5.0% of the expenditures of the higher education sector on R&D (5.4% in 2017) and 7.3% of the government sector's R&D expenditures[1] (3.6% in 2017). In contrast, direct support of businesses from domestic public sources in Germany, for example, constituted a mere 3.2% of business sector expenditures on R&D in 2017, but business sources contributed nearly 13.4% to the R&D expenditures of the higher education sector and more than 10% of the government sector's R&D expenditures, which stems in part from the long tradition of collaboration between academia and industry that functions in Germany (e.g. the Fraunhofer Model). Unfortunately the last available data for Austria are for 2015, nevertheless certain similarities to the Czech Republic can be seen in the distribution between funds going from businesses to public entities, with private

[1] In the case of the government sector, only domestic business resources are implied, which eliminates the impact of the licensing fees of the Institute of Organic Chemistry and Biochemistry of the AS CR.

sources providing 5.3% in the higher education sector (HERD) and 6.3% in the government sector (GOVERD). In contrast, Austrian businesses are relatively more successful in acquiring public support, with domestic public resources contributing 12% to expenditures in the business sector. What is more, Austrian enterprises also make relatively abundant use of indirect support (Figure 1.11), which could be a successful way to accelerate private expenditures in the Czech RDI system and help increase the competitiveness of the Czech state.

Figure 1.6: Proportion of business resources in higher education R&D expenditure (HERD) in 2008–2017 in international comparison (in %)

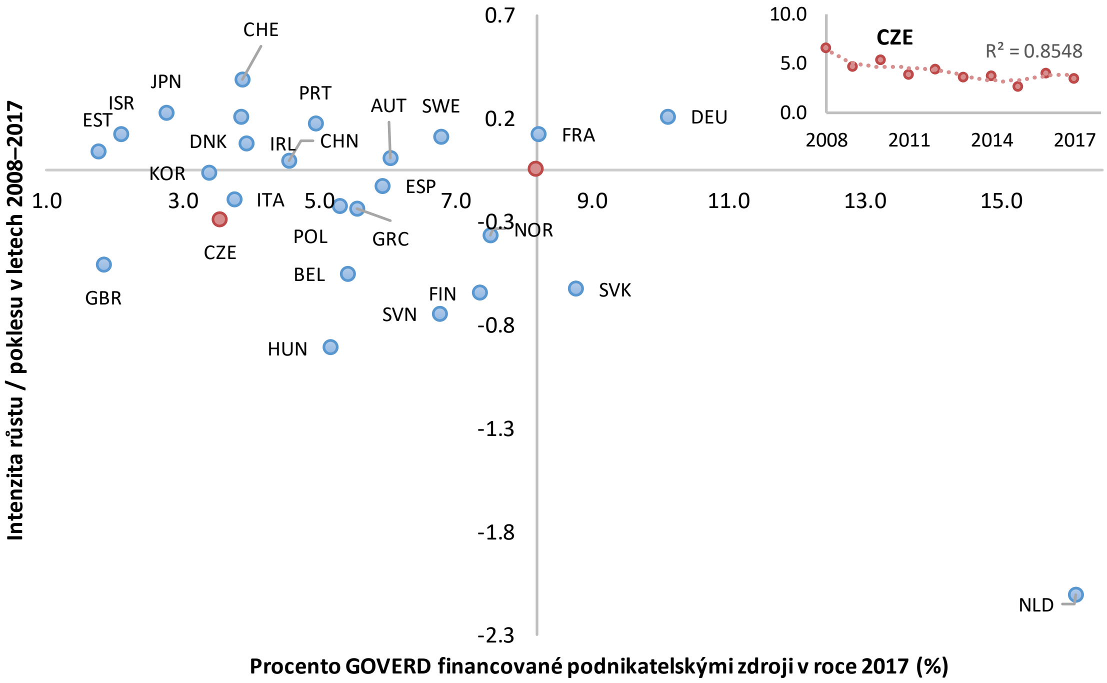


Intensity of increase/decrease in 2008–2017

Percentage of HERD funded from business resources in 2017 (%)

Source: OECD – Main Science and Technology Indicators

Figure 1.7: Proportion of business resources in government sector R&D expenditure (GOVERD) in 2008–2017 in international comparison (in %)



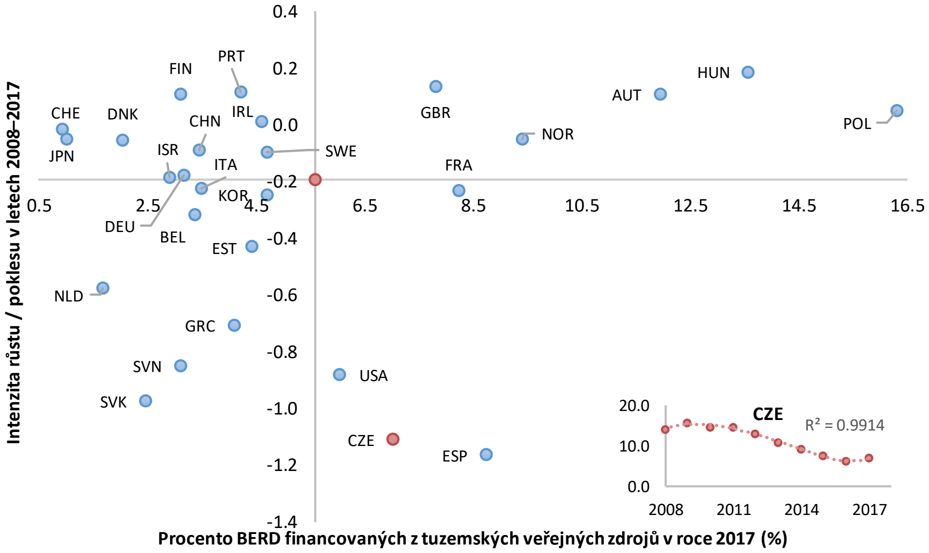
Intensity of increase/decrease in 2008–2017
Percentage of GOVERD funded from business resources in 2017 (%)

Source: OECD – Main Science and Technology Indicators | The intensity of increase/decrease in 2008–2017 is expressed as the direction of the regression line (a positive value indicates a rising trend, a negative value a falling one). The intersection of axes indicates the theoretical position of the EU 28. The coefficient of determination R^2 indicates the closeness of dependence represented by the curve. Business sources include the following funds: revenue from sale of R&D services (research for business needs), revenue from licensing fees (e.g. for patents, know-how), other revenue (e.g. leasing of buildings and facilities, revenue from sale of property, paid courses, consulting, financial donations).

A more detailed analysis of the share of domestic business resources in funding R&D conducted in the higher education sector shows that the Czech Republic has long numbered among the EU states with a relatively low level thereof (Figure 1.6). Based on the trend from recent years it can be expected that the Czech Republic's position will improve in the coming years and approach the EU average. The share in higher education R&D expenditures is a similar situation to that of the share of domestic business resources in government sector R&D expenditures (Figure 1.7). In this indicator the Czech Republic still lags behind the mean value of the EU Member States, and based on long-term development of this indicator, no improvement of the situation can be expected in the coming years.

The share of domestic public funding in business sector R&D expenditures (Figure 1.8) was high in the past in the Czech Republic, reaching 7% in 2017. In 2011 it was still at 14.7%, which was followed by a gradual shift towards the European average (in 2016 this was 6.35% for the EU 28, in 2015 5.6%).

Figure 1.8: Proportion of domestic public resources in gross business expenditure on research and development (BERD) in 2008–2017 in international comparison (in %)



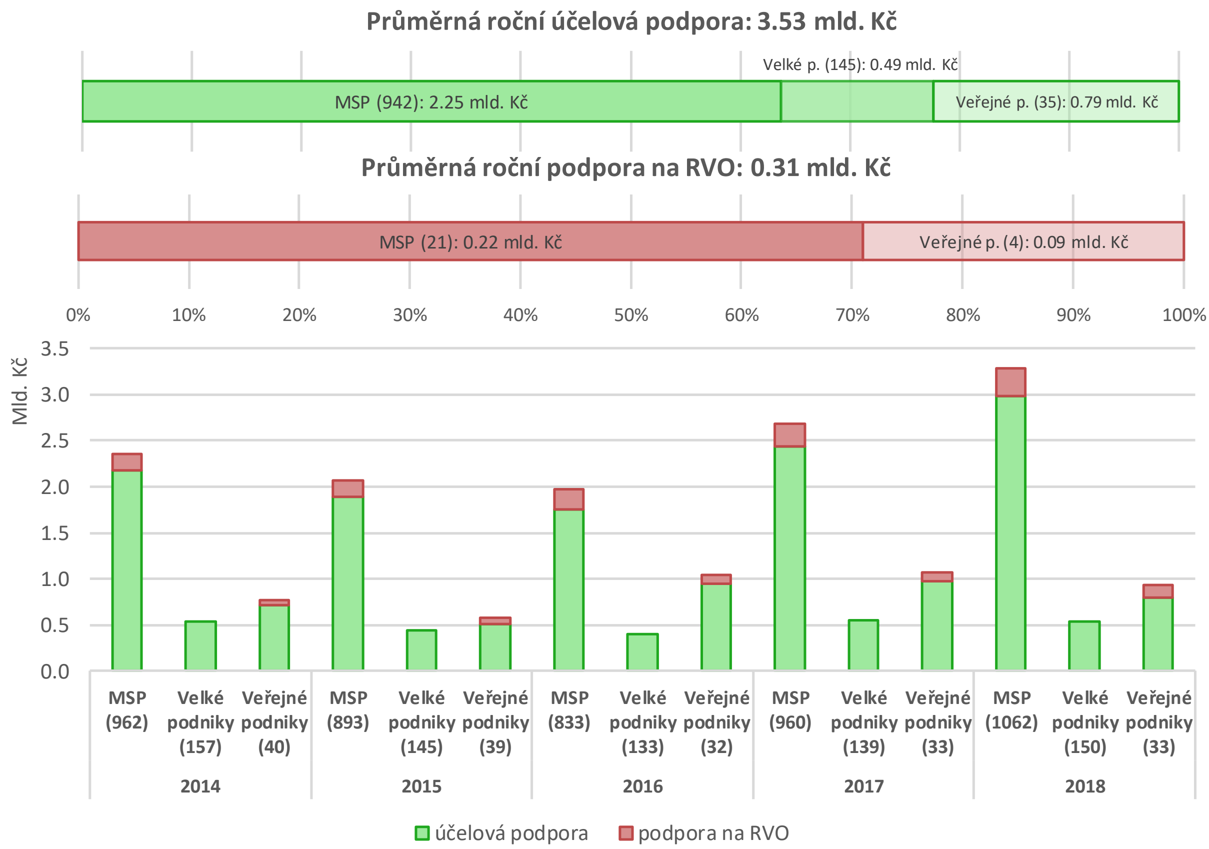
Intensity of increase/decrease in 2008–2017
Percentage of BERD funded from domestic public resources in 2017 (%)

Source: OECD – Main Science and Technology Indicators and Eurostat | The intensity of increase/decrease in 2008–2017 is expressed as the direction of the regression line (a positive value indicates a rising trend, a negative value a falling one). The intersection of axes indicates the theoretical position of the EU 28. The section in the bottom right corner demonstrates the course of values in individual years in the Czech Republic; the coefficient of determination R^2 indicates the closeness of dependence represented by the curve.
The domestic public funds include funding spent on co-financing EU operational and framework programmes.

1.3 Direct and indirect support for research and development in the business sector

Figure 1.9 below presents the distribution of direct public support in the business sector. Data were used from the RDI IS on the support actually drawn from the SB, with private businesses comprising the group of SMEs and large enterprises. According to the data submitted to the RDI IS, **in 2018 the total direct support for private enterprises drawn was CZK 3.82 bn**. Of this amount, CZK 307 mil. was spent to support long-term conceptual development for 21 private enterprises in 2018, with the remaining CZK 3.5 bn. spent on other forms of direct R&D support (i.e. primarily on targeted support projects). On average in 2014–2018 public enterprises obtained CZK 880 mil. (23%), large enterprises CZK 490 mil. (13%), and SMEs CZK 2.470 bn. (64%). **Between 2014 and 2018 the overall support for the business sector increased by CZK 1.1 bn., while support for private enterprises rose CZK 933 mil.** Support rose primarily for SMEs (by CZK 930 mil.), and in the case of large enterprises public support grew only minimally (by approximately CZK 3 mil.). Figure 1.9 captures the development in number of entities in selected categories (see parentheses). The most abundant group is SMEs, followed (with a large gap) by the group of large enterprises, and the smallest group is public enterprises.

Figure 1.9: Direct support for R&D in the business sector from the state budget in 2014–2018



Average annual targeted support: CZK 3.53 bn

Large ent. (145): CZK 0.49 bn

SMEs (942): CZK 2.25 bn Public ent. (35): CZK 0.79 bn

Average annual support for development of research organisations: CZK 0.31 bn
SMEs (21): CZK 0.22 bn Public e. (4): CZK 0.09 bn

CZK bn

SMEs Large enterprises Public enterprises …

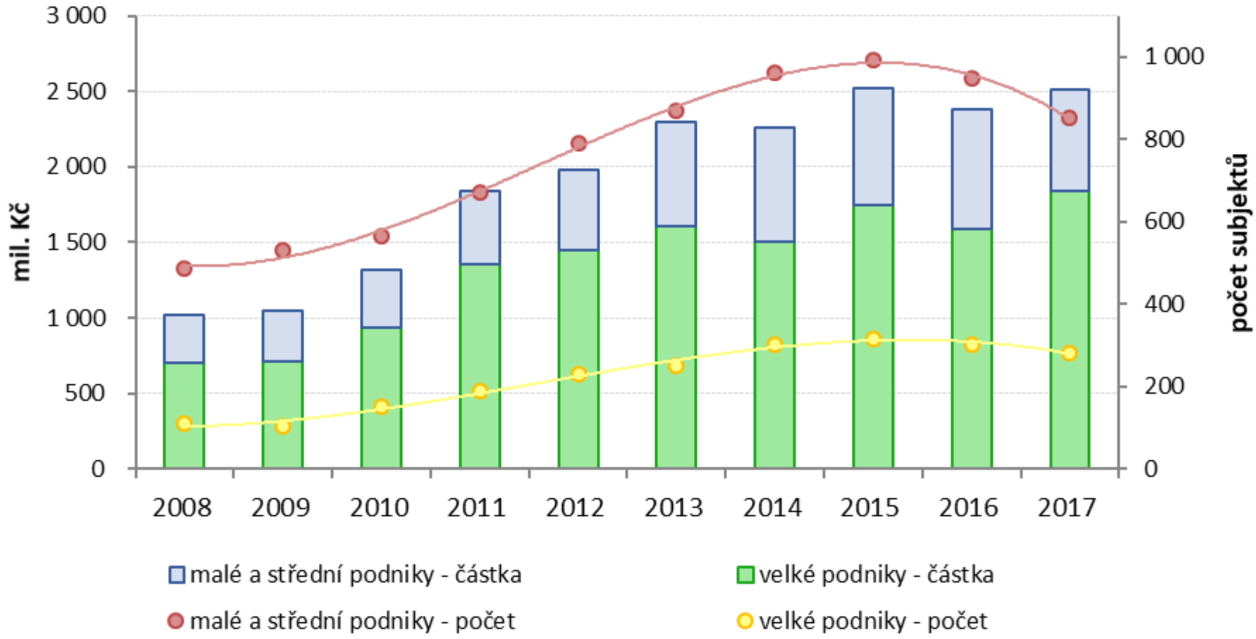
targeted support support for research organisation development

Source: RDI IS after adjusting entity categories based on CZSO methodology for statistical studies. | The number of entities is in parentheses.

Aside from direct R&D support from the SB, private enterprises are also supported indirectly in the form of items that are deductible from the income tax base of legal persons.[2] **In 2017, the amount of indirect support for R&D at businesses in the Czech Republic reached CZK 2.52 bn.** (Figure 1.10). Compared to 2008 this support has risen nearly 150% (i.e. from CZK 1.02 bn.), with this increase primarily caused by significant growth in the expenditure deductions applied, particularly by large enterprises. Despite the fact that the number of private enterprises that made use of indirect R&D support fell in 2017, the volume of deducted R&D expenditures increased, and thereby also the amount of R&D tax support claimed. After 2010, when the tax rate for legal persons stabilised at 19%, the amount of indirect public support for R&D rose continuously up until 2013. This was followed by a trend of alternating decreases (2014, 2016) and increases (2015, 2017). **In 2017, 283 large enterprises made use of indirect public support, claiming R&D tax support of CZK 1.84 bn.**, which constitutes over 75% of the overall amount of indirect public support for private enterprises. Thus the average R&D tax support per large enterprise was CZK 6.5 mil., while for SMEs it was more than eight times lower (i.e. CZK 0.79 mil.).

[2] Under Section 34 (4) and (5) of Act No. 586/1992 Coll. on Income Tax.

Figure 1.10: Indirect support for R&D in the business sector in the Czech Republic in 2008–2017



CZK mil.

number of entities

small and medium enterprises – amount

large enterprises – amount

small and medium enterprises – number

large enterprises – number

Source: CZSO based on GFD administrative data | The graph does not present indirect support to public enterprises as the number of public enterprises claiming deductions ranges in the single digits and the overall amount of indirect support was also negligible in comparison with private enterprises.

For some businesses[3] scepticism may persist in connection with the ambiguous and unpredictable approach of local tax authorities to assessing claimed costs. A significant shift on this issue came with the document "Information on the R&D project as a necessary condition for claiming deductions on R&D support under Section 34(4) and (5) of the Income Tax Act" issued by the GFD in September 2017.[4] This information could rectify the formal shortcomings of R&D projects. The fact that no single methodological framework has been established for recognising costs to be deducted reduces the potential utilisation of indirect support by a broad spectrum of businesses (in particular SMEs), while also increasing the risk of abuse of this type of support. As mentioned above, in 2018 a WG was established for R&D tax deductions, the members of which include representatives of the RDIC, MF, GFD, Confederation of Industry of the Czech Republic, Association of Research Organisations, and the Association of SMEs. The shared goal for tax

[3] E.g. the press release on the briefing "Perspectives for strategic financing of science through to 2024" accessible at http://www.vyzkum.cz/FrontAktualita.aspx?aktualita=822544 [accessed 2019-10-30].

[4] Ref. No. 89174/17/7100-10110-013213; accessible at http://www.financnisprava.cz/assets/cs/prilohy/d-novinky/2017_DPFO-DPPO_Info-pro-uplatneni-odpoctu-na-podporu-vyzkumu-a-vyvoje.pdf [accessed 2019-10-30]; this is an interpretation on the formal requirements of projects.

deductions in R&D is to remove the uncertainty of taxpayers using these deductions while also not increasing the likelihood of deductions being abused, all while respecting the instrument's ultimate goal of "supporting competitiveness".

For a more detailed analysis of direct and indirect public support for private enterprises, data provided by the CZSO were used. In the following Table 1.1 is an overview of the development in number of private enterprises that made use of at least one type of public support in 2013–2017 (i.e. direct or indirect). It is also possible to follow the development of overall public support including the structure of such support by selected criteria such as: type of support, type of ownership, and the sector in which private enterprises operate, or by their predominant activity under CZ-NACE. The number of private enterprises grew continuously up to 2015, but in 2016 it dropped suddenly year-on-year by nearly 150. This drop was partially caused by the decrease in number of businesses that made use of indirect support for their R&D and in part by a reduction in the number of private enterprises utilising direct public support, which was partly caused by the transition to the new programming period and approaching end of the TIP programme under the MIT. In terms of the volume of public support, a majority is obtained by domestic businesses, but the share of businesses under foreign control has been rising since 2014, and in 2017 it reached nearly 39%. It can be expected that in further years the share of domestic businesses will rise again, as drawing from the TRIO programme and OP EIC is getting underway, both of which accentuate support for the group of SMEs, under which mostly domestic businesses fall.

Table 1.1: Development of public support of R&D at private enterprises in the Czech Republic in 2013–2017

		2013	2014	2015	2016	2017
Number of enterprises using public support		1 960	2 090	2 062	1 918	1 966
of which:	domestic	1 491	1 594	1 564	1 448	1 515
	under foreign control	469	496	498	470	451
		2013	**2014**	**2015**	**2016**	**2017**
Gross public R&D support (CZK mil.)		7 956	7 625	7 212	5 259	6 494
of which:	direct domestic support	3 954	3 778	3 156	2 459	3 040
	direct foreign	1 705	1 583	1 532	415	938
	indirect	2 297	2 263	2 525	2 384	2 516
Structure of gross public R&D support by type of support in %						
of which:	direct domestic support	49.7	49.5	43.8	46.8	46.8
	direct foreign	21.4	20.8	21.2	7.9	14.4
	indirect	28.9	29.7	35.0	45.3	38.8
Gross public R&D support by enterprise ownership						
of which:	for domestic enterprises	5 484	5 277	4 556	3 330	3 977
	for enterprises under foreign control	2 472	2 345	2 656	1 929	2 517
Structure of support by ownership in %						
of which:	for domestic enterprises	68.9	69.2	63.2	63.3	61.2
	for enterprises under foreign control	31.1	30.8	36.8	36.7	38.8
Gross public R&D support by sector						
of which:	manufacturing industry	3 470	3 396	3 533	2 540	3 201
	information and communication activities	1 225	1 273	1 361	935	1 104
	professional, scientific and technical activities	2 254	2 149	1 710	1 307	1 617
	other sectors	1 008	808	609	476	572
Structure by sector in %						
of which:	manufacturing industry	43.6	44.5	49.0	48.3	49.3
	information and communication activities	15.4	16.7	18.9	17.8	17.0
	professional, scientific and technical activities	28.3	28.2	23.7	24.9	24.9
	other sectors	12.7	10.6	8.4	9.0	8.8

Source: CZSO

The more detailed structure of R&D support at private enterprises in the Czech Republic in 2017 is provided in Table 1.2. In 2017, each enterprise received indirect public R&D support of CZK 2.2 mil. on average. For private domestic enterprises the average support amount was CZK 1 mil., for private foreign enterprises this amount was five times higher. This difference is primarily due to the higher number of private domestic enterprises (greater representation of micro and small enterprises in this group) and the lower overall amount of indirect R&D support. Large enterprises, and particularly those under foreign control, much more frequently prefer indirect public R&D support over direct public support. The manufacturing industry is traditionally an industry into which nearly half of all public support for private enterprises flows. Of all branches of the manufacturing industry, businesses in the automotive industry (CZ-NACE 29) claimed the highest amount of R&D tax support in 2017.

Table 1.2: Structure of support for R&D in private enterprises in 2017

Beneficiary, sector, field	Number of enterprises			Support amount (CZK mil.)			Share of support (%)		
	total	ownership		total	ownership		for foreign	for domestic	direct/indirect
		foreign	domestic		foreign	domestic			
Manufacturing industry	658	210	448	1 780	1 295	485	73.0	27.0	
of which: 26 Electronic industry	60			89	34	55	38.0	62.0	
27 Electrical industry	75			201	143	58	71.0	29.0	
28 Engineering industry	158			299	194	105	65.0	35.0	
29 Automotive industry	37			710	696	14	98.0	2.0	
Selected fields total	330			1 299	1 067	232	85.0	18.0	
Information and communication activities	168	32	136	292	115	172	39.4	60.6	
Professional, scientific and techn. activities	146	46	100	268	194	74	72.4	27.6	
Other	163	49	114	176	94	82	53.4	46.6	
Indirect support	1 135	337	798	2 516	1 698	818	67.5	32.5	38.7
Direct domestic support	847	144	703	3 040	534	2 506	17.6	82.4	46.8
Direct foreign support	262	36	226	938	285	653	30.4	69.6	14.5
Gross public R&D support to enterprises in the Czech Republic				**6 494**	**2 517**	**3 977**	**38.8**	**61.2**	**100.0**

Source: CZSO

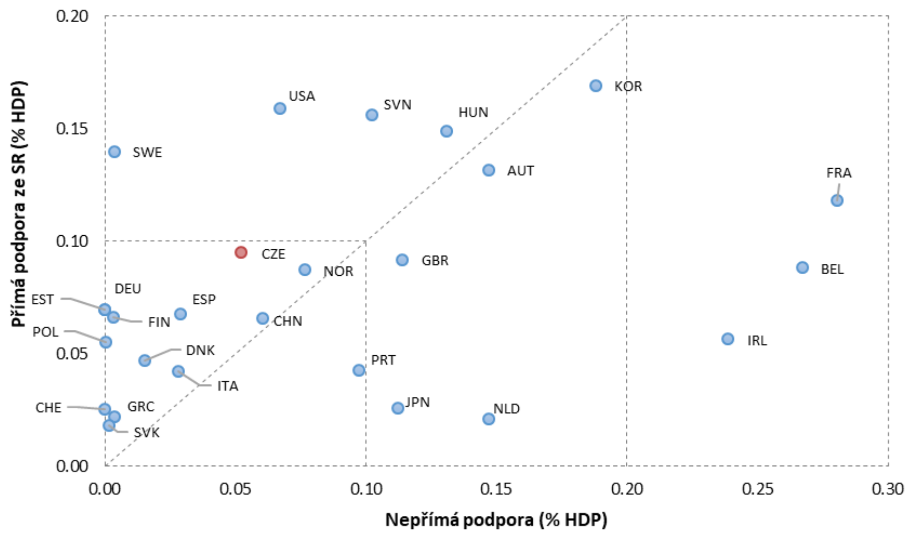
INTERNATIONAL COMPARISON

If we observe the business sector R&D expenditures that come right from the SB along with what is called indirect R&D support in the business sector, the international comparison will come out differently than when taking into account solely expenditures from direct support (Figures 1.3 and 1.11). Only the limited number of countries that keep track of indirect RDI support in the business sector and submit this information to international databases can be used for an international comparison. Moreover, data for such a comparison were only available up to 2016, thus the comparison was conducted on average values for the five-year period of 2012–2016.

It is evident from Figure 1.11 that countries such as France, as well as Belgium and Ireland, make use primarily of indirect support, and to a much greater extent than the Czech Republic. The intensity of direct support is higher in France, comparable in Belgium and lower in Ireland than in the Czech Republic. In contrast, the intensity of direct support is relatively high in South Korea, Austria and Hungary, yet at the same time indirect support is utilised to a relatively large extent. In terms of the intensity of direct support, the Czech Republic holds a position comparable to the UK, although the average intensity of indirect support is higher there. China and the USA report a similar level of indirect support as the Czech Republic, but the intensity of direct support in the USA is twice as high as in the Czech Republic, while in China the average intensity of direct support is lower. In Germany, Finland, Switzerland, Estonia and Italy the intensity of indirect support is lower than in the Czech Republic, or indirect support is not utilised at all or is highly limited. Summing together the intensities of direct and indirect support, the Czech Republic reports a value of 0.15%

of the GDP, which is approximately 2.4 times more than in the case of Denmark and nearly 2.1 times more than in Italy, but on the other hand 2.7 times less than in France and 2.4 times less than in Belgium and South Korea and two times less than in Ireland.

Figure 1.11: Direct and indirect support for RDI in the business sector as a percentage of GDP in international comparison (average for 2012–2016)



Direct support from the state budget (% of GDP)

Indirect support (% of GDP)

Source: OECD – Main Science and Technology Indicators R&D Tax Incentive Indicators

2 Funding of research and development from the state budget

Domestic public resources earmarked for carrying out RDI consist primarily of the SB for RDI, the proposal of which is approved every year by the government in the manner defined by Act No. 130/2002 Coll., on Support for Research, Experimental Development and Innovation from Public Funds and on Amendments to Some Related Acts (the Act on Support for Research, Experimental Development and Innovation), as amended. After being incorporated into the SB system, the amount of RDI support is included as a named item in the individual chapters of the State Budget Act. The amount of support is stipulated each year by the State Budget Act.

2.1 Process for producing draft state budget for research and development

Preparation of the draft SB for RDI is a continuous and comprehensive process described illustratively in Diagram 2.1 below. According to Section 35(2)(k) and (l) of the Act on Support for Research, Experimental Development and Innovation, the RDIC provides for drawing up the draft amount of gross RDI expenditures for individual budget headings and their mid-term outlook. Since 2015, the state RDI budget has been conceived as part of preparations for the period after 2020, when there is a risk of a decrease in the share of RDI expenditures financed from public resources caused by the expected abatement of EU resources.

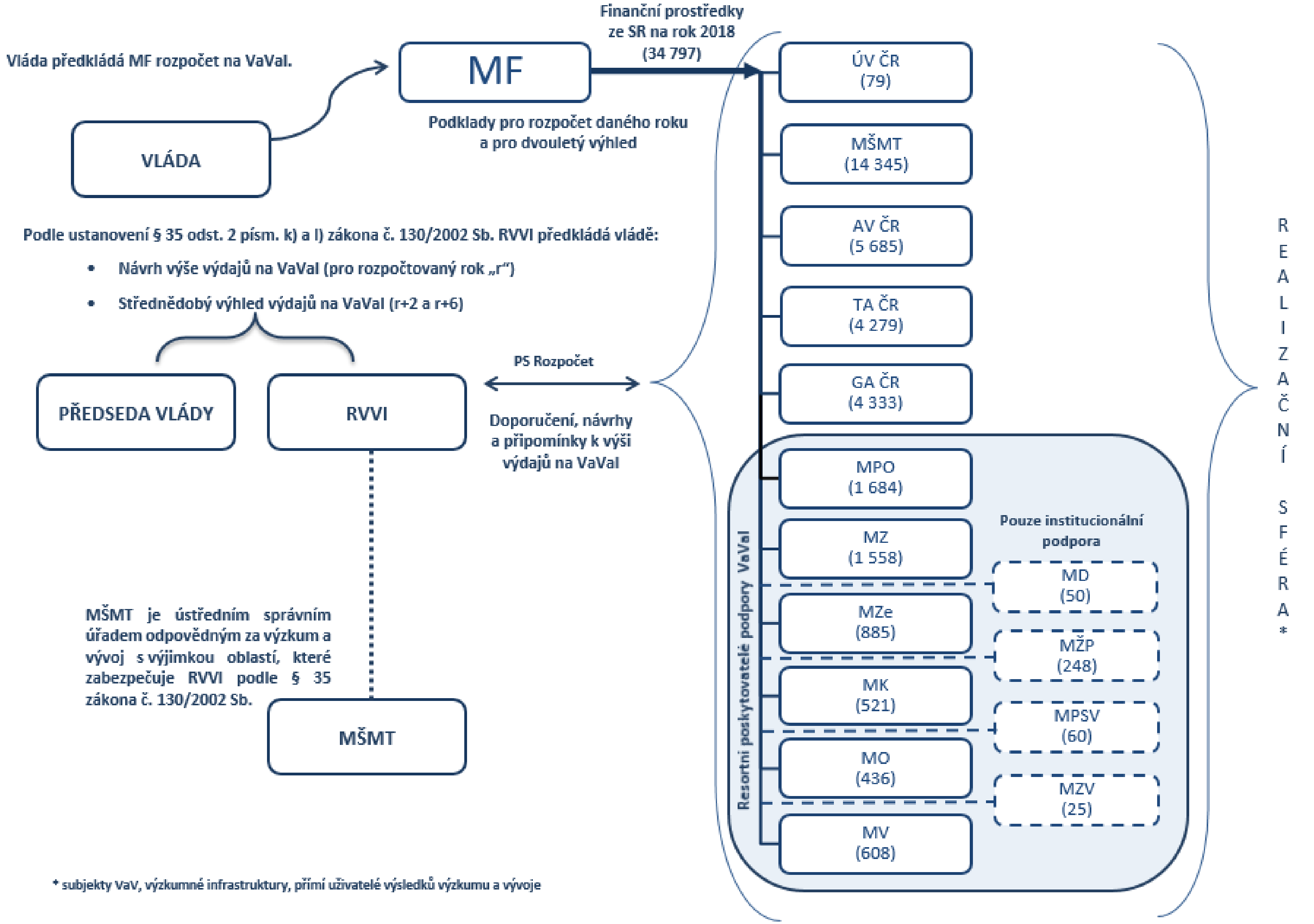
The proposal for SB expenditures stems from the document *National Policy on Research Development and Innovation for 2016–2020 (NP RDI)*. Over the course of 2018 a Report Evaluating Fulfilment of Measures of the National Policy on Research, Development and Innovation of the Czech Republic for 2016–2020 was drawn up, and was approved by the Czech government in February 2019. The Report includes an update to the NP RDI for the 2019–2020 period, which was prepared in the context of proposed amendments to measures described in the Report.[5]

Boosting RDI funding after 2020 is a goal of the 2019–2030 Innovation Strategy of the Czech Republic (Innovation Strategy), which the government approved with its Resolution No. 104 of 4 February 2019. Intensive preparations for the Innovation Strategy took place in the second half of

[5] The description and relevant data on fulfilment of measures showed that the majority of these were fulfilled or are being fulfilled on an ongoing basis. In order to preserve continuity, it was necessary to continue fulfilling the measures up to the end of the NP RDI's validity, i.e. until the end of 2020. For certain measures it was necessary to modify the instrument for fulfilling them. The merging of certain measures into one, or division of a single original measure into two separate ones, was related to this. In light of the short time, however, the effect of the measures could not yet be reflected in a change to the statistical indicators.

2018 as a reaction to the government's plan to support Czech science, research and innovation to enable the Czech Republic to become one of Europe's innovation leaders during the next 12 years. One of the goals of the Innovation Strategy is to "boost financing of R&D (measured as a percentage of the GDP): 2020: 2.0%, 2025: 2.5%, 2030: 3.0%, i.e. growth of 0.1 pp a year, of this growth to 1% from public resources and from business resources to 1.5% in 2025 and 2% in 2030." In the coming years the expenditure proposal will thus take into account the objectives of the Innovation Strategy in addition to the NP RDI.

Diagram 2.1: Creation of the draft State Budget Expenditure on RDI for 2018 (in CZK mil.): chapter responsibilities, role of central authority and financial flows (without European financial resources and their co-financing from the state budget)



* subjekty VaV, výzkumné infrastruktury, přímí uživatelé výsledků výzkumu a vývoje

(left side)

Government presents RDI budget to MF. MF Financial resources from budget for 2018 (34 797)
GOVERNMENT Materials for budget of the given
year and for two-year outlook

Pursuant to the provision of Section 35(2)(k) and (l) of the Act No. 130/2002 Coll. the RDIC presents to the Government:

- Proposal of RDI expenditure (for budget year "r")
- Mid-term outlook of RDI expenditure (r+2 and r+6)

PRIME MINISTER RDIC Budget WG
Recommendations, proposals and comments on the amount of RDI expenditure

MEYS is the central administrative authority responsible for R&D, except for areas managed by the RDIC under Section 35 of Act No. 130/2002 Coll.
MEYS

* R&D entities, research infrastructure, direct users of R&D results

(right side)

Department providers of RDI support

OG CR (79)

MEYS (14 345)

AS CR (5 685)

TA CR (4 279)

CSF (4 333)

MIT (1 684)

MH (1 558)

MA (885)

MC (521)

MD (436)

MI (608)

Solely institutional support

MT (50)

MEn (248)

MLSA (60)

MFA (25)

REALISATION SPHERE*

Since 2017 the expenditure proposal has been structured into 15 budget chapters, with four ministries once again becoming providers based on the RDIC's proposal: the MT, ME, Ministry of Foreign Affairs and the MLSA. These chapters are, however, only providers of institutional support. The gross budgeted expenditure on RDI was approved by law in 2018 was CZK 34.797 bn., with the OG CR's chapter including only costs for the activities of the RDIC and funds for in-kind or financial rewards for exceptional results, which totalled CZK 79 mil. The chapters for the AS CR, Grant Agency and Technology Agency contain the costs for activities, while several other budget chapters contains funds for organising public competitions and evaluation of projects and expenditures for in-kind or financial rewarding of exceptional results, with these "operating" costs totalling CZK 2.065 bn. in 2018 (i.e. 5.9%). All chapters aside from the OG CR primarily include expenditures intended for distribution to individual entities carrying out RDI; in 2018 these funds were budgeted at CZK 32.653 bn.

In order to streamline and clarify communication with the individual budget chapters, several WGs were gradually set up since 2014 (Budget WG I–V), from which over the course of the following years a single WG of public support providers was consolidated. In an effort to achieve closer cooperation with the providers, the RDIC approved and appointed rapporteurs from among the RDIC members for individual RDI areas (and thus also for individual providers) at its special session on 7 September 2018.

The MEYS, as the central administrative authority responsible for R&D under the competent law as the provider of by far the highest proportion of RDI support from public funds (approximately 41% of the support from the SB) and as the managing authority of the OP RDE – the programme with the highest income from ESIF sources – has long had a considerable influence on the drafting of the RDI budget proposal. Aside from the exceptionally large volume of routine expenditures for organisations founded and run by the MEYS, MEYS also brings to bear specific items of extra-ministerial scope in the draft expenditures, namely expenditures for: (i) advancement of research organisations whose superior authority is not a provider of RDI support, (ii) international cooperation of the Czech Republic on RDI and (iii) support for major research infrastructure projects. Furthermore the MEYS is, for what is called the sustainability period, the provider of support to projects from the National Sustainability Programmes I and II (NSP I and II), whereby each of the centres built from OP RDI can obtain support under one project in NPU I or NPU II; in the future this sustainability support will be gradually shifted to the item of support for Research Organisation Development (ROD). In the case of ROD support for research organisations whose superior authority is not a provider of RDI support, after 2017 the situation was sorted out, with the competency for allocating ROD shifting back to their founders in most cases; thus in 2018 the MEYS actually only funded one extra-ministerial organisation, the founder of which is the State Administration of Land Surveying and Cadastre. The Ministry of the Interior (MI) also has a similar situation in terms of distributing ROD to extra-ministerial research organisations, allocating ROD to three extra-ministerial research organisations under the Ministry of Justice (MJ) and State Office for Nuclear Safety (SONS).

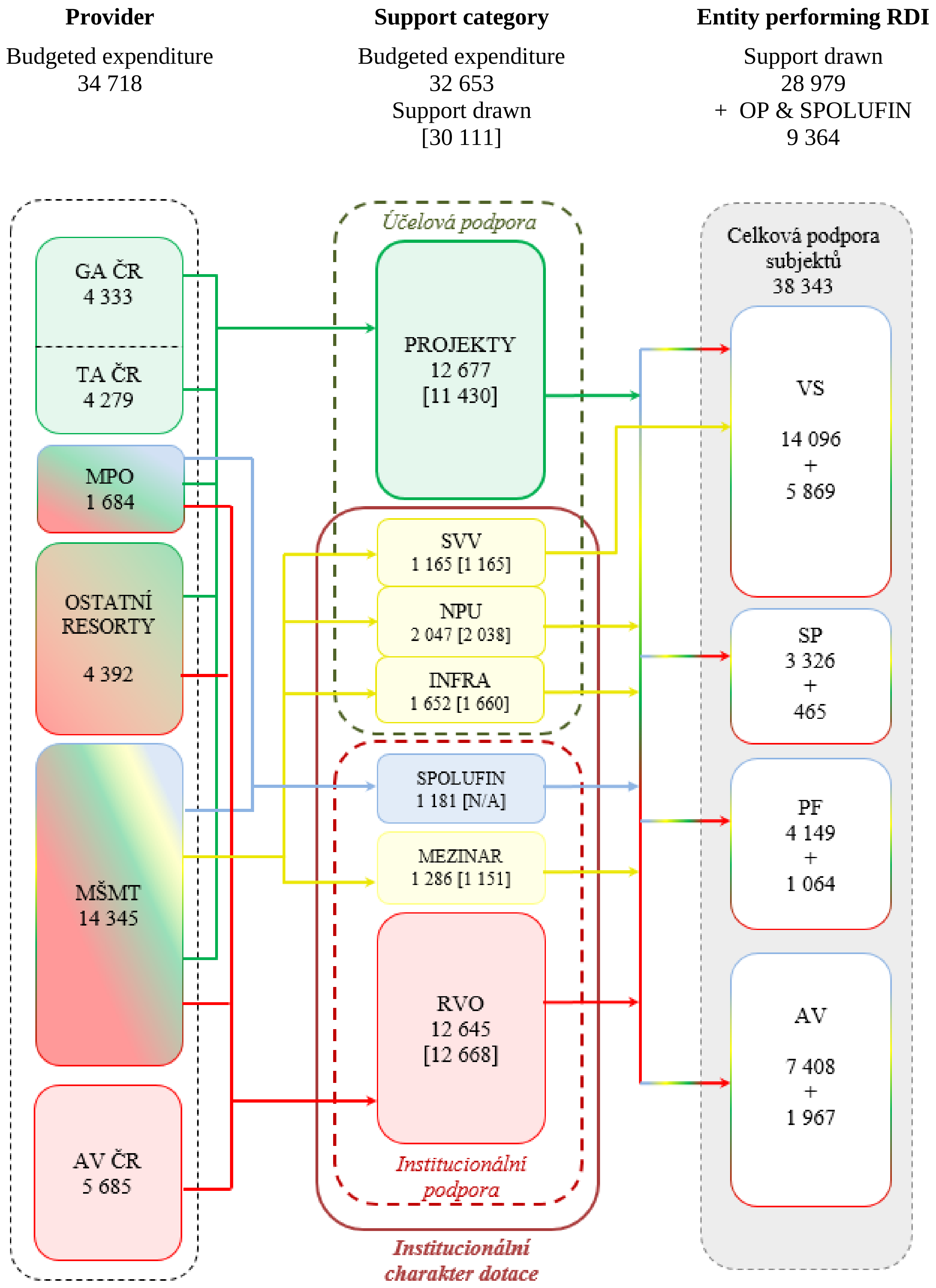
2.2 Categories of R&D support in the Czech Republic and structure of providers and beneficiaries

In 2018, SB funds were distributed to entities carrying out RDI via 14 providers, which is evident from Diagram 2.2. For distribution, the providers use the support categories defined by the Act on Support for Research, Experimental Development and Innovation. The majority of providers make use of programmes and grants (depending on whether they are going into basic or applied research) as the main categories for targeted support (PROJECTS) and funds for long-term conceptual development of research organisations as the main category for institutional support (ROD). The category of co-financing of RDI operational programmes from the SB (SPOLUFIN) is tied to structural funds in the field of RDI, thus it is managed by the MEYS and MIT. MEYS is also responsible for the remaining categories laid down by the Act on Support for RDI. This is support for major infrastructure (INFRA), international cooperation of the Czech Republic in R&D executed under international contracts (MEZINAR) and support for specific university research (SUR). The National Sustainability Programmes I and II (NSP) have particular significance and are targeted support programmes within the meaning of the Act on Support for RDI, but are intended to help ensure sustainability of projects funded from priority axes 1 and 2 of OP RDE (European Centres of Excellence, Regional Research and Development Centres), by which it differs significantly from other programmes.

By Act No. 457/2016 Coll., on the State Budget of the Czech Republic for 2017, RDI expenditures of CZK 32.66 bn. were approved, which represents an increase of CZK 3.57 bn. compared to 2016. In 2017, Act No. 474/2017 Coll., on the State Budget of the Czech Republic for 2018 managed to achieve a further significant year-on-year increase in the budget, despite the fact that when making the draft RDI budget, for the first time the RDIC took significant account of the amount of claims for unused expenditures by individual providers. The gross expenditure for 2018 rose by CZK 2.14 bn. (i.e. by 6.5%) to CZK 34.80 bn., with institutional expenditures increasing by CZK 0.83 bn. (i.e. 5.1%) and targeted expenditures by CZK 1.30 bn. (i.e. 8%). The greatest volume of increase was achieved for the TA CR (CZK 765 mil. or 23%), AS CR (CZK 552 mil. or 10.7%) and the MEYS (CZK 417 mil. or 3%).

Diagram 2.2 shows that individual groups of beneficiaries can make use of all categories of support from the SB with the exception of SUR, which is primarily intended for universities. Multi-source funding from several providers via various instruments has advantages for the beneficiary in the possibility of combining multiple funding sources based on the entity's needs in accordance with its strategy for conducting RDI. A high level of funding that is comprised of a large number of non-concurrent targeted support can cause financial instability for entities and prevent long-term strategic planning in terms of HR and research objectives. Moreover, in a situation where it is possible to combine many instruments from various providers, preventing duplications and multiplications in financing is highly complicated. For strategic planning of RDI budget expenditures at the national level, it is essential among other things to distinguish between various categories of support in terms of their potential benefit.

Diagram 2.2: Method of funding R&D from the state budget and volume of funds spent in 2018 (in CZK mil.)



GA CR 4 333	*Targeted support*	Overall support of entities 38 343
TA CR 4 279	PROJECTS 12 677 [11 430]	HE 14 096 + 5 869
MIT 1 684	SUR 1 165 [1 165]	SB 3 326 + 465
OTHER MINISTRIES 4 392	NSP 2 047 [2 038]	LN 4 149 + 1 064
MEYS 14 345	INFRA 1 652 [1 660]	Depts of AS CR 7 408 + 1 967
AS CR 5 685	SPOLUFIN 1 181 [N/A]	
	MEZINAR 1 286 [1 151]	
	ROD 12 645 [12 668]	
	Institutional support	
	Institutional nature of subsidy	

AS CR *– public research institutes established by the AS CR under Act No. 341/2005 Coll.;* ***HE*** *– institutions of higher education (public, state and private);* ***SB*** *– state budgetary organisations, organisational units of the state and public research institutes outside the AS CR and state universities;* ***LN*** *– legal and natural persons, individuals and institutions that do not fall under the above categories, e.g. joint-stock companies, limited-liability companies, charitable associations, foundations, citizens' groups*
PROJECTS *– grant or programme project;* ***SUR*** *– specific university research;* ***INFRA*** *– major research infrastructure projects;* ***NSP*** *– National Sustainability Programmes I and II;* ***SPOLUFIN*** *– co-financing of OPs;* ***MEZINAR*** *– international cooperation;* ***ROD*** *– long-term conceptual development of research organisations*

The Act on RDI Support clearly separates targeted and institutional funding, but some categories of support are included under targeted funding even though by their nature they are more institutional. From an analytic viewpoint it is more appropriate to include the categories SUR, INFRA and also NSP under institutional support, as the categories SUR, INFRA and NSP have a similar effect as ROD, i.e. supporting the stability and development of the research base.[6] In contrast, the category SPOLUFIN and in part also MEZINAR have more of a targeted character, because they are co-financed by projects selected on the basis of competition, nevertheless in the case of MEZINAR only CZK 34 mil. was drawn in the form of projects, while the remaining CZK 1.117 bn. was fees for the Czech Republic's participation in international R&D programmes and membership in international R&D organisations. Generally projects have specific objectives,

[6] The research base means human resources in RDI and research infrastructure within the meaning of Communication from the Commission 214/C 198/01 – Framework for State aid for research and development and innovation that are concentrated in organisations conducting research, development, innovation and knowledge transfer.

usually field-specific and pre-defined in strategic documents at the national or ministerial level[7] (an exception are projects focused on supporting what are called horizontal activities, e.g. international cooperation, excellence, competitiveness, etc.). The deciding factor for the project's success is not who receives the aid, but whether the target output is generated and whether the output is beneficial for the specific field of economic activity or society as a whole.

Diagram 2.2 also presents the quantified financial flows for 2018. It shows the distribution of expenditures into individual budget chapters in the amount approved by Act No. 474/2017 Coll., on the State Budget of the Czech Republic for 2018 (left column; not including the chapter for the OG CR, which is not actually a provider). The middle column shows the financial flows broken down into categories of support in the amount approved by the law, also displaying the drawn support reported in the RDI IS (in the square brackets). The diagram's right column then lists the financial volumes drawn by entities conducting RDI. The SB funds actually drawn by RDI entities in 2018[8] differ in total from the funds drawn for individual categories of support, with this difference totalling about CZK 1.132 bn. This difference arises after deducting the MEZINAR category in the right column, as over CZK 1.1 bn. was paid out directly to international organisations, plus another nearly CZK 16 mil. from the PROJECTS category was paid out to foreign entities. It is problematic to divide funds drawn in the case of operational programmes (OP RDE and OP EIC) into the EU part and the SB part (SPOLUFIN), as the data on record in the RDI IS reports the drawn aid together, thus in the right column it is added to the drawn support for the category OP and SPOLUFIN. Discrepancies in the actually drawn and legally approved support for individual categories can be explained by the inclusion of claims for unused expenditures, with another possible explanation of the final difference being a time lag in the process of distributing funding on the basis of results of public tenders from a previous period to projects from approved programmes.

In comparison with 2017 there was a CZK 2.095 bn. increase in the funds approved by law for support categories. The most marked increase took place in favour of the ROD category (year-on-year growth of CZK 1.516 bn. or 13.6%). The year 2017 was unique in that ten targeted aid programmes (mostly under the MEYS) ended at once. Despite this fact, the second highest increase in 2018 was recorded by the PROJECTS category (year-on-year growth of CZK 973 mil. or 8.3%), with this increase being primarily caused by the growth in allocation for TA CR programmes.

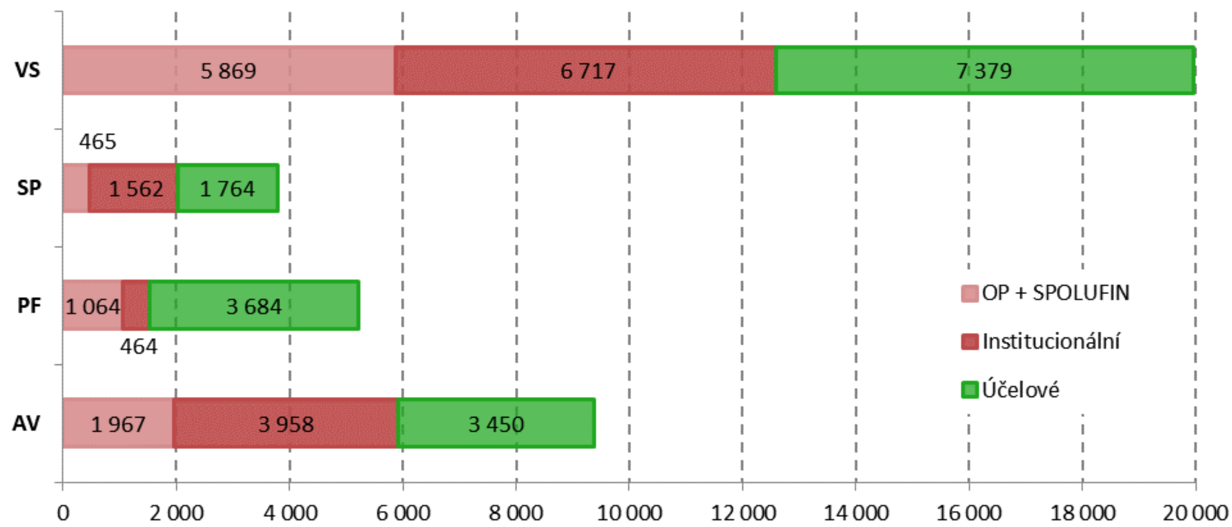
Specific volumes of institutional and targeted support within the meaning of the Act on RDI Support drawn in 2018 by individual groups of beneficiaries are presented in Figure 2.1. If we leave out the OP + SPOLUFIN category, the targeted component of support forms a predominant share

[7] E.g. *National priorities of oriented research, experimental development and innovation* approved by Government Resolution No. 552 of 19 July 2012, ministerial or intra-ministerial concepts for RDI development.

[8] Based on data from RDI IS exported 1 August 2019.

of the overall support for all groups of beneficiaries. In the case of businesses this fundamental predominance (71%) can be considered desirable; for public entities it indicates an increased risk of year-on-year instability in financing. The share of targeted funding for universities was 37% in 2018 and the share of targeted funding in the OP + SPOLUFIN category was 29%. For state budgetary organisations these shares were 47% and 12%. In the case of AS CR institutes, the share of drawn institutional support (without OP + SPOLUFIN) was 42% in 2018. Interpretation is significantly influenced by the inclusion of instruments of an institutional nature under targeted support and the uneven development in drawing of ESIF funds. For universities it is necessary to take into account multi-source funding including funds for educational activities, which are not included in the above ratios.

Figure 2.1: Volume of state budget funds and part of OPs drawn by groups of beneficiaries in 2018 (in CZK mil.)



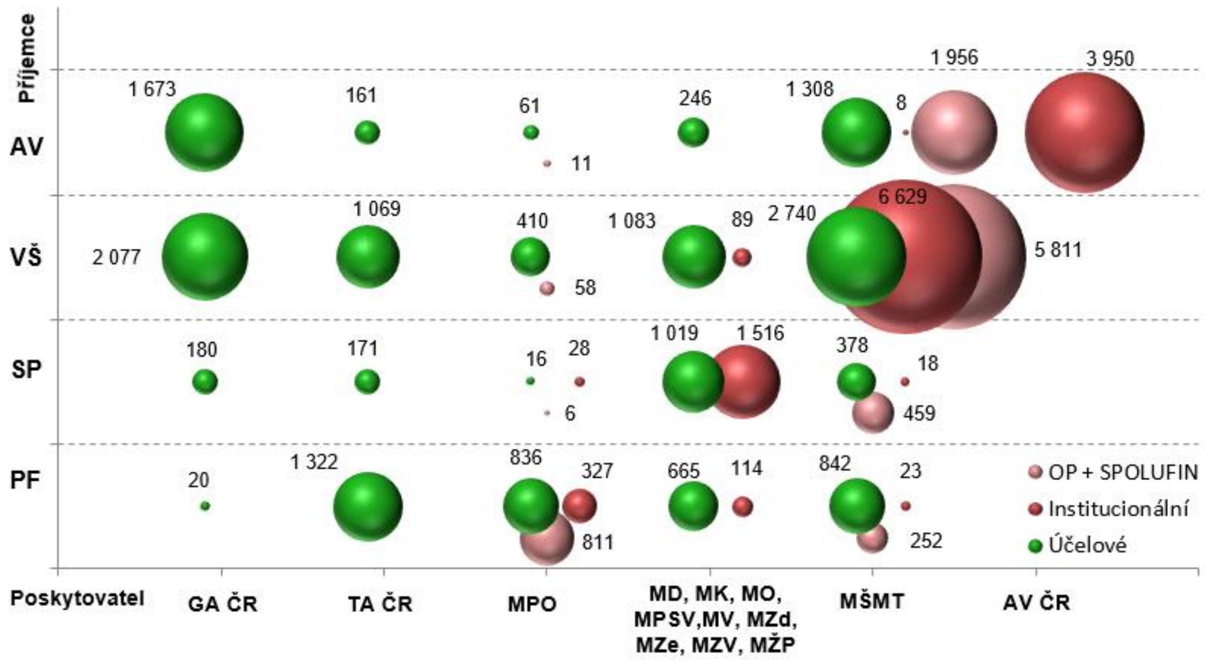
HE
SB
LN
AC

OP + SPOLUFUN
Institutional
Targeted

Source: RDI IS, export 1 August 2019 | Does not include funds earmarked for fees for Czech participation in international R&D programmes and membership in international R&D organisations.
***AS** – public research institutes established by the AS CR under Act No. 341/2005 Coll.; **HE** – institutions of higher education (public, state and private); **SB** – state budgetary organisations, organisational units of the state and public research institutes outside the AS CR and state universities; **LN** – legal and natural persons, individuals and institutions that do not fall under the above categories, e.g. joint-stock companies, limited-liability companies, charitable associations, foundations, citizens' groups*

The share of individual providers in funding groups of beneficiaries from the SB and part of OPs in 2018 can be seen in Figure 2.2.

Figure 2.2: Distribution of funds from state budget and part of OPs drawn by groups of beneficiaries in 2018 by individual provider (in CZK mil.)



Beneficiary
AS
HE
SB
LN

Provider GA CR TA CR MIT MT, MC, MD, MLSA, MI, MH, MA, MFA, ME MEYS AS CR

Source: RDI IS, export 1 August 2019 | Does not include funds earmarked for fees for Czech participation in international R&D programmes and membership in international R&D organisations.

In light of the position of the managing authority of OP RDE and OP EIC, for the MEYS and MIT the chart includes the category OP + SPOLUFIN. The highest amount from this category was drawn by universities (CZK 5.9 bn.), followed by institutes of the AS CR (CZK 2.0 bn.), businesses (CZK 1.1 bn.) and budgetary organisations (CZK 0.5 bn.). Targeted funds are obtained by all groups of beneficiaries from all providers with the exception of funds from the AS CR, as it provides institutional support (ROD) to its own institutes exclusively,[9] with this totalling nearly CZK 4 bn. in 2018. GA CR funds are primarily utilised by universities (CZK 2 bn.) and AS CR institutes (CZK 1.7 bn.). Support from the TA CR should go primarily to businesses (CZK 1.3 bn.), but to a significant extent it also went to universities (CZK 1.1 bn.). The MIT supports primarily businesses, both with targeted support (CZK 0.8 bn.) and institutionally via ROD (CZK 0.3 bn.). Nevertheless, a significant amount of MIT targeted support once again goes into universities

[9] Aside from institutional support, the budget chapter for the Academy of Sciences of the Czech Republic also includes operating costs – in 2018 this was CZK 1.738 bn., i.e. CZK 159 million more than in 2017.

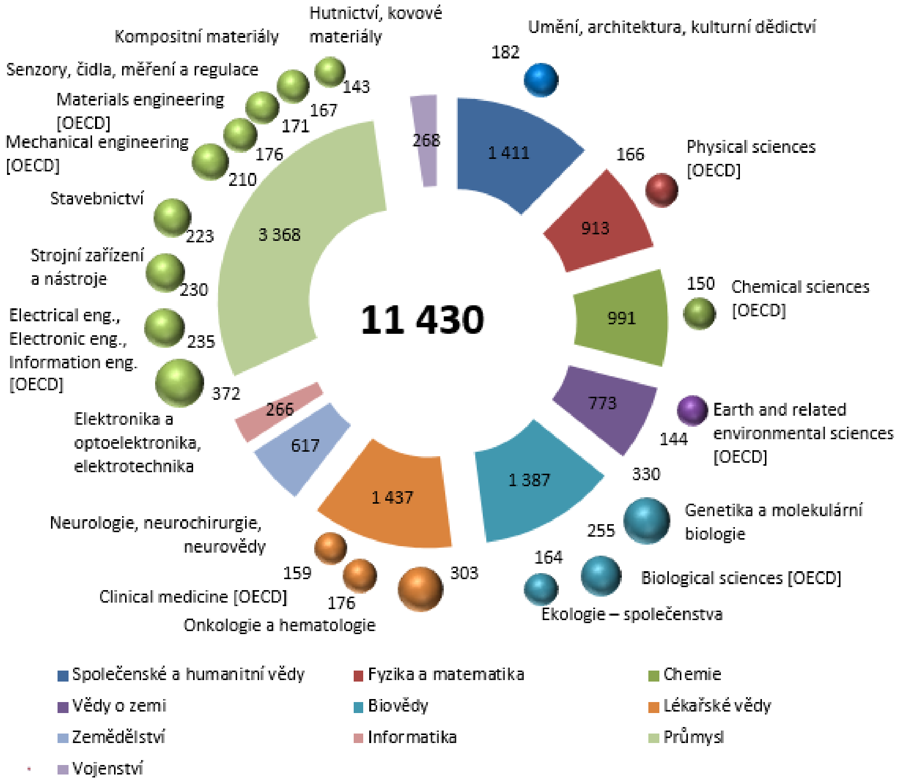
(CZK 0.4 bn.). The MEYS, which is the largest provider in terms of volume of funds distributed, distributes primarily institutional support to universities (CZK 6.6 bn., not including SPOLUFIN). MEYS targeted funds are utilised most by universities (CZK 2.7 bn.), at just under half that AS CR institutes (CZK 1.3 bn.), and also by businesses (CZK 0.8 bn.). Other ministries, i.e. the MT, MC, MD, MLSA, MI, MA, MH, MFA and ME, are focused primarily on the entities they have established (the group SB). They support them both institutionally (CZK 1.5 bn.) and with targeted aid (CZK 1 bn.), with the MT, MLSA, MFA and ME providing only support for ROD. Targeted support from these other ministries is, however, also successfully utilised by universities (CZK 1.1 bn.) and businesses (CZK 0.7 bn.). The low financial share of AS CR departments in drawing targeted support from the TA CR and other ministries could be an indication of its focus more on basic research than applied research.

2.3 Field structure of targeted support for research and development

The following subchapter presents data broken down into the field structure according to the code list introduced by the RDI IS; data for newly launched projects is currently being inputted in the structure of the OECD Fields of Research and Development. Shifting the code list into the OECD structure is also essential for implementing the national level of research organisation evaluation under the 2017+ Methodology, which was approved by a government resolution on 8 February 2017. It is assumed that the data from the RDI IS for the coming periods will be more useful analytically thanks to harmonisation of the codes.

Figure 2.3 shows the targeted support by field groups in 2018. Only funds for programme and grant projects are included (a total of 26 programmes and groups of grant projects, see Table 2.1 for the list), i.e. not including major research infrastructure projects and projects funded via the NSP that have an institutional character from an analytical standpoint.

Figure 2.3: Targeted support for PROJECTS from the state budget to groups of fields and individual fields in 2018 (in CZK mil.)



(clockwise)

Art, architecture, cultural heritage

…

…

…

Genetics and molecular biology

…

Ecology – communities

Oncology and haematology

…

Neurology, neurosurgery, neuroscience

Electronics, optoelectronics, electrical eng.

…

Machinery and tools

Construction

…

…

Sensors, measurement and regulation

Composites

Metallurgy, metal materials

Social Sciences and Humanities

Earth Sciences

Agriculture

Military

Physics and Mathematics

Life Sciences

Informatics

Chemistry
Medical Sciences
Industry

Source: RDI IS, export 1 August 2019 | Only fields whose support exceeded CZK 140 mil. in 2018 are included.

The targeted support for PROJECTS (CZK 11.4 bn.) attests to the success of the scientific teams of individual field groups and selected RDI fields in competitions for national funds. Interpretation is nevertheless limited by the specifics of the field breakdown in the RDI IS, a gradual shift to the new code list still being fine-tuned, and the focus of certain programmes on support for horizontal activities. From the example of the high level of support drawn for the Art, Architecture and Cultural Heritage field, it is also evident that certain fields within the field groups are preferred by the focus of the programme (NAKI II). From the perspective of the field focus of projects, the most strongly supported group of fields was Industry (CZK 3.4 bn.) followed by Medical Sciences (CZK 1.4 bn.), Social Sciences and Humanities (CZK 1.4 bn.) and Life Sciences (CZK 1.4 bn.). Financial support reaching nearly CZK 1 bn. was also reported by the Chemistry and Physics and Mathematics groups.

Figure 2.5 presents the distribution of funds for programme and grant projects to field groups by provider. The Industry group of fields is supported primarily through the programmes of the TA CR and MIT. Medical Sciences are supported predominantly from targeted support funds under the MH chapter and also from the GA CR chapter. Aside from the MC, Social Sciences and Humanities are also supported significantly by the GA CR. Grant support under the GA CR focuses the most on Life Sciences, Chemistry and Physic and Mathematics. Table 2.1 follows the budgeted support under the law, support allocated and actually drawn, as entered by individual providers into the RDI IS. By monitoring the differences between the budgeted and actually drawn support, disproportionally high claims for unused expenditures can be avoided and the process of preparing the draft SB expenditures on RDI can be streamlined. In the case of the BETA2 programme, large differences can be observed between the allocated and actually drawn support; such discrepancies also took place in the BETA programme, where unused expenditure claims were incorporated into other programmes under the TA CR chapter.

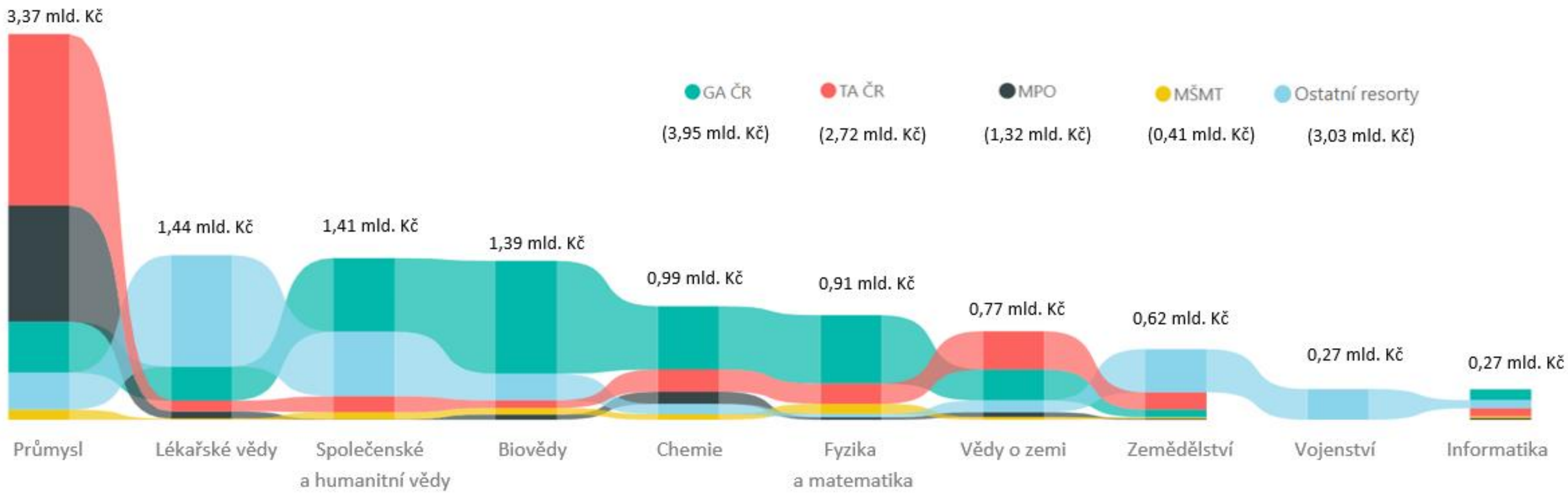
For an international comparison of the distribution of R&D expenditures by field, data was obtained from the OECD database from 2016. These data unfortunately do not contain information on the source of R&D expenditures, so it cannot be directly determined what part is solely public aid and thus targeted support for projects from the SB as per Figure 2.3. The overall R&D expenditures were at least divided up by sector of use. In the case of the government (GOVERD) and higher education (HERD) sectors, it can be assumed that public sources of funding for conducting R&D predominated (i.e. domestic public or public from abroad). In the public sector we can see that the most R&D expenditures in the Czech Republic went into the field Natural Sciences (50%), while for other countries the share of R&D funds for this field ranged between 20–40%. In the case of the business sector we can see a dominance of Engineering and Technology for all countries and a relatively large share of expenditures for the Natural Sciences field. The share of R&D expenditures in the public sector focused on the Medical Sciences field reached 10% in the Czech Republic, which is comparable to the majority of countries presented in Figure 2.4; only in the Netherlands was this share 2.5 times higher than in the Czech Republic. Research in the public sector focused on the remaining three fields of Agricultural and Veterinary Sciences, Social Sciences and Humanities and the Arts is balanced in the Czech Republic in terms of R&D expenditures. If we compare the distribution of share of funding in the public sector and the distribution of results by FORD field (Figure 7.7), in both cases the Natural Sciences and Engineering and Technology fields dominate, but the remaining distribution of number of results does not copy the composition of the share of funding. The breakdown of the share of results is closer to the share of funding in the case of the number of results in WoS published in Q1 and Q2 journals (see Figure 7.11); in comparison the Humanities field sticks out, which is due to the specifics of the field and the publication habits in our country in general.

Figure 2.4: Indicative international comparison of R&D expenditures by sector and scientific field (2016)

SECTOR: GOVERD and HERD
SECTOR: BERD

Source: OECD, own calculations and processing | Data for international comparison were only available for a limited number of countries; data for most EU states were lacking.

Figure 2.5: Targeted support for PROJECTS from the state budget for groups of fields in 2018 by provider (in CZK bn.)



GA CR (CZK 3.95 bn.) TA CR (CZK 2.72 bn.) MIT (CZK 1.32 bn.) MEYS (CZK 0.41 bn.) Other ministries (CZK 3.03 bn.)

Industry Medical Sciences Social Sciences and Humanities Life Sciences Chemistry Physics and Mathematics Earth Sciences Agriculture Military Informatics

Source: RDI IS, export 1 August 2019

Table 2.1: RDI programmes and groups of grant projects funded from the state budget in 2018 (in CZK mil.)

Provider	Programme name	Budget support for 2018 under Act No. 474/2017	Data submitted to RDI IS: Allocated support in 2018		Data submitted to RDI IS: Support drawn in 2018	
			State budget support	Total costs	State budget support	Total costs
GA CR	Standard projects	3 027.8	2 985.3	3 218.3	2 977.0	3 212.5
GA CR	Projects for supporting excellence in basic research	483.5	485.6	486.4	482.4	483.2
GA CR	International projects	129.1	80.4	88.1	80.4	88.1
GA CR	LA grants	73.0	30.6	31.8	30.6	31.9
GA CR	Junior grants	500.0	383.8	385.7	378.5	380.4
GA CR	Support for international cooperation in obtaining ERC grants	10.0				
MC	Programme for supporting applied research and experimental development of national and cultural identity for 2016–2022 (NAKI II)	425.0	509.1	510.5	495.4	497.0
MD	Development of the armed forces of the Czech Republic	333.8	375.5	375.5	356.2	356.2
MIT	TRIO	1 083.0	1 341.3	1 896.4	1 324.3	1 891.6
MEYS	ERC CZ	39.8	36.0	36.0	36.0	36.0
MEYS	Inter-Excellence	545.0	647.6	742.5	369.8	464.7
MI	Security research programme for the needs of the state 2016–2021	139.2	163.6	165.3	156.5	156.5
MI	Czech security research 2015–2020	400.0	446.9	481.1	436.8	477.2
MH	Programme for supporting applied medical research and development for 2015–2022	911.4	1 186.2	1 206.5	1 156.4	1 176.5
MA	Comprehensive sustainable systems in agriculture 2012–2018 "CSS"	270.0	269.2	330.0	268.7	329.5
MA	MA applied research programme "Earth" 2017–2025	156.1	156.3	161.9	156.1	161.7
TA CR	Programme for supporting applied research and experimental development ALFA	3.0	2.8	4.3	2.8	4.3
TA CR	Competence Centres	930.0	846.4	1 240.1	836.5	1 230.1

			Data submitted to RDI IS			
Provider	Programme name	Budget support for 2018 under Act No. 474/2017	Allocated support in 2018		Support drawn in 2018	
			State budget support	Total costs	State budget support	Total costs
	Support programme for cooperation in applied research and experimental development through joint projects of technological and innovation agencies DELTA	231.0	92.1	133.0	92.6	129.0
	Applied research, experimental development and innovation programme GAMA	245.0	166.3	169.3	140.6	143.6
	Programme for supporting applied research and experimental development EPSILON	1 691.5	1 286.8	2 141.2	1 244.5	2 073.4
	Programme of public contracts in research, experimental development and innovation for public administration BETA2	340.0	48.4	48.4	46.8	46.8
	Programme for supporting applied research ZETA	120.0	163.7	198.2	161.4	195.5
	Programme for supporting applied research, experimental development and innovation THETA	200.0	83.0	118.0	78.2	111.7
	Programme for supporting applied social science and humanities research, experimental development and innovation ETA	290.0	124.5	144.3	121.2	139.2
	Programme for supporting applied research, experimental development and innovation National Competence Centres	100.0				
Total		12 677.2	11 911.1	14 312.6	11 429.7	13 816.8

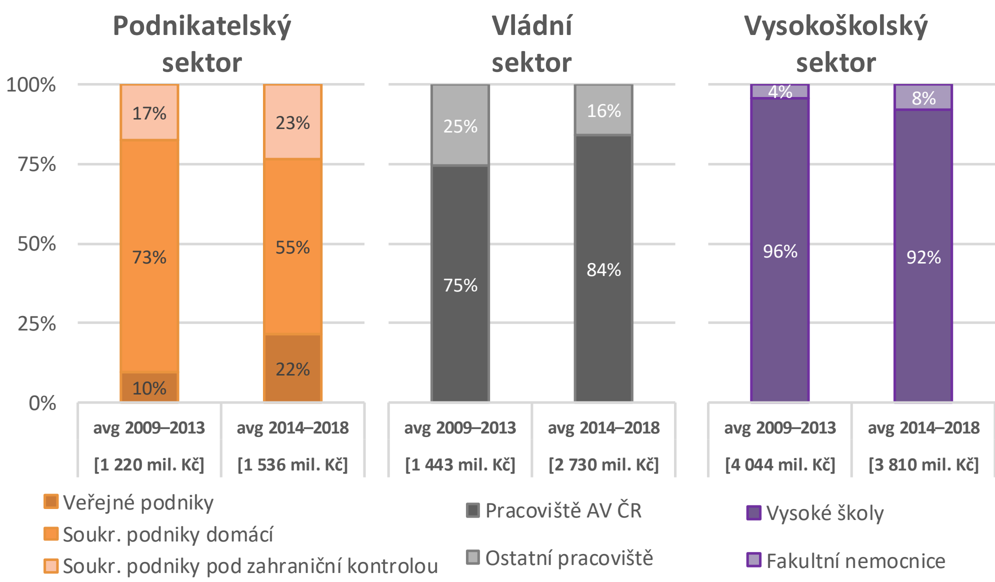
Source: RDI IS, export 1 August 2019; proposals for programmes and groups of grant projects approved by the government
The table does not include Major Infrastructure Projects for RVI (programme code LM), the National Sustainability Programme I (programme code LO) and National Sustainability Programme II (programme code LQ) due to their institutional character. Total costs = funding from all financial sources.

3 Support for research, development and innovation in the Czech Republic from European funds

In the case of the Czech Republic, foreign public resources from which R&D activities are funded consist primarily of income from the EU structural funds used for funding via individual operational programmes. For Czech R&D these are primarily two operational programmes: Operational Programme Enterprise and Innovation for Competitiveness (MIT) and OP RDE (MEYS), as well as Operational Programme Prague – Growth Pole of the Czech Republic (OP PGP), to a marginal extent (see Diagram 3.1). Foreign public resources also include other resources from the EU budget (particularly research framework programmes – currently H2020) and resources from international, government and public organisations outside the EU (CERN, ILL, ESA, NATO, OECD, UN, WHO, Norway/EEA etc.).

The development of foreign resources in the period between 2009–2018 was described in detail in Chapter 1. It can also be observed what research organisations in the Czech Republic made use of foreign public resources to finance their research activities (see Figure 3.1). The most successful group of entities carrying out R&D from the perspective of volume of funding from foreign public resources in the monitored period was the group comprising universities, followed by AS CR institutes and then private enterprises. According to the IS data, public RDI support totalling CZK 9.4 bn. was drawn from OP EIC and OP RDE in 2018. This amount includes both the amount from the EU and the amount from the SB (OP + SPOLUFIN), see Chapter 2 for more. According to the available data, higher education institutions obtained 62% of the CZK 9.4 bn. from OP EIC and OP RDE (OP + SPOLUFIN) in 2018, AS CR institutes 21% and businesses 11%.

Figure: 3.1: R&D expenditures from foreign resources by type of research organisation in 2009–2018 (CZK bn.)



Business sector Government sector Higher education sector

Public enterprises
Domestic private enterprises
Private enterprises under foreign control

AS CR institutes
Other workplaces

Universities
University hospitals

Source: CZSO, own compilation

3.1 Framework of research, development and innovation support from European Structural and Investment Funds in the Czech Republic

For the 2014–2020 period, a budget of EUR 351.8 bn. was earmarked for fulfilling the goals of the Economic, Social and Territorial Cohesion Policy (32.5% of the overall EU budget), which is allocated under five European Structural and Investment Funds (ESI Funds, ESIF). In addition to the ERDF, ESF and Cohesion Fund (CF), in 2014–2020 this group also includes the EAFRD and EMFF.[10] Under the cohesion policy, 11 thematic objectives (TO) were set out. These dictate the areas on which the ESIF must focus in all Member States through interventions defined in operational programmes.

The Partnership Agreement (PA) is the umbrella document for drawing ESIF for the 2014–2020 programming period in the Czech Republic. This document analyses the socioeconomic situation, development needs and potential of the Czech Republic. The PA defines the priorities, objectives, expected results and basic starting points that, if respected, can lead to maximum complementarity and synergy (material, financial and chronological concord) not only among ESIF programmes, but also with other EU financial instruments and potentially national programmes as well. The PA links to the strategic documents at the EU level (Europe 2020 Strategy) and the national level (e.g. the National Policy for Research, Development and Innovation and the National RIS3 Strategy, the creation of which was a pre-condition for drawing funding from the ESIF in this programming period).

As part of the introductory analysis of the PA, the following six key problems for the research and innovation system in the Czech Republic were identified:

- insufficient quality and international openness of research
- weak focus of research on benefit for society
- low level of application of R&D results in innovations
- shortage of quality human resources for R&D
- insufficient quality of research management at national and institutional level

[10] Partnership Agreement for the 2014–2020 programming period

- insufficient utilisation of R&D results in agriculture[11]

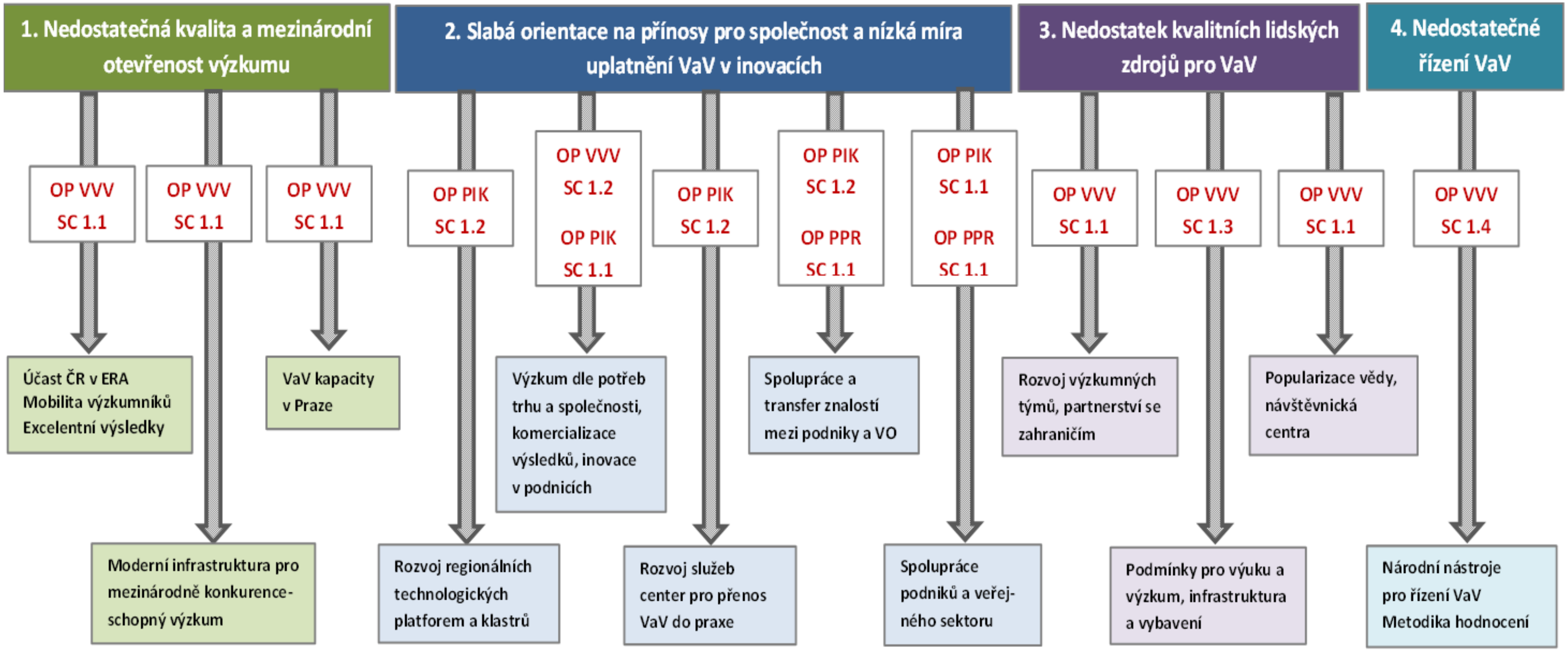
ERDF funds totalling over EUR 2.4 bn. were earmarked for the Czech Republic for supporting resolution of the above issues and achieving objectives (total EU support also including performance reserve),[12] which are provided via the operational programmes OP RDE, OP EIC, and OP Prague – Growth Pole of the Czech Republic.[13] Diagram 3.1 displays the problematic areas and needs for RDI development and the link between interventions and the aforementioned operational programmes.

[11] Partnership Agreement in 2014–2020 programming period. (4th revision, March 2018), pp. 30–35.

[12] Thematic Objective 1 in the Czech Republic is also supported from the European Agricultural Fund for Rural Development (approximately EUR 76 mil.). Also processed in the Analysis are data relating to allocations under ERDF.

[13] Partnership Agreement in 2014–2020 programming period. (4th revision, March 2018), pp. 133–135.

Diagram 3.1: RDI problems and development needs, support from operational programmes in 2014–2020



1. Insufficient quality and international openness of research			2. Weak focus on benefits for society and low level of R&D application in innovations					3. Insufficient quality of human resources in R&D			4. Insufficient management of R&D
OP RDE SO 1.1	OP RDE SO 1.1	OP RDE SO 1.1	OP EIC SO 1.2	OP RDE SO 1.2 OP EIC SO 1.1	OP EIC SO 1.2	OP EIC SO 1.2 OP PGP SO 1.1	OP EIC SO 1.1 OP PGP SO 1.1	OP RDE SO 1.1	OP RDE SO 1.3	OP RDE SO 1.1	OP RDE SO 1.4
Czech participation in ERA Mobility of researcher		R&D capacities in Prague		Research by needs of market and society, commercialisation of results,		Cooperation and knowledge transfer between		Developing research teams, international		Popularisation of science, visitors' centres	

s Excellent results				innovation in businesses		businesses and RO		partnerships			
	Modern infrastructure for internationally competitive research		Development of regional technological platforms and clusters		Expanding services of centre for putting R&D into practice		Collaboration between businesses and public sector		Conditions for teaching and research, infrastructure and equipment		National instruments for R&D management Evaluation methodology

Notes: *OP RDE* *SC 1.1: Increasing international quality of research and results thereof*
SC 1.2: Building capacity and boosting long-term cooperation of ROs with application sphere
SC 1.3: Improving quality of infrastructure for research-educational purposes
SC 1.4: Improving strategic management of research at the national level
OP EIC *SC 1.1: Increasing innovation performance of enterprises*
SC 1.2: Increasing intensity and effectiveness of cooperation in R&D
OP PGP *SC 1.1: Higher level of intersectorial cooperation stimulated by regional government*
SC 1.2: Easier creation and development of knowledge-intensive companies

Source: Partnership Agreement; European Structural and Investment Funds 2014–2020 in a Nutshell. MRD, 2017 (own compilation)

A precondition for fulfilment of the EU regional and cohesion policy and objectives of the Europe 2020 strategy is the National RIS3 Strategy, which aims to effectively aim European funds at boosting innovative activity. The financing of this strategy includes funds from OP RDE, OP EIC and OP PGP. The current state of disbursement and level of implementation is described in more detail in Chapter 4 – Implementation of the National Research and Innovation Strategy for Smart Specialisation of the Czech Republic.

The primary objective of **OP RDE** is to help move the Czech Republic towards an economy based on an educated, motivated and creative workforce, and on producing quality research results and utilising them to increase the country's competitiveness. The managing authority is the MEYS. The programme **OP PGP** is designed to ensure effective realisation of investments in Prague that will lead to increased competitiveness of Prague as a growth pole of the country and help ensure the quality of life of its inhabitants. The managing authority is the City of Prague. Achieving a competitive and sustainable economy based on knowledge and innovation is the main goal of the **OP EIC**. The managing authority is the MIT.

Member States are obliged to inform about whether the funds spent via the ESI Funds are helping to meet the objectives laid down in the PA through summary reports which they submit to the European Commission twice per programming period (2017 and 2019). The source of information on drawing of ESIF for 2014–2020 is the "Quarterly Report on Implementation of ESI Funds in the Czech Republic and Fulfilment of Funding Priorities" (hereinafter "QR"), which is issued by the Ministry of Regional Development (MRD) – National Coordination Authority (MRD-NCA). In the fourth QR for 2018, in the part that summarises fulfilment of the Partnership Agreement funding priority "FP 03 – a research and innovation system based on quality research linked to the application sphere and leading to commercially exploitable results" it is stated that 67 projects were realised for strengthening long-term cooperation between research organisations and the application sphere, for which CZK 833 mil. was paid out. At the same time implementation of 1 612 innovations was promised in legal acts. The revenues of the support businesses achieved as a result of the implemented innovation exceeded the target amount severalfold and reached over CZK 11 bn. The OP RDE is focused primarily on supporting basic research and increasing the quality of the research environment. 164 projects with a volume of nearly CZK 19.5 bn. were supported for increasing excellence and the international openness of research, with funds exceeding CZK 7.2 bn. paid out. In December 2018, two calls were announced for supporting major research infrastructure projects, with a total of CZK 3 bn. earmarked for them. The number of international patent applications (PCT) in beneficiary commitments reached 130.

3.2 HORIZON 2020 framework programme

The main EU instruments for funding research and innovation at the European level are the framework programmes. For 2014–2020, H2020 has an approved budget of EUR 77.028 bn. and the budget for the EURATOM programme totals EUR 1.603 bn. H2020 is focused in particular on research excellence and more massive support for innovation, placing an emphasis on linking research and innovation in connection with the market, creating business opportunities, social impact and collaboration among teams within the EU and outside it. The objective of the H2020 programme is to support economic growth and create new jobs by helping to build a society and economy founded on knowledge and innovation. Complementarity with ESIF is encouraged.

The structure of the H2020 is made up of three main, mutually supportive priorities (pillars): (i) Excellent Science (EUR 24.4 bn.); (ii) Industrial Leadership (EUR 17 bn.) and (iii) Social Challenges (EUR 29.7). Also supported are what are called horizontal areas: (iv) Spreading Excellence and Widening Participation (EUR 0.8 bn.) and (v) Science with and for Society (EUR 0.5 bn.). The budget for the H2020 framework programme and the structure of priority areas along with the allocations converted roughly into CZK are listed in Table 3.1. The programme is open to the broadest possible range of participants, not just from EU countries, but also from other countries offering cooperation on R&D. According to the interim evaluation from March 2019 (TC AS CR report[14]) of H2020 and EURATOM, the recommended financial support reached EUR 41.123 bn., which is only 52.3% at this advanced stage of the programme. Meanwhile, in many respects, the Czech Republic's possibilities remain even below this unsatisfactory average. For each EUR 1 invested in the H2020 programme, an amount more than 1/3 lower is returned through Czech research teams, i.e. EUR 0.59. Consideration of the "financial effectiveness of the Czech Republic's participation" once again leads to the conclusion that the Czech Republic invests more in the FP than it receives from it.

Table 3.1: Horizon 2020 budget

	Abbrev.	% of total budget	EUR mil.	CZK mil.*
Excellent Science		**31.73**	**24 441**	**647 687**
European Research Council	ERC	**17.00**	**13 095**	
Future and Emerging Technologies	FET	**3.50**	**2 696**	

[14] TC AS CR (2018) see: https://www.tc.cz/cs/storage/76c563961ab6afa1c4bedd0ef8837f7cc87a7143?uid=76c563961ab6afa1c4bedd0ef8837f7cc87a7143 [accessed 2019-11-30].

	Abbrev.	% of total budget	EUR mil.	CZK mil.*
Marie Skłodowska-Curie Actions	MSCA	**8.00**	**6 162**	
Research Infrastructures	INFRA	**3.23**	**2 488**	
Industrial Leadership		**22.09**	**17 016**	**450 924**
Leadership in Enabling and Industrial Technologies	LEIT	**17.60**	**13 557**	
Access to Risk Finance	RISKFIN	**3.69**	**2 842**	
Innovation in Small and Medium Enterprises	SME	**0.80**	**616**	
Societal Challenges		**38.53**	**29 679**	**786 494**
Health, Demographic Change and Wellbeing	HEALTH	**9.70**	**7 472**	
Food Security, Sustainable Agriculture and Forestry, Marine and Maritime and Inland Water Research, and the Bioeconomy	FOOD	**5.00**	**3 851**	
Secure, Clean and Efficient Energy	ENERGY	**7.70**	**5 931**	
Smart, Green and Integrated Transport	TPT	**8.23**	**6 339**	
Climate Action, Environment, Resource Efficiency and Raw Materials	ENV	**4.00**	**3 081**	
Europe in a Changing World – Inclusive, Innovative and Reflective Societies	SOCIETY	**1.70**	**1 309**	
Secure Societies: Protecting Freedom and Security of Europe and its Citizens	SECURITY	**2.20**	**1 695**	
Science with and for Society	**SEWP WIDENING**	**0.60**	**462**	**12 243**
Spreading Excellence and Widening Participation	**SWAFS**	**1.06**	**816**	**21 624**
European Institute of Innovation and Technology (EIT)	**EIT**	**3.52**	**2 711**	**71 842**
Non-Nuclear Direct Action of the Joint Research Centre (JRC)	**JRC**	**2.47**	**1 903**	**50 430**
TOTAL EU H2020 CONTRIBUTION 2014–2020		**100.00**	**77 028**	**2 041 242**
Nuclear fusion – indirect actions		**45.42**	**728**	
Nuclear fission – indirect actions		**19.68**	**316**	
Direct actions of the Joint Research Centre		**34.90**	**560**	
EURATOM 2014–2018		**100.00**	**1 603**	**42 480**

**rough conversion at rate EUR 1=CZK 26.5*
Source: European Commission, TC AS CR

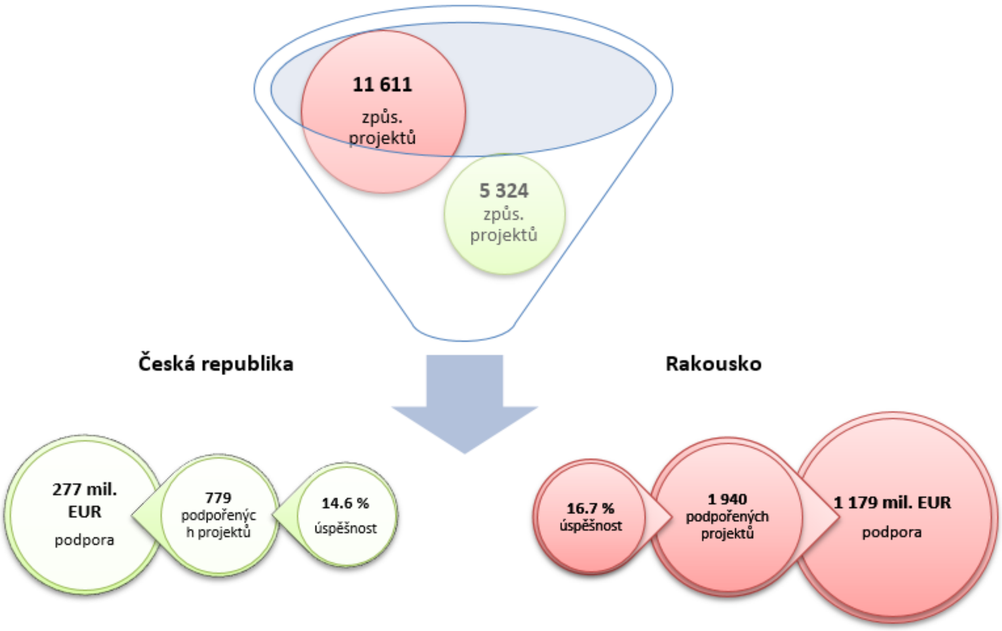
ANALYSIS OF PROJECT AND FINANCIAL SUCCESS RATE OF THE CZECH REPUBLIC UNDER H2020[15]

For a basic comparison of the project and the financial success rate of the Czech Republic, Austria was chosen, seeming to be a suitable benchmark for comparing the position of the Czech Republic and for a potential direction of the Czech Republic in terms of

[15] This analysis was conducted on the basis of data sent by the TC AS CR and another starting point was the evaluation report of the TC AS CR.

participating in the H2020 programme so that the Czech Republic could become a country that increases its competitiveness and the competitiveness of the EU as a whole. The following Figure 3.2 depicts the project and financial success rate of proposed H2020 projects for the Czech Republic and AUT.

Figure 3.2: Project and financial success rate of proposed H2020 projects, comparison of CZE and AUT



eligible projects
Czech Republic Austria

EUR 277 mil. support
779 supported projects
14.6% success rate

16.7% success rate
1 940 supported projects
EUR 1.179 bn. support

Source: TC AS ČR, data extracted from E-CORDA database as of 13 March 2019

The overall budget for the H2020 programme and EURATOM is CZK 2.084 trillion (see Table 3.2). The Czech Republic and AUT have a higher project success rate than the average value for all participating states, both having relatively close project success rate values (CZE: 14.6%; AUT: 16.7%). Austria, however, submits almost 60% more projects for assessment than the Czech Republic, which is then reflected in the overall amount recommended for funding, which is nearly 4.3 times higher in Austria. According to the available data, Austria has thus obtained financial support of CZK 31.4 bn., while in comparison the Czech Republic has received a mere CZK 7.3 bn. The Czech Republic is unfortunately at a disadvantage compared to Austria and other E-15 Member States in that this is just the 4th framework programme it is taking part in (i.e. since 1999, with the first framework programme having been launched in 1984). Our low participation in FPs is caused by low involvement in preparing project proposals, which is not the result of low quality of Czech research teams and workplaces, but their capacities likely being focused on other activities (e.g. researching projects funded from ESIF or the SB). The Czech Republic should focus on building relationships with foreign partners and creating strong ties that in the future could increase the Czech Republic's participation and success rate in the forthcoming Horizon Europe framework programme. The MEYS has an important role in negotiating the new framework programme, as it is representing the Czech Republic in talks. More detailed information on current preparations for the new framework programme are listed at the conclusion of this chapter.

Table 3.2: Project and financial success rate of proposed H2020 projects, comparison CZE and AUT

	H2020 in total	of which	
		CZE	AUT
Project proposals			
Number of project proposals	190 866	5 324	11 611
Number of projects recommended	23 055	779	1 940
Project success rate (%)	12.08	14.63	16.71
National share	100	3.38	8.41
Recommended financial support			
Proposed financial support (EUR mil.)	288 531	2 237	7 179
Recommended financial support (EUR mil.)	41 123	277	1 179
Financial success rate (%)	14.25	12.38	16.42
National share	100	0.67	2.87
Rough conversion at rate (EUR 1 =CZK 26.5)			
Proposed financial support (CZK mil.)	7 646 072	59 281	190 244
Recommended financial support (CZK mil.)	1 089 760	7 341	31 244
Budget H2020 + EURATOM (EUR mil.)	78 631		
Budget H2020 + EURATOM (CZK mil.)	2 083 722		

Source: TC AS CR, data extracted from E-CORDA database as of 2019-03-13
Note: The table provides financial data for the 2014–2018 period.

Figure 3.3 below provides a comparison of the success rate of the Czech Republic with Austria and the average of all participating states (ALL)[16] by individual pillars and priority areas. In terms of the volume of financial support, the most important thematic areas for

[16] The approach to the H2020 programme can differ for individual countries, which can distort the situation in comparing average values for all states, nevertheless for a basic comparison this indicator can be utilised.

allocation are under the pillars Excellent Science, Industrial Leadership and Societal Challenges. The Czech Republic has so far recorded a lower project success rate than Austria in the thematic areas of these pillars with the exception of three (INFRA, ICT and FOOD). At the same time, it must be mentioned that Austria surpasses the average of participating countries in project success rate in most activities. In the Excellent Science pillar the Czech Republic achieved better results than Austria in terms of project success rate (ratio between number of submitted project proposals and number of projects commenced) in the thematic area INFRA, which is focused on research infrastructure (CZ 52%, AT 35%). In this area Austria did, however, obtain higher absolute financial support (projects recommended for funding). In the other thematic areas of this pillar the Czech Republic achieved a lower success rate compared to Austria. In the thematic area European Research Council (ERC), the Czech Republic registered a below-average project success rate, while Austria achieved a higher success rate than the average of participating countries. Participation in ERC projects is generally considered an indicator of the quality of scientific institutions, or even an important indicator of national research as a whole, and for this reason Chapter 3.2.1 is dedicated to this priority area. In the thematic area Future and Emerging Technologies (FET), the Czech Republic had average success, while Austria registered an above-average success rate. Austria was also more successful than the Czech Republic in activities focused on human resources (Marie Sklodowska-Curie Actions – MSCA).

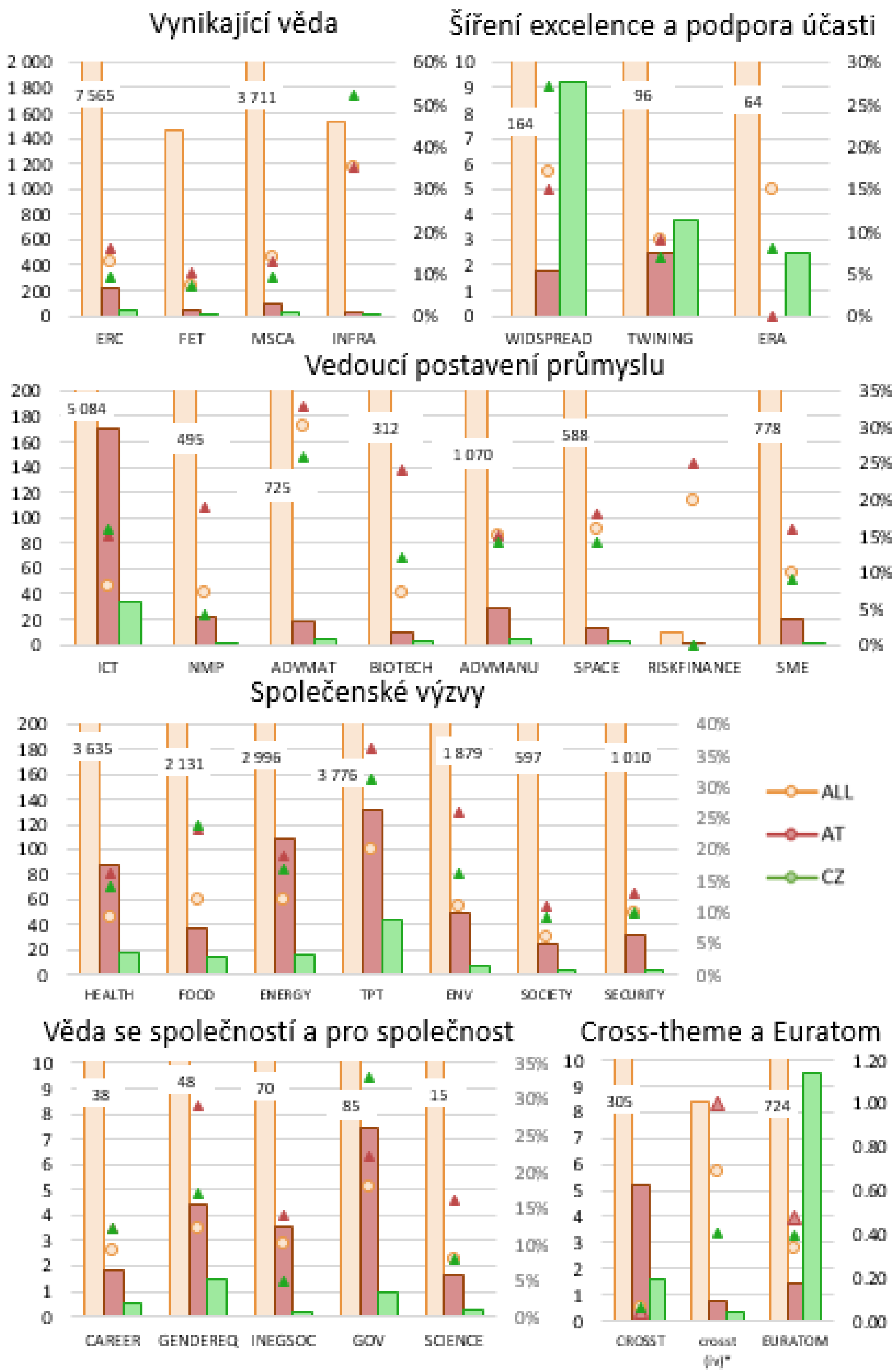
In the Industrial Leadership pillar, the most funding is allocated for the thematic area Leadership in Enabling and Industrial Technologies (LEIT). Of these technologies, the most financially significant for the Czech Republic was Information and Communication Technologies (ICT), for which the Czech project success rate is slightly higher than in the case of Austria (CZ 16%, AT 15%). The success rate of both observed countries ranged above the European average. In the areas Advanced Materials (ADVMAT) and Advanced Manufacturing Systems (ADVMANU), the Czech Republic was above the overall average in project success rate, but Austria was more successful even in terms of absolute financial support for projects recommended for funding. In Nanotechnologies (NMP) and Biotechnologies (BIOTECH) the Czech project success rate lags significantly behind Austria, with Austria having achieved considerably better results in these areas than the overall average. The Czech Republic submitted four projects in the area Access to Risk Finance (RISKFINANCE) – support for start-ups in all phases of their development through debt and equity financing; unfortunately, none were supported. A weak point of the RDI system in the Czech Republic is insufficient venture capital investment in innovative business, which is also evidenced by the values of the composite indicator SII (for more see Chapter 8). Success in this area could thus be important in the future in terms of meeting the objectives of the 2019+ Innovation Strategy.

In the pillar of Societal Challenges, the Czech Republic achieves a lower project success rate than Austria in all activities aside from the thematic area FOOD focused on food security, sustainable agriculture, marine research and the bioeconomy. With a project success rate of 24% the Czech Republic was slightly more successful in this area than Austria, which had a success rate of 23%. For the other activities under this pillar the Czech Republic achieved worse results in project success rate than Austria, but for almost all activities it was above the average of other countries. For the area focused on Protecting Freedom and Security in Europe (SECURITY) it is at the average level.

Of the other H2020 horizontal activities, the Czech Republic was highly successful in the Euratom Programme 2014–2018, where it had 39 out of 101 submitted projects recommended for funding. Entities from the Czech Republic thus received support of EUR 9.477 mil. Austria only submitted 17 projects in this area, with eight recognised as qualified for funding, and its total amount was EUR 1.448 mil.

In the field of Spreading Excellence and Widening Participation, the Czech Republic managed to achieve an 8% project success rate and acquired financial support of nearly EUR 2.5 mil. under the measure ERA CHAIRS (ERA), which is focused on accepting excellent scientific workers to universities and research institutions that have a high potential for developing research excellence (Austria did not participate in this measure). In the area focused on Teaming among excellent research organisations and regions that have a lower effectiveness level in research (WIDESPREAD), the Czech Republic had a significantly higher project and financial success rate than Austria. From the perspective of financial support obtained, the Czech Republic was also more successful in the field focused on partnership of research organisations (TWINNING). Under the activity Science with and for Society, the Czech Republic took part in five of eight sections, with the financial support it received totalling EUR 3.41 mil.

Figure 3.3: Project and financial success rate of the Czech Republic in the H2020 programme by individual pillar in international comparison (EUR mil.)



Excellent Science	Spreading Excellence and Widening Participation
Industrial Leadership	
Societal Challenges	
Science with and for Society	Cross-theme and Euratom

Source: TC AS CR, data extracted from E-CORDA database as of 2019-03-13 | Left vertical access: financial support in the EUR mil., right vertical axis: projects success rate in %; crosst (iv) Spreading excellence and* *widening participation – crosst. Not captured in the graphs are the priority areas in which the Czech Republic has not yet participated (not having had any Eligible Proposals): Pillar IV – IPNET, PSF, Pillar V – RESACCESS, IMPACT, KNOWLEDGE, Cross-themes: (i) Excellent Science – crosst; (ii) Industrial Leadership – crosst; (iii) Societal Challenges – crosst; (iv) Spreading excellence and widening participation – crosst (v) Science with and for Society – crosst, and also no cross-theme yet captured (ii) Industrial Leadership – crosst, in which the Czech Republic had zero success.*

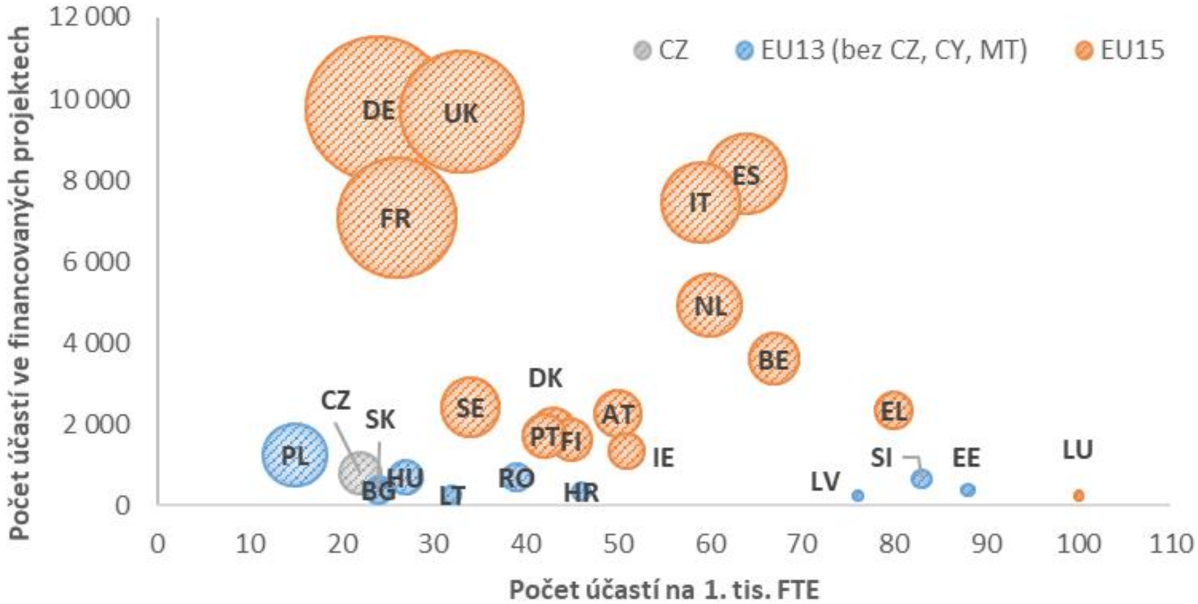
According to the analytic studies of the European Commission and the TC AS CR, the Czech Republic still numbers among the EU Member States with the lowest participation in FPs. Considering that the budget for the next framework programme Horizon Europe has been significantly increased (EUR 100 bn.), it is advisable that the Czech Republic make such interventions so as to help raise the participation of Czech scientists in European research. In May the TC AS published a comprehensive analysis of the Czech Republic's participation in H2020; selected conclusions are published in the following subchapter.

SELECTED CONCLUSIONS FROM THE ANALYSIS OF THE TC AS (2019)

According to the conclusions of the TC AS CR analysis (2019), the Czech Republic is unfortunately underrepresented in H2020 projects, with only 22 participations per 1 000 researchers (FTE). The Czech Republic thus lags considerably behind countries with a similar research capacity such as AT, FI, DK and PT, as well as most of the EU 13 countries (Figure 3.4). The total number of Czech teams endeavouring to participate in H2020 was not only lower in absolute numbers than countries with a comparable population (BE, SE, EL, AT, PT, HU), but also lower than much smaller countries such as IE and SI. The low participation of Czech scientists is thus reflected in the permanently low values of many indicators assessing our activity within them. Of course, the criterion of success rate alone does not necessarily indicate the importance of the teams involved in the programmes. It depends on the type of project, the structure of participants and the budgets of the individual projects. At the same time, it must be assumed that "overall success rate" summarises the success of all projects or participants regardless of whether their contribution to the project consisted of extensive research activities of fundamental importance or of participation in a research training network (e.g. travel expenses).

Figure 3.4 Activity and financial contribution of EU Member States in the H2020 programme

Number of participations in funded projects



CZ EU 13 (not including CZ, CY, MT) EU 15

Number of participations per 1 000 FTE

Source: taken from TC AS CR (2019)

Note: The graph is based on data that concern participants in funded projects in the role of EU contribution beneficiaries. The vertical axis presents the number of participations of the given Member State in H2020 projects, the horizontal axis the number of participations per 1 000 scientific and academic workers of the given EU state (FTE). The size of the circle corresponds to the number of researchers of the given EU state. The graph does not show the very small European countries of CY and MT, which have a specific structure to their R&D systems. Source: e-CORDA H2020 projects and participants – 2018/06/01, Eurostat: number of researchers – full-time equivalent (FTE) – data from 2016, (FR and PL data from 2015), produced by TC AS CR.

The largest part of the budget for the H2020 programme goes to the priority Societal Challenges. The Czech Republic successfully took part in all seven identified Priority Areas. The Czech Republic has the most funded projects in the field of ENERGY, followed by FOOD, HEALTH, ENV, SOCIETY and SECURITY. International nuclear research projects under EURATOM are a traditionally successful area for the Czech Republic.

The composition of Czech participants in H2020 is characterised by a large proportion of teams from the higher education and research sector (57%), followed by SMEs, which applied most of their project proposals through the SME instrument.

Czech coordinators coordinate a minimum of projects focused on RIA[17] and IA[18] based on the cooperation of major international consortia. In H2020, 11% of Czech teams

[17] Research and Innovation Actions are projects focused on a broad spectrum of activities in the field of both basic and applied research and technological development with the aim of acquiring new knowledge, testing the viability of new/perfected technologies, procedures, products or services.

took part in project proposal preparations in the role of coordinator. The low number of project coordinators is a long-term problem not only of the Czech Republic, but of essentially all the EU 13 states. Moreover, according to a more detailed analysis, coordinators from EU 13 states including the Czech Republic submit a considerably lower proportion of high-quality project proposals than in the case of the EU 15 states.

As in the past, what is utterly essential and key for the Czech Republic is cooperation with the most important European scientific institutions. The Czech Republic numbers among the 13 countries that spend almost 49% of their costs in projects with "top" institutions, and among the EU 13 it is one of those that utilise this cooperation more intensively than most others. The presence of top institutions in research consortia when preparing project proposals unequivocally increases the quality of the project proposal and thereby its chance for realisation and obtaining a financial contribution from the H2020 budget. The experience acquired in cooperation with the best in research is irreplaceable and H2020 creates an ideal opportunity for this. In this regard the Czech Republic's position in the EURATOM programme is exceptional (particularly in the part dealing with nuclear fission). The Czech Republic is clearly one of the most active and most successful countries in the EU 28 in this. The Czech Republic is also relatively successful in entering projects of Joint Technology Initiatives (JTIs), which number among the instruments of support for forming strategic partnerships between the public research sector and business for supporting research, development and innovation activities.

PREPARATION OF A NEW FRAMEWORK PROGRAMME FOR 2021–2027

On 7 June 2018, the European Commission presented a proposal for a framework programme for research, development and innovation for 2021–2027. A budget of nearly EUR 100 bn. has been proposed for the Horizon Europe programme and additional Euratom programme. EUR 97.6 bn. will be allocated for Horizon Europe (of that EUR 3.5 bn. for the InvestEU fund) and 2.7 bn. is earmarked for Euratom. Horizon Europe links up to H2020, but brings the following innovations:

- **European Innovation Council** – financial support for high-risk breakthrough innovations that could create new market opportunities
- **New EU-wide research and innovation objectives (missions)** – these objectives will be focused on the societal and economic challenges faced by individual states.

[18] Innovation Actions are projects comprising above all activities that move a new/perfected technology, product, process or service toward market application (e.g. prototyping, testing, demonstrating, piloting, large-scale product validation and market replication).

Citizens, stakeholders, Member States and the European Parliament will work together to define them.

- **Maximising innovation potential across the EU**
- **Greater openness** – the principle of "open science", open access to data and publications
- **A new generation of European partnerships** and broader cooperation with other EU programmes

In 2019 the EU organised several public consultations on the forthcoming programming period:

- The **Strategic Plan for the future framework programme Horizon Europe** (8 September 2019) aimed to involve the public in the first formal plan that will determine the future creation of work programmes and calls for project proposals in the first four years of the Horizon Europe programme (2021–2024).
- The **Implementation Strategy** (15 September 2019), which should deal primarily with the question of how the new framework programme for research and innovation should be executed so as to meet its ambitious goals, and what form the legal documents, processes and instruments for Horizon Europe should take in order to support the programme's political objectives.
- A draft amendment to **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** (27 September 2019), which aims to simplify the state aid rules as they apply to national funding of projects that fall under EU programmes with the aim of ensuring compliance between the funding rules and the rules for provision of state aid.
- The **Digital Europe programme** (25 October 2019), the goal of which is to gather the opinions of stakeholders about key areas, elements and priorities in the initial phase of this forthcoming programme (2021-2022).
- The **Connecting Europe Facility programme** (11 September 2019), the content of which is building trans-European networks and infrastructure in the sectors of transport, telecommunication and energy. The outputs of this consultation, to which representatives of industry, academic institutions and the public sector could contribute, will be used in producing the implementing plan and specific funding proposals.

EUROPEAN RESEARCH COUNCIL (ERC)

The ERC was set up by the European Commission in 2007 to boost the excellence, dynamic and creativity of European research. Through grants, the ERC supports top researchers and their teams in high-risk research that promises key benefits. For projects funded by the ERC it is expected that they will advance the boundaries of human knowledge and contribute to unexpected discoveries and technological breakthroughs that lay the foundations for new industrial sectors, markets and societal innovations. Ultimately, the work of the ERC should shape the European research base so that it is better able to react to the needs of society and provide Europe with the research capacity needed to deal with global challenges.

ERC grants are based on a "bottom-up approach", with the area of research and project objectives being established by the researchers themselves, or rather the Principal Investigator. This approach is much more flexible than if researchers had to stick to priorities laid down by politicians, and it is expected from this that funds will go into promising and novel areas. ERC grants are awarded in open competition and can be applied for by anyone regardless of their origin, which creates a more competitive environment than for grants at the national level. The main evaluation criterion is the excellence of the proposal and project investigator, which is assessed as part of a high-quality peer review evaluation. The investigator should conduct the research at a host institution in the EU or associated country (applying for the grant on behalf of the host institution).[19] Nevertheless, the grant is tied to the person of the investigator and is transferrable – over the course of the research the investigator can thus change host institutions.[20] Assessment of the project proposals is provided for by 25 expert panels divided into three research areas: Physical Sciences and Engineering, Life Sciences, and Social Sciences and Humanities. Each panel is headed by a chair, who chairs the meetings of their panel's members and is responsible for the credibility of the whole peer review evaluation. The panels are international and their members are appointed by the ERC Scientific Council.[21]

The Scientific Council also determines the scientific strategy and evaluation criteria (methodology), sets out the work programme and manages the proposal calls. The Scientific Council is composed of 22 leading scientists named by the European Commission at the recommendation of an independent selection committee. The Council is chaired by the ERC

[19] The exception is Synergy Grants, for which one of the principal investigators can perform the research at a host institution outside the EU or associated country.

[20] European Research Council [online]. European Commission [accessed 2019-06-13]. Available at: https://erc.europa.eu/

[21] Horizon 2020: in brief on the programme. Updated ed. Prague: TC AS, [2014]. ISBN 978-80-86794-44-0.

president, who runs it and represents the ERC externally. The ERC Executive Agency (ERCEA) provides for implementation of the Scientific Council's strategy and implementing the work programme. It is also in charge of managing the calls, providing support and information to grant applicants, organising the peer review evaluations, and concluding and managing grant agreements. The activity of the Executive Agency is supervised by the Steering Committee appointed by the European Commission.[22] According to the ERC annual report for 2018, nearly 500 employees work at the Executive Agency. For the sake of completeness of the above summary it can be stated that the Czech Republic has a representative in the ERC bodies in Tomáš Jungwirth, who is a member of the Scientific Council and the Steering Committee.[23]

Under H2020 the ERC falls under the pillar Excellent Science and for the whole period of 2014–2020 it has an allocation of EUR 13.1 bn., i.e. 17% of the overall programme budget. The ERC currently distributes these funds in the form of five types of grant.[24]

Starting Grants are intended for talented young scientists in the phase of creating their own research teams who acquired their PhD two to seven years ago. It is expected that the project investigators have scientific results corresponding to the level of their scientific career (up to five publications in major international peer-reviewed journals). The amount of aid is up to EUR 1.5 mil. for a period of five years.

Consolidator Grants support scientists at the stage of consolidating their own independent research teams who acquired their PhD 7–12 years ago. A greater volume of results achieved is expected from the investigator compared to Starting Grants (up to 10 publications in major international peer-reviewed journals). The amount of aid can be up to EUR 2 mil. for a period of five years.

Advanced Grants focus on internationally recognised experts who have demonstrably impacted their field in the last 10 years. They should be exceptional leaders with original and breakthrough results. The amount of support can range up to EUR 2.5 mil. for a period of five years. The Principal Investigator need not have the title of PhD.

Synergy Grants are intended for groups of two to four principal investigators and their teams addressing a joint project of cutting-edge research. The synergistic and complementary effects resulting from cooperation must be so strong that without their effect the potential

[22] European Research Council [online]. European Commission [accessed 2019-06-13]. Available at: https://erc.europa.eu/.

[23] Annual report on the ERC activities and achievements in 2018 [online]. Luxembourg: Publications Office of the European Union, 2019 [accessed 2019-10-29]. ISBN 978-92-9215-083-9. Available at: https://op.europa.eu/en/publication-detail/-/publication/2b8710fd-5048-11e9-a8ed-01aa75ed71a1/language-en/format-PDF/source-search

[24] HORIZON 2020 [online]. TC AS [accessed 2019-10-29]. Available at: https://www.h2020.cz/cs/vynikajici-veda/evropska-vyzkumna-rada-erc/informace

result would not be achievable, i.e., if each investigator were working independently. The amount of support can total up to EUR 10 mil. for a period of six years.

Proof of Concept focuses on supporting successful ERC grant investigators in the phase of commercialising the results of their research. Grants can be applied for by investigators whose project is still underway or which ended less than 12 months before the call deadline. The amount of aid totals a maximum of EUR 150 000 and is generally allocated for a period of one year.

Although the ERC budget is relatively large, ultimately it does not have enough funds to finance all the quality projects recommended for funding. At the national level this problem is addressed by the **MEYS programme – "ERC CZ"**, which supports projects that received an "A" or "B" grade in the second round of ERC evaluation, but which were not selected for financing. The programme focuses on both Czech and international scientists under the assumption that the project will be carried out in the Czech Republic. The programme has been running since 2012 and will provide its final aid in 2026. A total of CZK 1.1 bn. has been prepared for eligible projects in the budget, of which CZK 0.4 bn. has been committed by contract under 11 projects.[25]

Other Czech instruments associated with the ERC are the **groups of GA CR grant projects "Grant Projects for Excellence in Basic Research EXPRO" and "Support for ERC Applicants"**. The EXPRO group of grant projects focuses on advancing excellent research and is intended to help researchers acquire the requisite knowledge and experience and overcome barriers that reduce the success of project proposals with the ERC. The output of a successfully completed project is a project proposal submitted to an ERC call. Support for the EXPRO group of grant projects started being provided in 2019 and the date for cessation of support is set at 2030. The overall expenditures for EXPRO projects are planned at CZK 13.5 bn.[26] The group of grant projects "Support for ERC Applicants" is the GA CR's response to the ERC's recommendation to create a national programme for funding visits by young talented scientists – future applicants for ERC grants – to existing foreign ERC grant investigators and their teams. Thanks to their stay abroad our scientists acquire the necessary experience to successfully apply themselves for ERC grants. Support is provided from 2016–2022 and overall expenditures of CZK 61.5 mil. are expected.[27]

[25] ERC CZ programme in the wording approved by Government Resolution No. 293 of 29 April 2019.

[26] Proposal for group of grant projects Grant Projects for Excellence in Basic Research EXPRO approved by Government Resolution No. 756 of 23 October 2017.

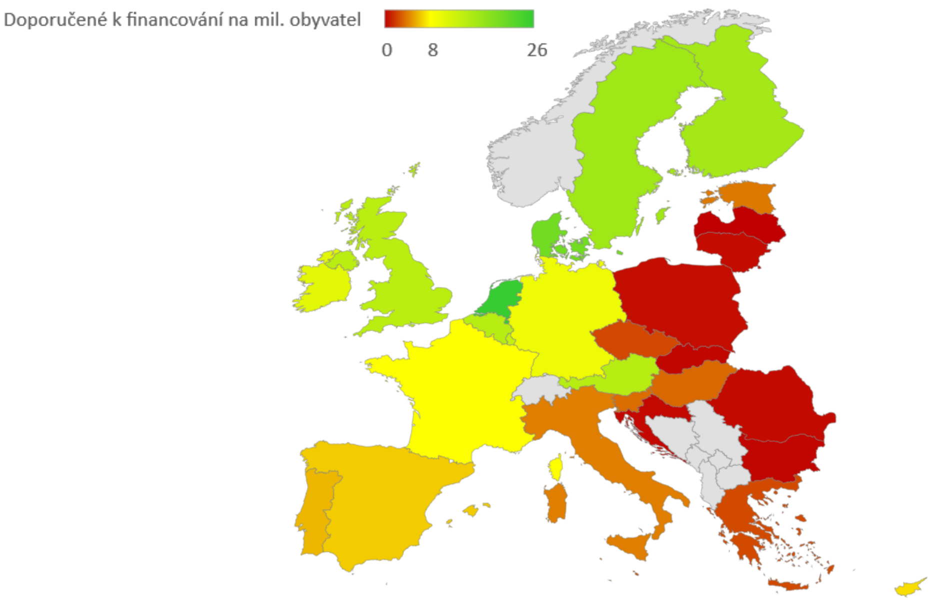
[27] Proposal for group of grant projects Support of International Cooperation for Acquiring ERC Grants "Support for ERC Applicants") approved by Government Resolution No. 448 of 18 May 2016.

Position of the Czech Republic within the EU

Under H2020 the Czech Republic lags significantly behind Western Europe (the EU 15) in activity in the ERC. While in the monitored period the average EU 15 country had 12.1 projects recommended for funding per million inhabitants, in the case of the Czech Republic this number was 2.3. The other new Member States (the EU 13) also lag behind Western Europe, with the average value of the EU 13 at 1.8; the best of the new countries is Cyprus, with a value of 6.9. Estonia, Slovenia and Hungary also achieve higher values than the Czech Republic. Top of the class within the EU is the Netherlands (25.7), followed by the Scandinavian countries (16–20.4) and Austria (14.4).

The low number of projects recommended for funding in the case of the Czech Republic is not primarily caused by a low success rate of submitted applications. Though this rate is 3 pp below the EU 15 average of 12% Finland, for example, with an 8% success rate is fourth in the number of recommended projects per million inhabitants, while Germany (with a much higher success rate of 16%) is tenth. The cause can be seen more in the very low number of applications submitted. Seven of the ten best-placed countries in the EU 28 submitted over 100 applications per million inhabitants, compared to 26 attributed to applicants from the Czech Republic[28].

Figure 3.5 ERC projects recommended for funding by host institution in 2014–2018 (EU 28)



Recommended for funding per mil. inhabitants

---

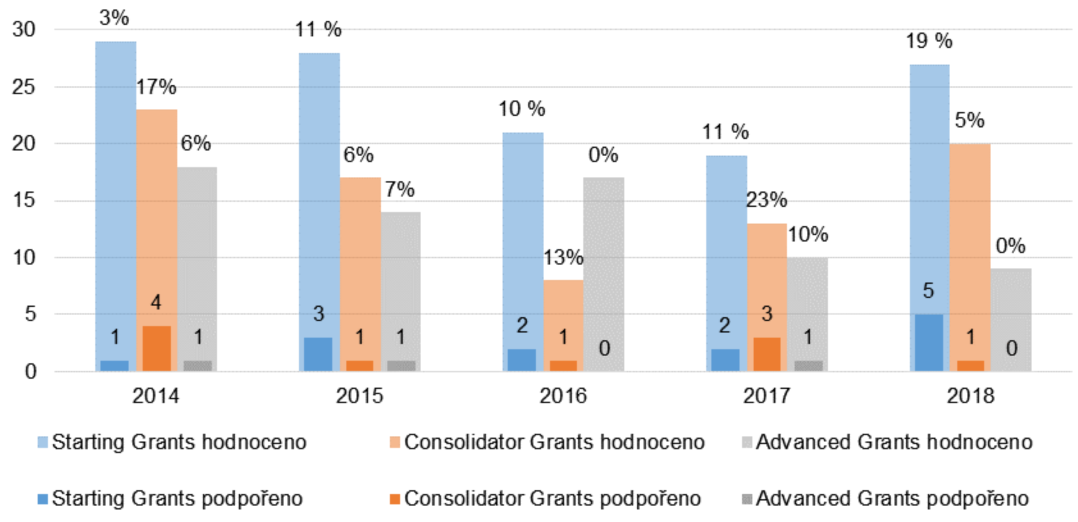
[28] An applicant from the Czech Republic is understood as a host institution based in the Czech Republic. The investigator of a project at a host institution in the Czech Republic can be a Czech or a foreigner.

Source: own compiling based on Eurostat and https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-dashboard [cit. 2019-06-13], with use of Bing ® GeoNames, HERE, MSFT, Microsoft, Wikipedia

ACTIVITY OF APPLICANTS FROM THE CZECH REPUBLIC IN TIME

In the 2014–2018 period we do not see any significant increase in activity by applicants from the Czech Republic for ERC grants. Researchers from Czech host institutions were most active in Starting Grants focused on excellent young scientists at the stage of consolidating their own independent research teams, where an average of 25 applications with a Czech host institution were evaluated per year. The level of success most frequently ranged around 11%, and 2018 was exceptionally successful, with five projects obtaining a grant, i.e. a success rate of nearly 19%. The interest in Consolidator Grants and Advanced Grants was similar, with 16 Consolidator Grant applications and 14 Advanced Grant applications being evaluated per year, but in the case of the latter grant scheme, the number of assessed applications has been falling in recent years. For Consolidator Grants the level of success was highly variable (from 5% to 23%), and in the case of Advanced Grants, applicants from the Czech Republic managed to succeed in individual years with a maximum of one project a year. Applicants from the Czech Republic have hardly participated in the Proof of Concept and Synergy Grants schemes.

Figure 3.6: Activity of applicants from the Czech Republic in the ERC and their success in 2014–2018



evaluated
supported

Source: European Research Council [accessed 2019-10-22], available at: https://erc.europa.eu/projects-figures/statistics

Unlike the other grant schemes, in the case of Starting Grants and Advanced Grants it is possible to look deeper into the past, as they have a sufficiently long history. Over a ten-year timeline, a comparison of the success rate in Starting Grants in the 2009–2013 period and in the following five-year period comes out favourably, with three projects with a host institution from the Czech Republic in the project proposal succeeding in the first period and 13 projects in the following one. A similar comparison for Advanced Grants comes out neutrally, as three projects succeeded in both periods, see the table below.

Table 3.3: Success of the Czech Republic in Starting Grants and Advanced Grants in 2009–2018

Grant scheme	2009–2013			2014–2018		
	Evaluated	Supported	Success rate	Evaluated	Supported	Success rate
Starting Grants	146	3	2.05%	124	13	10.48%
Advanced Grants	65	3	4.62%	68	3	4.41%

Source: European Research Council [accessed 2019-10-22]. Available at: https://erc.europa.eu/projects-figures/statistics

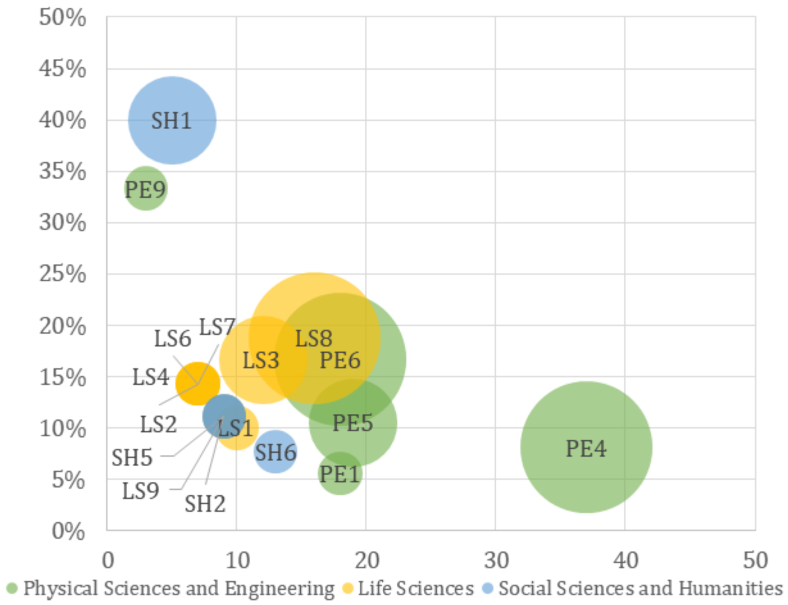
Field of focus of projects from the Czech Republic

Assessment of project proposals at the ERC is provided for by 25 panels divided into three research areas: Physical Sciences and Engineering (PE; 10 panels), Life Sciences (LS; nine panels) and Social Sciences and Humanities (SH; six panels). The panels cover sub-fields within the given area. Assignment of the project to a certain panel is proposed by the project's principal investigator.

In 2015–2018 more than half the project proposals from applicants in the Czech Republic aimed for the field of Physical Sciences and Engineering, where there was also the lowest average success rate, just under 7%. Fewer project proposals (29%) were submitted to Life Sciences with an average success rate of over 14%. The remaining projects (17%) were assessed by panels from Social Sciences and Humanities and the average success rate was not quite 11%. The overall highest number of successful project proposals was in the field of Life Sciences (11).

If we look at the level of individual panels, we discover that applicants from the Czech Republic targeted panel PE4 Physical and Analytical Chemical Sciences the most (37 project proposals), followed by the panels PE5 Synthetic Chemistry and Materials, PE1 Mathematics, PE6 Computer Science and Informatics and LS8 Ecology, Evolution and Environmental Biology (from 16 to 19 project proposals). Each of the 25 panels evaluated an average of 11 project proposals from Czech applicants. In terms of success rate, applicants from the Czech Republic reached the highest values in the panels SH1 Individuals, Markets and Organisations and PE9 Universe Sciences (40% and 33% respectively), but the former panel only evaluated five projects and the latter only three. Overall, the greatest number of successful project proposals were in the aforementioned panels PE4 Physical and Analytical Chemical Sciences, PE6 Computer Science and Informatics and LS8 Ecology, Evolution and Environmental Biology. On the other hand, in eight panels no project proposal with an applicant from the Czech Republic was successful.

Figure 3.7: Success rate of projects from applicants in the Czech Republic by ERC panel in 2014–2018



PE1 Mathematics
PE4 Physical and Analytical Chemical Sciences
PE5 Synthetic Chemistry and Materials
PE6 Computer Science and Informatics
PE9 Universe Sciences
LS1 Molecular Biology, Biochemistry, Structural Biology and Molecular Biophysics
LS2 Genetics, 'Omics', Bioinformatics and Systems Biology
LS3 Cellular and Developmental Biology
LS4 Physiology, Pathophysiology and Endocrinology
LS6 Immunity and Infection
LS7 Applied Medical Technologies, Diagnostics, Therapies, and Public Health
LS8 Ecology, Evolution and Environmental Biology
LS9 Applied Life Sciences, Biotechnology and Molecular and Biosystems engineering
SH1 Individuals, Markets and Organisations
SH2 Institutions, Values, Environment and Space
SH5 Cultures and Cultural Production
SH6 The Study of the Human Past

Source: European Research Council [accessed 2019-10-22], available at: https://erc.europa.eu/projects-figures/statistics
| The horizontal axis shows the number of evaluated project proposals, the vertical axis the success rate of project proposals and the size of the bubbles corresponds to the number of successful projects. The largest bubble indicates three successful projects, the smallest one project. The best positioned bubbles are in the top right, which indicates a high number of evaluated projects and a high success rate. In the monitored period none of the panels, or fields, placed in this area.

RECIPIENTS OF ERC GRANTS IN THE CZECH REPUBLIC

In 2014–2018, researchers from 13 research organisations in the Czech Republic and five regional capitals (City of Prague, Brno, České Budějovice, Olomouc and Pardubice) successfully applied for ERC grants; these were public universities and institutes of the AS CR. The most successful were research organisations based in the City of Prague that took part in 20 projects and in total obtained nearly EUR 25 mil., which is more than half of the funds for the whole Czech Republic. Public universities from Brno participated in seven projects and received another EUR 11.1 mil. in support from the ERC, i.e. one-fifth of the funds for the Czech Republic. The most successful research organisation was the Charles

University, both in terms of aid amount and number of supported projects. It participated in nine projects and obtained EUR 10.5 mil., i.e. one-fifth of the overall support. It was successful in Starting Grants (StG) and Consolidator Grants (CoG) focused on young scientists, as well as in Synergy Grants (SyG), but it did not take part in any supported project in Advanced Grants (AdG) intended for established, internationally recognised experts. Masaryk University participated in five projects and managed to succeed in Advanced Grants as well, obtaining EUR 7.7 mil. overall. The trio of most successful Czech organisations is rounded out with three projects and support of EUR 6.8 mil. by the Biology Centre of the AS CR based in České Budějovice. Altogether, beneficiaries in the Czech Republic managed to obtain EUR 46.4 mil., which represents 0.35% of the ERC budget for the whole H2020 period. The average amount for each participant under the project totalled EUR 1.4 mil.

Table 3.9: ERC grant beneficiaries from the Czech Republic in 2014–2018

	StG	CoG	AdG	SyG	Total partici pations	Financial support (€)
Charles University	5	3		1	9	10 452 009
Masaryk University	2	2	1		5	7 696 003
Biology Centre of the AS CR	1	1	1		3	6 804 650
Czech Technical University in Prague		1	1		2	4 733 500
Institute of Molecular Genetics of the AS CR	1	1	1		3	3 926 375
Brno University of Technology	2				2	3 377 369
Masaryk Institute and Archives of the AS CR		1			1	1 995 950
Palacký University in Olomouc		1			1	1 831 103
Economics Institute of the AS CR	1	1			2	1 821 727
Pardubice University	1				1	1 644 380
Institute of Organic Chemistry and Biochemistry of the AS CR	1				1	1 405 625
Heyrovsky Institute of Physical Chemistry of the AS CR	1				1	485 750
Institute of Physics of the AS CR		1			1	177 750
TOTAL	15	12	4	1	32	46 352 190

Source: TC AS CR 7 August 2019 (based on data from eCORDA)
The table lists the number of participations in supported ERC projects. Multiple organisations from the Czech Republic can take part in a single project, and in such a case the project is counted for all participating organisations. This situation only occurred for one project and involved two organisations.

RECOMMENDATIONS FOR ERC:

- One of the countries that is considerably more successful than the Czech Republic is Israel.[29] Currently there is a Czech Diplomat for Science, Research and Technology/Innovation active in Tel Aviv (Israel), managed by the OG CR, or rather

[29] Per million inhabitants, Israel has 15 times more project proposals and projects recommended for funding, with over double the success rate of project proposals, i.e. 20%. In the given parameters Israel even surpasses the Netherlands, which in ERC is highly successful.

the Research, Development and Innovation Council. The activity of this diplomat could be directed to the following tasks:

  - presentation of Czech research organisations (research infrastructures) in Israel as sites for carrying out ERC grants
  - organising of incoming missions of Israeli scientists to Czech research organisations
  - a study of the most successful Israeli research organisations at ERC with the goal of finding measures that could be copied to the Czech environment (adopting best practice)[30]

- ERC grants are tied to the person of the principal investigator. In light of the fact that there are not many Czech investigators of ERC grants, it is possible to organise interviews with the majority of them. The subject of the interviews would be determining their experience, motivation, identifying barriers for those interested in ERC grants, collecting opinions, proposals for improvements, etc. Following up on the interviews, specific measures could be defined. According to the TC AS[31] 40% of Czech researchers work on ERC grants abroad, while a foreigner working on an ERC grant at a host institution in the Czech Republic is something of a rarity. The interviews could determine the reason for this situation.
- Conducting an in-depth analysis of the success of Charles University, Masaryk University and the Biology Centre of the AS CR in the context of their size (number of researchers, R&D budget), including a comparison with foreign research organisations. The result would be information on whether the selected research organisations can be considered successful even adjusting the values to be per researcher, for example. For positively evaluated cases an analysis would then be conducted on measures implemented at these research organisations to support parties interested in ERC grants.

[30] This measure is in keeping with the strategic pillar "Smart Marketing" from the Innovation Strategy of the Czech Republic 2019–2030.

[31] Echo: Information on European research, development and innovation. Prague: TC AS, 4-5/2018. ISSN 1214-7982.

4 Implementation of the National Research and Innovation Strategy for Smart Specialisation of the Czech Republic

The National RIS3 Strategy constitutes one of the **implementation instruments** of the National Policy for Research, Development and Innovation of the Czech Republic for 2014–2020 in the field of applied and market-oriented research and at the same time fulfils the **precondition** for implementing EU regional policy interventions in the field of research, development and innovation.

4.1 Characteristics of the National RIS3 Strategy

In the context of public European policies, the National RIS3 Strategy represents a prerequisite for implementing EU policies that are focused on support for economic growth of EU countries using the principles of smartness, sustainability and inclusiveness.

An important attribute of the design of RIS3 is an emphasis on what is called the entrepreneurial discovery process (**EDP**). This involves profiling areas of research and economic specialisation and RIS3 research topics defined with the participation of representatives of public administration, the business and academic sectors, and also civil society.

The current National RIS3 Strategy comprises two basic structural levels. The first level constitutes what are called **horizontal objectives** broken down by key areas of change and strategic (and more detailed specific[32]) objectives. The breakdown of horizontal objectives is summarised in Table 4.1.

Table 4.1: Structure of horizontal objectives in National RIS3 Strategy

RIS 3 key areas of change	RIS3 strategic objectives
A: Innovation	A.1: Innovation in companies A.2: Founding of new companies A.3: Internationalisation of SMEs
B: RDI quality	B.1: Knowledge domains relevant for RIS3
C: RDI economic benefits	C.1: Research for the needs of the application sphere
D: Human resources for RDI	D.1: School graduates D.2: Identifying and utilising talented individuals D.3: RDI employees
E: Support for eGovernment and eBusiness	E.1: Developing eGovernment E.2: Developing eBusiness and ICT in enterprise E.3: Developing ICT infrastructure

[32] see National Research and Innovation Strategy for Smart Specialisation of the Czech Republic – 2018 update [accessed 2019-11-30]. Available at: https://www.mpo.cz/cz/podnikani/ris3-strategie/dokumenty/

RIS 3 key areas of change	RIS3 strategic objectives
F: Social and societal challenges	F.1: Experimental solutions to societal challenges F.2: Cooperation among local stakeholders in addressing employment and social inclusion in Czech regions

Source: S3 Strategy Unit of the MIT

The second structural level of the National RIS Strategy is **application branches and knowledge domains (vertical objectives)**. Vertical objectives represent priorities on which oriented and applied research in the Czech Republic should focus, and which it would be good to support regarding the national economic and research performance in a European and global context. Profiling areas of specialisation and new trends occurs on the basis of guided expert discussion under the advisory bodies of the RIS3 Steering Committee (called the National Innovation Platforms) with equal representation of the business, research and academic spheres and public administration (realisation of the EDP process). Significant perspectives for identifying **application branches** (see Table 4.2) were the development of foreign trade, export specialisation and R&D expenditures in the business sector by branch of economic activity.

Table 4.2: Application branches (RIS3 economic specialisation)

National Information Platforms	Application branches
NIP I – Engineering, energy, metallurgy	Mechanical engineering - mechatronics Energy Metallurgy
NIP II – Electronics, electrical eng. and ICT	Electronics and elec. eng. in the digital age Digital economy and digital content
NIP III – Manufacturing of means of transport	Automotive Railway and rail vehicles Aerospace industry
NIP IV – Pharmaceuticals, biotechnology, medical devices, life sciences	Pharmaceuticals, biotechnology, medical devices and life sciences
NIP V – Cultural and creative industries	Traditional cultural and creative industry New cultural and creative industries
NIP VI – Agriculture and the environment	Sustainable management of natural resources Sustainable agriculture and forestry Sustainable food production Ensuring a healthy and quality environment and efficient use of natural resources
NIP VII – Societal challenges	Security research Research in healthcare Labour, social services and the pension system
Region-specific application branches	Glass and ceramics Textiles Chemistry and the chemical industry Rubber and plastics Balneology and spas

Sources: S3 Strategy Unit of the MIT

As part of the EDP process, when updating RIS3 in 2018 a new application branch was added at the national level, ***Industrial chemistry***, which at the regional level replaced the existing region-specific application branches Chemistry and the chemistry industry and Rubber and plastics. In cooperation with the Ministry of the Environment, an ecologically focused application branch was added at the national level, ***Sustainable construction, human settlements and technical environmental protection.***

Knowledge domains in terms of broader and cross-thematic topics were set up in accordance with the definitions of EU key emerging technologies[33] (KETs). As part of the 2018 update, new megatrends in the field of science, technology and innovation were taken into account in RIS3, including proposals for new key technologies[34] on the part of the Directorate-General for Research and Innovation. The European Commission proposes classifying key technologies into three key technological areas:

- *Production Technologies*
- *Digital Technologies*
- *Cyber Technologies*

The EC proposal also adds two new key technologies to the existing key technologies, Artificial Intelligence and Security and Connectivity. For an example of the use of key technologies under RIS3, see Table 4.3.

Table 4.3: Knowledge domains (RIS3 research specialisation)

Area	Knowledge domain	Examples of research specialisations
Manufacturing technologies	**Advanced manufacturing technologies**	Smart, high-performance, high-precision and additive manufacturing and processes (production control and other processes); Robotics, Environmentally friendly propulsion technologies; Bio-refineries; Advanced energy conservation technologies, Lithography, technology for increasing the dimensions of silicon wafers in chip production; Measurement systems; Signal and information processing.
	Advanced materials Nanotechnologies	Advanced metals, Advanced synthetic polymers, Advanced ceramics, New composites, Advanced biopolymers, Smart materials, Nanomaterials, Nanotechnologies, Biomaterials, 2D materials, Nano/microsatellites.
	Industrial biotechnologies	Synthetic biology, Genomics (genetic engineering/synthetic genomes), Cell and tissue engineering, Biosensors, Bioactivators, Bioactuators, Neurotechnology.

[33] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS 'A European strategy for Key Enabling Technologies – A bridge to growth and jobs', Brussels, COM (2012) 341final.

[34] EUROPEAN COMMISSION: *Re-finding Industry – Defining Innovation*. Publication Office in Luxembourg, 2018 [accessed 2019-11-30]. Available: https://publications.europa.eu/en/publication-detail/-/publication/28e1c485-476a-11e8-be1d-01aa75ed71a1

Area	Knowledge domain	Examples of research specialisations
		Also numbering among the techniques/technologies used in biotechnology (and thus also in industrial biotechnology) are: • DNA/RNA; • Proteins and other molecules; • Cells, tissue cultures and engineering; • Procedural biotechnology (e.g. fermentation); • Genes and RNA vectors; • Bioinformatics.
Digital technology	**Micro and nanoelectronics Photonics**	Internet of things, Intelligent sensors, Quantum technology, Supercomputers (high-performance, neurocomputers, digital logic technologies), Displays (LCD, plasma) and lighting (LED, OLED), Photonics and Biophotonics.
	Artificial intelligence	Secure and verified communication on computer networks, Identification of criminals, Protection of electronic data, 5G, Human-computer interaction, Human-machine interaction, Medical monitoring, Autonomous robotic systems, Intelligent networks, big data. Artificial intelligence is utilised in improving health, monitoring hygiene and nutrition, nuclear tests, autonomous vehicles, in the arms industry (autonomous weapon systems), for language translators, in the use of satellites, agriculture and education.
Cybernetic technology	**Security and connectivity**	Electronic state and district administration, Electronic service administration, Electronic voting, eSafety and eSecurity, Blockchain.

Source: EC data, own compiling by S3 Strategy Unit of the MIT

In 2021 the existing domain *Knowledge for the digital economy, cultural and creative sector (industry)* will be fully transposed into the new knowledge domains *Artificial intelligence* and *Security and connectivity*. The non-technological domain of *Social science knowledge for non-technical innovation* will be eliminated and not replaced.

The 2018 updated to RIS3 (effective 1 April 2018) takes into account the transfer of the National RIS3 Strategy agenda from the OG CR to the MIT, which thus took over responsibility for producing and **implementing** the strategy in the Czech Republic and which is also responsible for negotiation and potential approval of the strategy at the European Commission. The main **steering** component of the strategy is the RIS3 Steering Committee, which works in particular with the central administrative authorities and other institutions in the field of support for research, development and innovation. The key partners for the committee's activities are the managing authorities of the operational programmes co-financed from the ESIF, for which RIS3 constitutes a prerequisite (ex ante conditionality), and the providers of national and ministerial support programmes. The national level has a coordinating role in relation to the regional RIS3 strategies (14 regions of the Czech Republic).

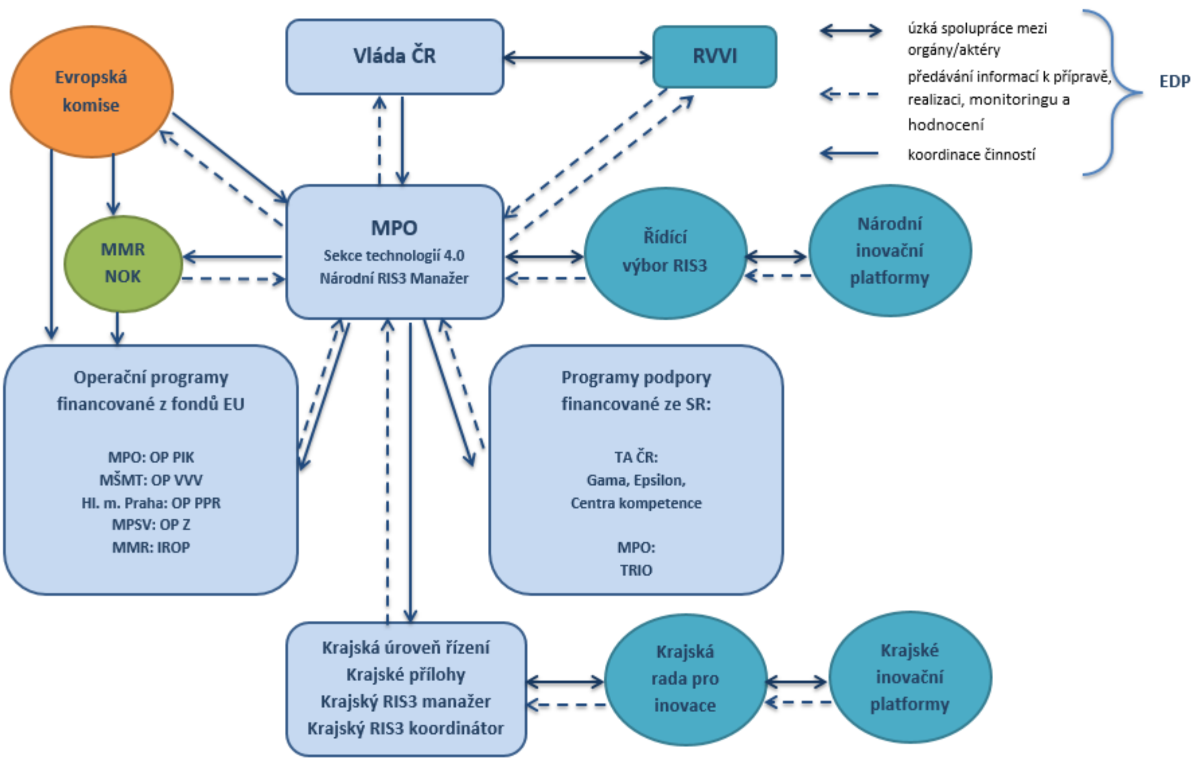
Monitoring of the National RIS3 Strategy focuses primarily on the drawing of funds for realised interventions broken down by the strategy's horizontal and vertical objectives and fulfilment of strategy indicators broken down by its strategic and specific objectives. The OP managing authorities provide the analytical team with information on relevant realised and submitted projects in the stipulated data structure, on the basis of which the RIS3 strategy database is produced.

Evaluation of the strategy means processing information obtained as part of regular monitoring and outside of it, interpretation of such information and formulating conclusions and recommendations for improving implementation and the overall strategic setting of the strategy.

Annual progress and the National RIS3 Strategy plan are published following approval by the RIS3 Steering Committee primarily in the **Report on Realisation and Implementation Plan**.[35]

For the system of management and implementation of the National RIS3 Strategy after 2018, see Diagram 4.1.

Diagram 4.1: System of management and implementation of the National RIS3 Strategy after 2018



European Commission	Czech Government	RDIC	close cooperation among authorities/stakeholders transfer of information on preparation, realisation, monitoring and evaluation coordination of activity
MRD NCA	MIT Technology 4.0 Section National RIS3 Manager	RIS3 Steering Committee	National Innovation Platforms

[35] See https://www.mpo.cz/cz/podnikani/ris3-strategie/dokumenty/ [accessed 2019-11-30].

Operational programmes financed from EU funds MIT: OP EIC MEYS: OP RDE Prague: OP PGP MLSA: OP E MRD: IROP		Support programmes funded from the state budget: TA CR: Gama, Epsilon, Centres of Competence MIT: TRIO	
	Regional management level Regional annexes Regional RIS3 Manager Regional RIS3 Coordinator	Regional Innovation Council	Regional Innovation Platforms

Source: S3 Strategy Unit of the MIT

4.2 Financing and fulfilling specific objectives and focusing on application branches with regard to the regional dimension

Financing of the *National RIS3 Strategy*[36] for 2015–2018 was monitored separately in the operational programmes and in the national and ministerial programmes for support of R&D.

So far in the operational programmes, funds have been set aside for the National RIS3 Strategy amounting to CZK 57.51 bn. from OP EIC and CZK 33.78 bn. from OP RDE. The other operational programmes cover significantly lower amounts, both planned and currently committed. OP EIC (64.8%) and OP RDE contribute by far the most to the funding of the National RIS3 Strategy, with a share of 27.8%. A much less significant amount falls to IROP (5.2%), OP PGP (1.6%) and OP E (0.6%). EU support is most utilised for financing the National RIS3 Strategy from OP RDE (CZK 27.13 bn.), as are Czech public resources (CZK 5.16 bn.). Private resources were used to finance the National RIS3 Strategy by far the most under the OP EIC programme (CZK 33.57 bn.). In total **CZK 103.87 bn.** of the planned CZK 212.70 bn., i.e. **48.8% of the planned funds** (see Table 4.4), was set aside for implementing RIS3 in the 2015–2018 period.

Table 4.4: Summary of financing of the National RIS3 Strategy from operational programmes (in CZK bn.)

Provider	Programme	Plan under RIS3	Share of plan	Current state				
				Private resources	Public resources	EU support	Total	Percentage
MIT	OP EIC	137.90	64.8 %	33.57	0.00	23.94	57.51	41.7%
MEYS	OP RDE	59.18	27.8 %	0.31	5.16	27.13	33.78	57.1%
City of Prague	OP PGP	3.37	1.6 %	0.38	0.62	1.00	2.01	59.6%
MRD	IROP	11.03	5.2 %	0.04	1.77	8.31	10.12	91.8%
MLSA	OP E	1.22	0.6 %	0.01	0.03	0.41	0.45	36.9%
Total		**212,70**	**100.0 %**	**34.31**	**7.58**	**60.79**	**103.87**	**48.8 %**

Source: OP MA data; own compilation of MIT

Of the TA CR national programmes for supporting research, development and innovation, during 2016–2018 the highest overall eligible costs for projects monitored in connection with the National RIS3 Strategy from the SB were CZK 3.93 bn. in the programme Centres of Competence, which also has the highest SB support of CZK 2.71 bn. Also playing a significant role in fulfilling the National RIS3 Strategy was the MIT's ministerial programme TRIO, the total project costs of which were CZK 3.62 bn. in the given period. In

[36] Unless stated otherwise, in the *National RIS3 Strategy* the term ‘financing’ is understood to mean the total approved (planned) eligible project expenditures/costs.

total **CZK 11.44 bn.** were allocated for fulfilling RIS3 in 2016–2018 of the planned CZK 9.85 bn., i.e. **116.1% of the planned funds**[37] (see Table 4.5).

Table 4.5: Summary of financing of National RIS3 Strategy from programmes for supporting R&D Centres of Competence, EPSILON, GAMA and TRIO (in CZK bn.)

Provider	Programme	Plan under RIS3 for 2016–2018	Share of plan	Current state			
				Czech non-public and foreign resources	State budget	Total costs[38] for 2016–2018	Plan fulfilment
TA CR	Centres of Competence	2.04	20.7%	1.23	2.71	3.93	192.6%
TA CR	EPSILON	4.19	42.6%	1.35	2.10	3.46	82.6%
TA CR	GAMA	0.85	8.6%	0.00	0.43	0.43	50.6%
MIT	TRIO	2.77	28.1%	1.07	2.55	3.62	130.7%
Total		9.85	100.0%	3.65	7.79	11.44	116.1%

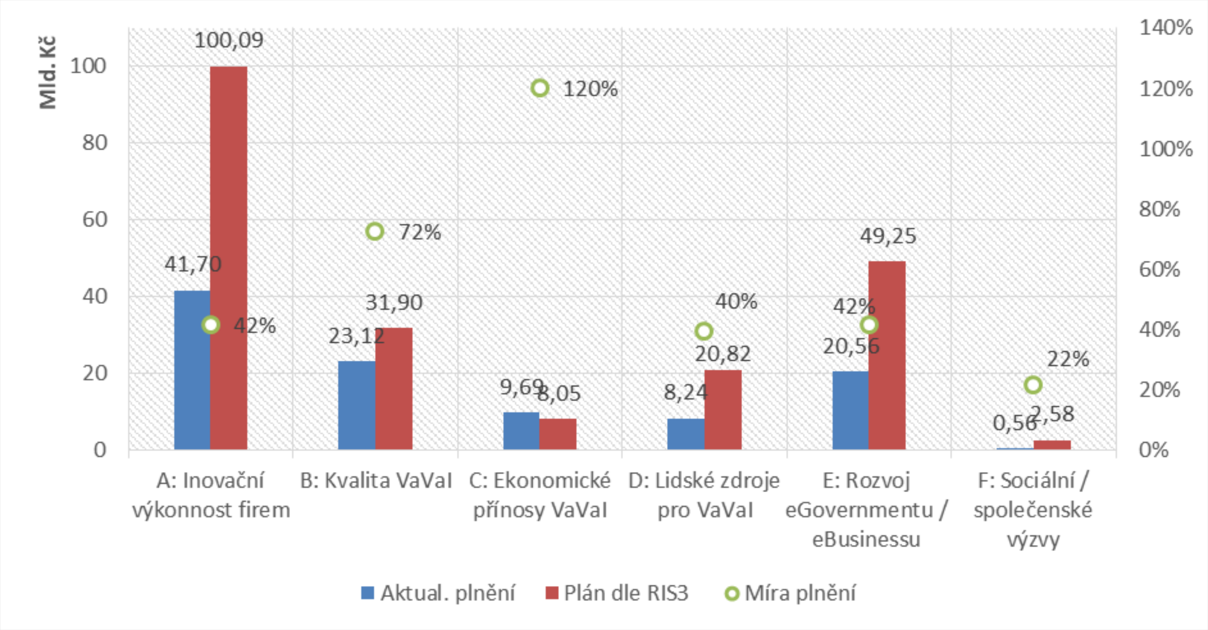
Source: RDI IS data; own compilation of MIT

Fulfilment of the National RIS3 Strategy objectives for the periods monitored above is illustrated here on the operational programmes and national and ministerial support programmes that the MIT monitors through harmonised sets of primary data. For operational programmes this is 3 323 projects in the programme OP EIC, 6 932 projects under OP RDE, 61 projects for OP PGP, 305 projects of IROP and 30 projects of OP E. In total this is **10 659 projects** with an issued legal act on provision of support and subsequent state. A total of **764** projects are approved and realised in the national and ministerial support programmes and monitored under the National RIS3 Strategy, of which 34 are in the Centre of Competence programme, 350 in the Epsilon programme, 34 in the GAMA programme and 346 in the TRIO programme.

[37] During implementation of the RIS3 financial plan for the national programme Centres of Competence (TA CR) and the ministerial programme TRIO (MIT), the planned support was exceeded. This approach is, however, in line with the RIS3 financial plan, as the scope of subordination of the RIS3 strategy to the given programmes is just 50% (TA CR programmes) and 80% (the MIT programme) of the programme budget for the whole period, and exceeding of the planned support fits into this limit.

[38] Approved or planned costs for individual projects.

Figure 4.1: Fulfilment of key areas of change (objectives) of National RIS3 Strategy in operational programmes (ESIF)



CZK bn

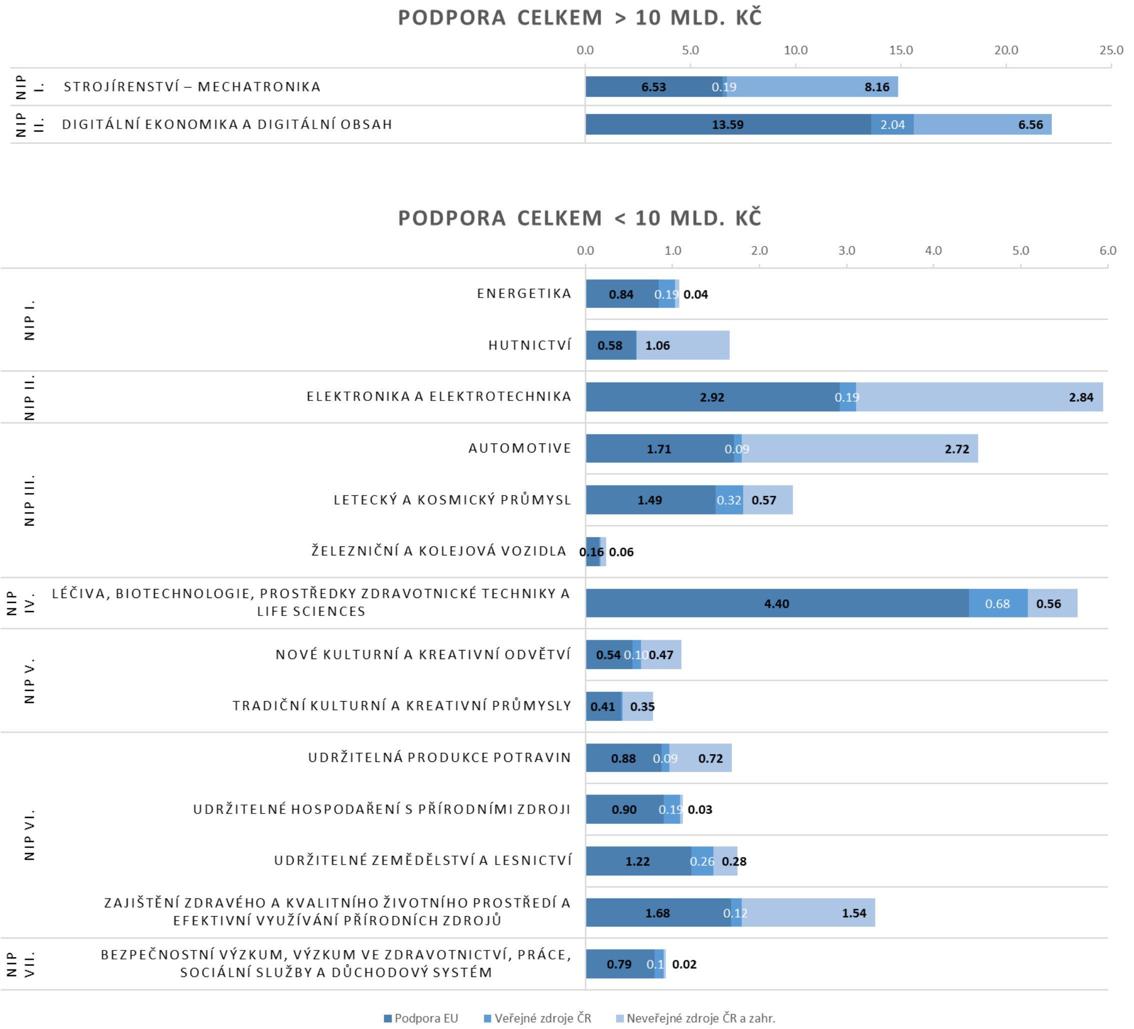
A: Innovation performance of companies B: RDI quality C: Economic benefits of RDI D: Human resources for RDI E: Development of eGovernment/eBusiness F: Social/societal challenges

Current fulfilment Plan under RIS3 Level of fulfilment

Source: OP MA data; own compilation of MIT

The most supported objective (key area) of the National RIS3 Strategy in operational programmes is ***innovation performance of companies*** with an amount of **CZK 41.70 bn.**, but this is only 42% of the overall support for this area planned for the 2014–2020 programming period under OP EIC. The planned expenditures are much lower for the other objectives. A greater level of fulfilment is reported by the area focused on RDI quality (long-term development of quality research workplaces, international openness of public research, etc.), which is supported in the OP RDE budget with an amount of CZK 23.12 bn., which represents 72% of the planned support. The area ***Development of eGovernment and eBusiness*** (greater use of ICT in business, increased capacity and quality of public ICT infrastructure and increasing its accessibility), supported from the budgets of OP EIC and IROP, is supported during the monitored period with an amount of CZK 20.56 bn. (42% of the planned support). A total of CZK 8.05 bn. is planned for the key area Economic Benefits of RDI (cooperation between research organisations and companies and commercial application of results of R&D) in OP RDE and OP PGP, but during the monitored period of 2015–2018 projects were approved with total expenditures of CZK 9.69 bn., meaning that the planned support for this National RIS3 Strategy objective has already been fulfilled (Figure 4.1).

Figure 4.2: Economic specialisation of the National RIS3 Strategy (operational programmes)



TOTAL SUPPORT > CZK 10 bn.
...
TOTAL SUPPORT < CZK 10 bn.
…
…
EU support Czech public resources Czech non-public and foreign resources

Source: OP MA data; own compilation of MIT

It is evident from Figure 4.2 that the most supported in operational programmes under the **economic specialisation of RIS3** is the application branch ***Digital economy and***

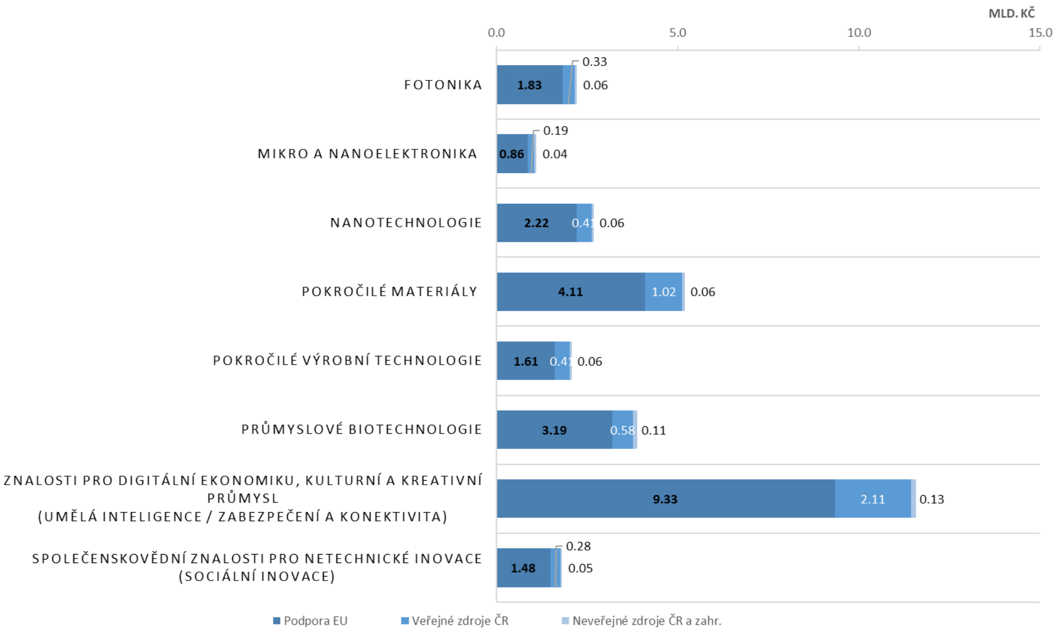
digital content (CZK 22.19 bn.), which is the most supported application branch overall.[39] The branches ***Mechanical engineering-mechatronics*** (CZK 14.88 bn.), ***Electronics and electrical engineering*** (CZK 5.97 bn.) and the platform focused on ***Pharmaceuticals, biotechnology and medical devices*** (CZK 5.65 bn.) were also significantly supported. Support for ***Automotive*** can also be considered good (CZK 4.51 bn.).

Based on economic analyses of market trends, the EC ranked the following among key EU technologies (KETs) in 2012[40]: (i) micro- and nanoelectronics, (ii) nanotechnology, (iii) photonics, (iv) advanced materials, (v) industrial biotechnology and (vi) advanced manufacturing technologies. The EC defines the individual key technologies as technologies that are "knowledge intensive and associated with high R&D intensity, rapid innovation cycles, high capital expenditure and highly skilled employment. They enable process, goods and service innovation throughout the economy and are of systemic relevance. They are multidisciplinary, cutting across many technology areas with a trend towards convergence and integration. KETs can assist technology leaders in other fields to capitalise on their research efforts." The current form of monitoring systems does not allow for direct data to be acquired for monitoring the research specialisation of RIS3 – knowledge domains (KETs). This issue has been discussed at regular MIT meetings with the representatives of OP managing authorities subject to the EC precondition. On the basis of a mutual agreement between OP RDE representatives, a knowledge domain was established by qualified estimate for projects tying in to the RIS3 strategy with a scope of CZK 19.10 bn., representing approximately 57% of the gross expenditure on the RIS3 strategy in the given operational programme in the given period. Similarly, representatives of OP PGP set knowledge domains by qualified estimates of CZK 1.42 bn., which represents approximately 71% of the overall expenditures on the RIS3 strategy in the given programme. The IROP and OP E programmes are specific in their material content; projects realised under IROP can be classified under the knowledge domain Knowledge for the Digital Economy in terms of research specialisation and projects under OP E under the domain Social Science Knowledge for Non-Technical Innovation. For this reason, the Knowledge for the Digital Economy domain appears to be by far the most supported (see Figure 4.3).

[39] Based on analyses of further data provided by the MIT to the National RIS3 Manager it can be stated that the increase support for the branch Digital Economy and Digital Content is a long-term trend. Even in 2007–2013 (during realisation of OPEI), this branch numbered among the most supported (approximately CZK 15.50 bn. was spent on it, or 14% of the overall expenditures for OPEI).

[40] See COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS 'A European strategy for Key Enabling Technologies – A bridge to growth and jobs', Brussels, COM (2012) 341final.

Figure 4.3: Research specialisations of the National RIS3 Strategy in operational programmes (excluding OP EIC)



CZK bn
...
EU support   Czech public resources   Czech non-public and foreign resources

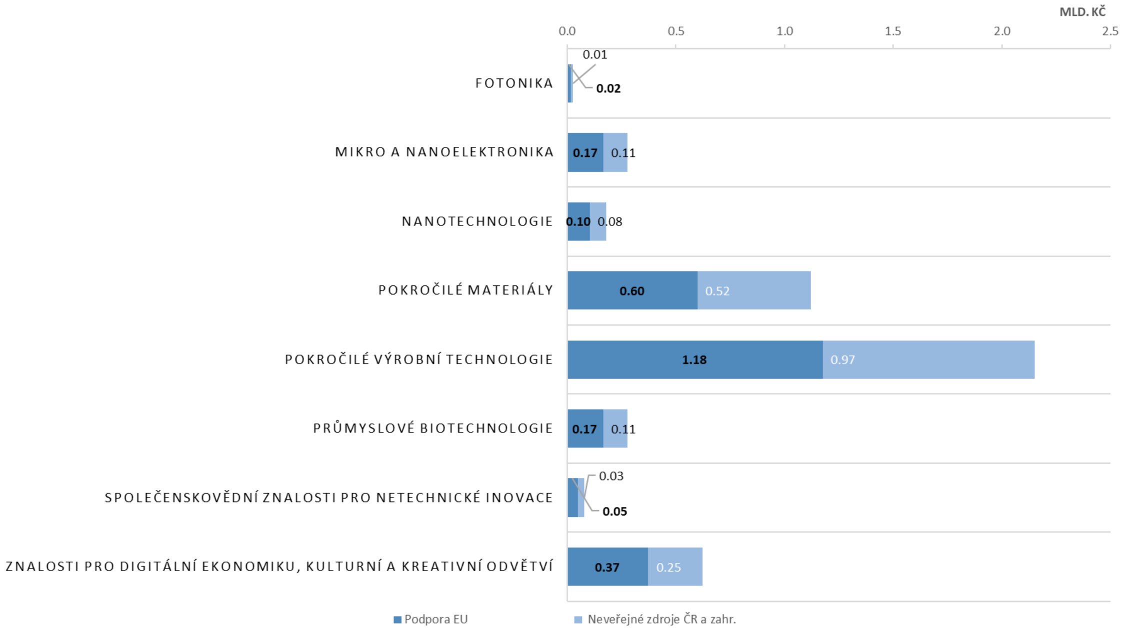
Source: OP MA data; own compilation of MIT

As Figure 4.3 shows, the knowledge domain Advanced Materials is well supported (CZK 5.19 bn.). Other knowledge domains range rather evenly between about CZK 1 and 4 bn.

According to the data provided by representatives of the OP EIC managing authority, in the monitored period a direct link between the project and selected knowledge domains was identified[41] for 231 projects with total expenditures of CZK 4.74 bn., which is around 8% of the total expenditure on RIS3 in the given operational programme. Under OP EIC the knowledge domains receiving the most support by far are Advanced Manufacturing Technologies (CZK 2.15 bn.) and Advanced Materials (CZK 1.12 bn.).

[41] Applicants are obliged to list knowledge domains in project applications. The evaluators then assess whether the listed knowledge domains are in line with the actual focus of the submitted projects.

Figure 4.4: Research specialisations of National RIS3 Strategy in OP EIC

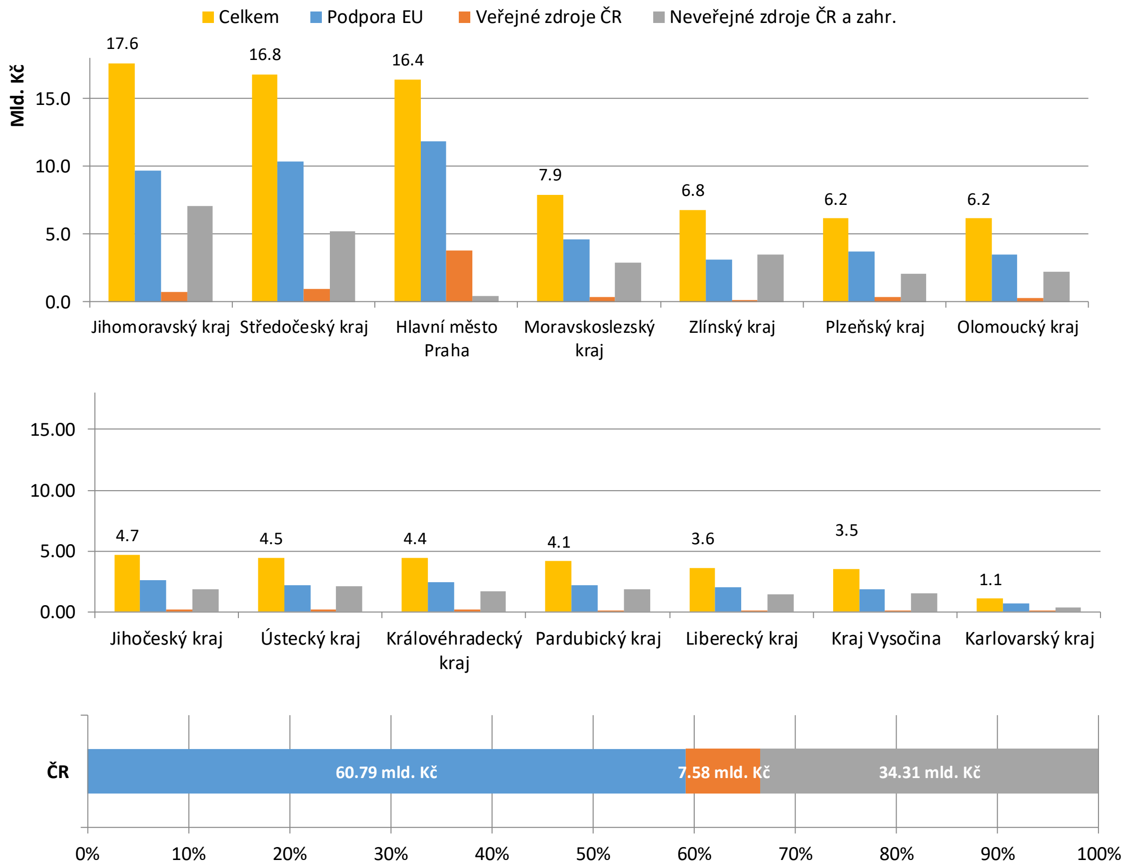


Source: OP MA data; own compilation of MIT

In contrast, in terms of the regional dimension, the established system for monitoring RIS3 allows for a closer look at the impact of nationwide operational programmes and national and ministerial support programmes on individual Czech regions, even with an eye to the given specifics of the region – region-specific application branches. With regard to the methodology of processing of underlying data files, it must be emphasised that for operational programmes the distribution of funding (total expenditure for a project) is monitored based on place of project realisation, and for national and ministerial programmes the distribution of funding (overall project costs) is monitored based on the registered office of the applicant/beneficiary.

By far the most funding from operational programmes (see Figure 4.5) goes to the South Moravian Region (CZK 17.6 bn.), the Central Bohemian Region (CZK 16.8 bn.) and the City of Prague (CZK 16.4 bn.). The distribution of funds to other regions ranges from CZK 3.5 bn. to CZK 7.9 bn. The exception is the Karlovy Vary Region (CZK 1.1 bn.), which receives the least funds by far.

Figure 4.5: Distribution of National RIS3 Strategy support in Czech regions (ESIF operational programmes)



Total EU support Czech public resources Czech non-public and foreign resources
CZK bn
South Moravian Region Central Bohemian Region City of Prague Moravian-Silesian Region Zlín Region Plzeň Region Olomouc Region
South Bohemian Region Ústí Region Hradec Králové Region Pardubice Region Liberec Region Vysočina Region Karlovy Vary Region

Czech Republic CZK 60.79 bn. CZK 7.58 bn. CZK 34.31 bn.

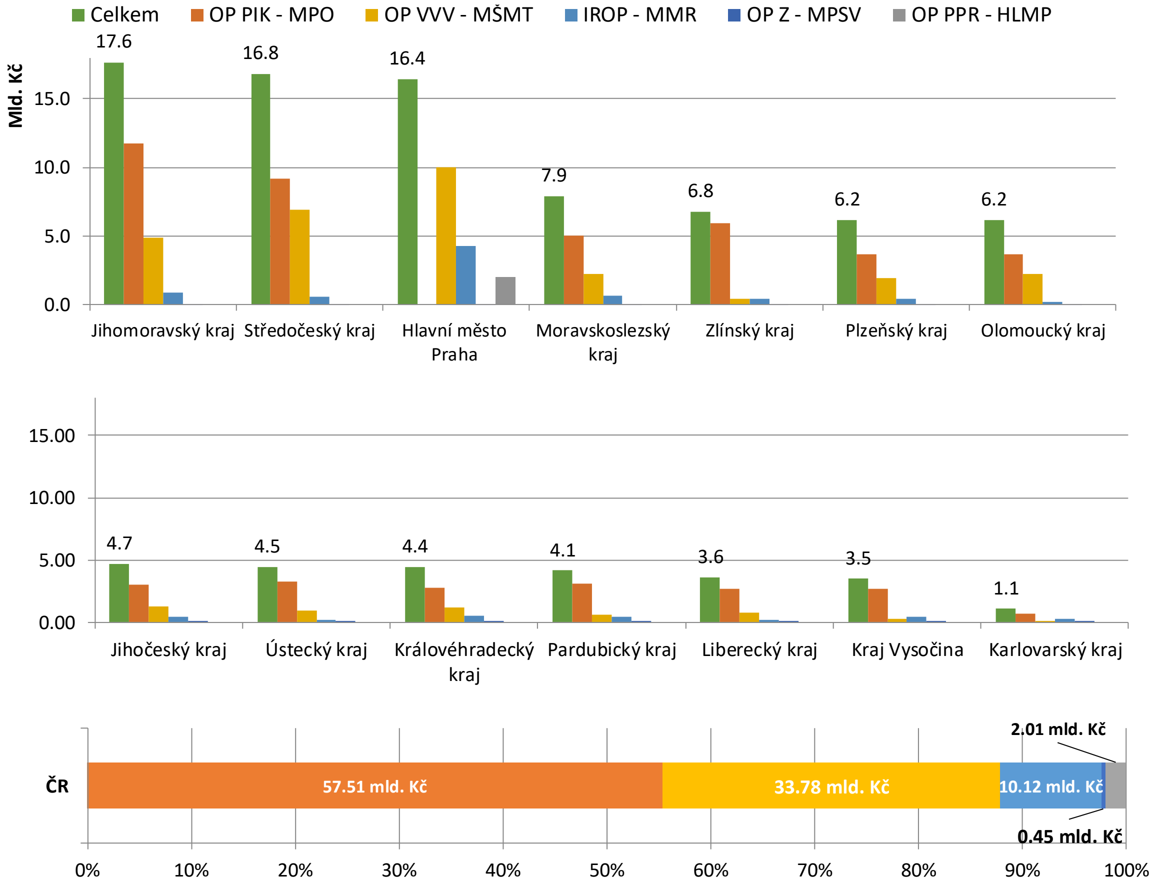
Source: OP MA data; own compilation of MIT

If we monitor the impact of operational programmes on individual Czech regions (see Figure 4.6), then under OP EIC[42] the most supported regions are the South Moravian Region (CZK 11.73 bn.) and Central Bohemian Region (CZK 9.21 bn.), under OP RDE the City of Prague (CZK 10.00 bn.) and the Central Bohemian Region (CZK 6.92 bn.). OP PGP is only realised in Prague (CZK 2.01 bn.). The IROP programme supports the City of Prague (CZK 4.32 bn.) the most, with all other regions supported to a relatively small extent

[42] The City of Prague is not a target territory for OP EIC, however.

(CZK 0.19 to 0.92 bn.). Support under the OP E programme is distributed at a relatively low level (approximately CZK 0.01 to 0.10 bn.) in all the regions of the Czech Republic.

Figure 4.6: Support of regions by ESIF programme and place of project realisation

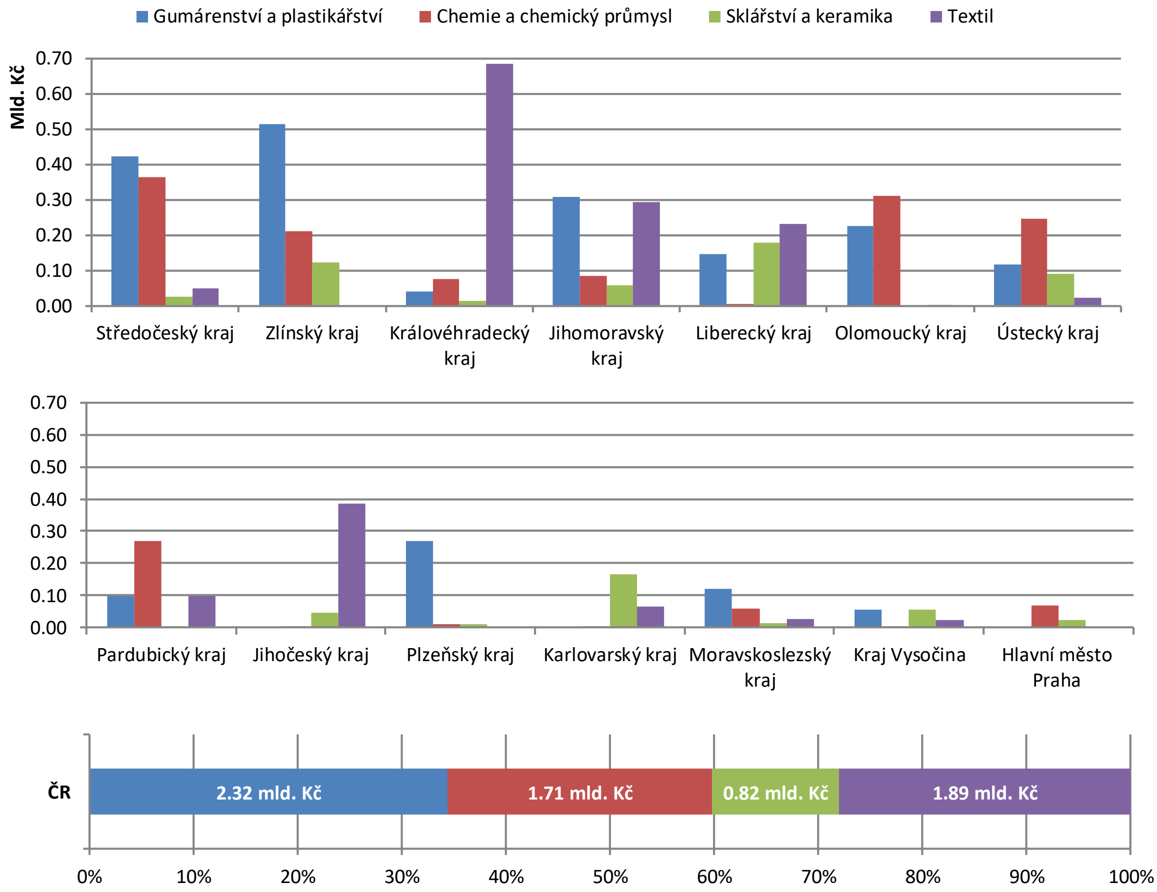


Total OP EIC – MIT OP RDE – MEYS IROP – MRD OP E – MLSA OP PGP – Prague

Source: OP MA data; own compilation of MIT

If we look at the economic specialisation in the various regions of the Czech Republic, Figure 4.7 portrays the distribution of regionally specific application branches in operational programmes. Chemistry and the Chemical Industry is focused primarily in the Central Bohemian Region (CZK 0.36 bn.) and the Olomouc Region (CZK 0.31 bn.). The Rubber and Plastics field is primarily concentrated in the Zlín Region (CZK 0.51 bn.), Central Bohemian Region (CZK 0.42 bn.) and South Moravian Region (CZK 0.31 bn.). The Textiles sector is most represented in the Hradec Králové (CZK 0.69 bn.), South Bohemian (CZK 0.39 bn.) and South Moravian Region (CZK 0.29 bn.).

Figure 4.7: Regionally specific application branches by place of project realisation (ESIF operational programmes)

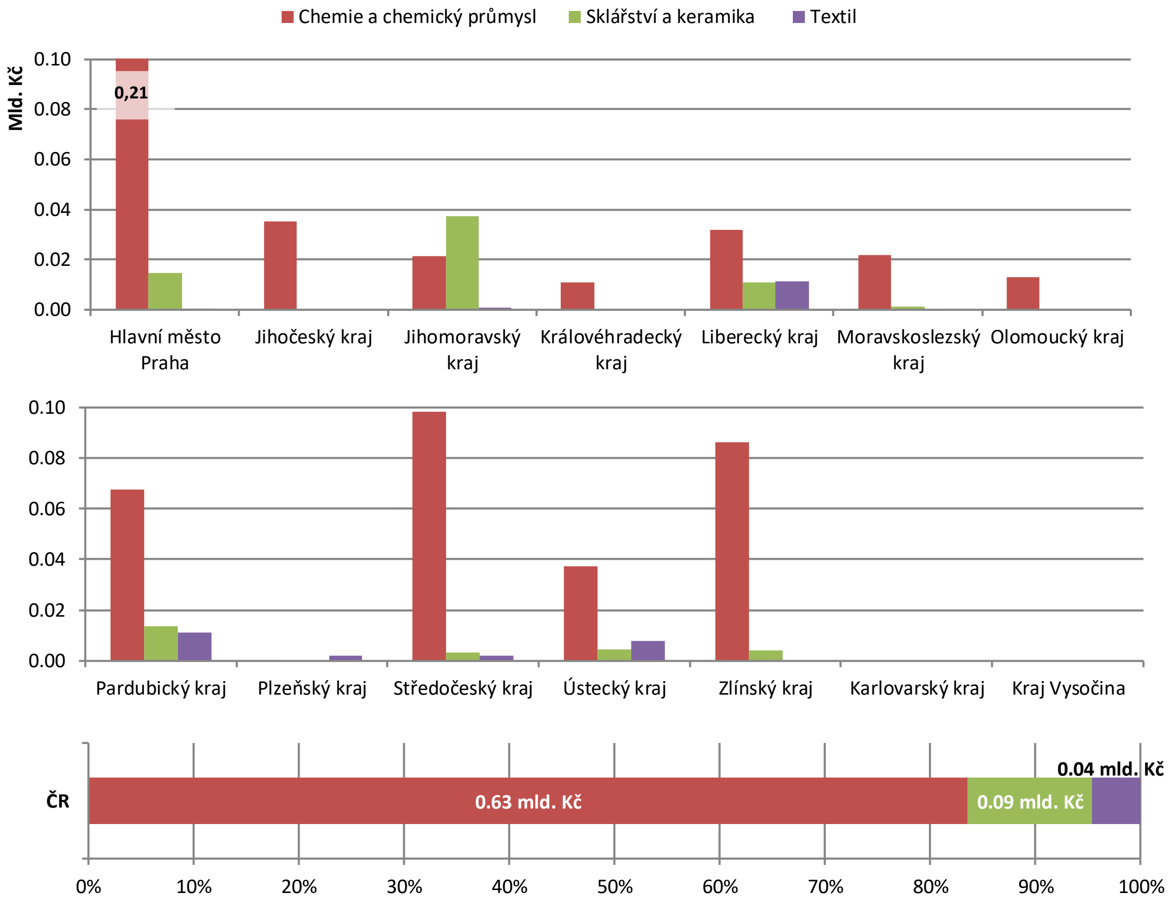


Rubber and Plastics Chemistry and Chemical Industry Glass and Ceramics Textiles

Source: OP MA data; own compilation of MIT

Figure 4.8 indicates national and ministerial programmes supporting entities whose projects are focused primarily on the regionally specific application branch Chemistry and the Chemical Industry, particularly for entities based in the City of Prague (CZK 0.21 bn.), the Central Bohemian Region (CZK 0.098 bn.), the Zlín Region (CZK 0.086 bn.) and the Pardubice Region (CZK 0.067 bn.).

Figure 4.8: Regionally specific application branches by entity headquarters (national programmes)



Chemistry and the Chemical Industry Glass and Ceramics Textiles

Source: OP MA data; own compilation of MIT

5 Human Resources in Research and Development

Human resources are an indispensable component of RDI. The intensity and quality of execution of RDI and the subsequent success of transformation of RDI results into new practical knowledge are based on the personal and professional qualities of human resources. Human resources in R&D are not only researchers, but also R&D technicians and specialists, as well as other support staff who are vital to the execution of R&D activities.

Human resources in R&D can be analysed from many different perspectives, such as worker expertise, R&D purpose, motivation to carry out R&D and many others. The gender perspective is gaining in importance in recent years.

The importance of human resources in R&D is also apparent from the amount of human resource data being seen in R&D. The number of records and statistics presented by the CZSO is further proof of this. This chapter presents only selected data about human resources in R&D; other data published by the CZSO should therefore be monitored.

In the Analysis of the Exiting State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad for the previous period, a section devoted to researchers and the field in which they completed their education was included in this chapter. Here a comparison was made of the number of researchers, university students and graduates by field of study. The data on the number of students since 2018 is reported only according to the International Standard Classification of Education (ISCED), which does not correspond to the scientific fields in which researcher numbers are reported. This section of the chapter is, therefore, not part of the following text.

To simplify this chapter, masculine pronouns are used to denote individuals. The author, however, has both men and women in mind, unless specified otherwise.

5.1 Number of People Employed in Research and Development

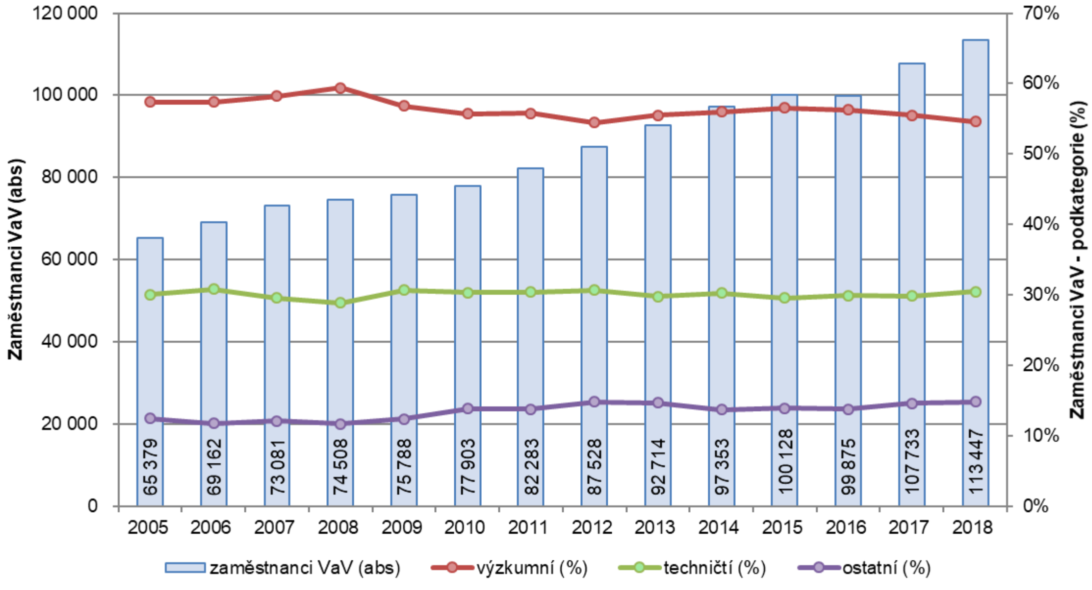
The number of people employed in R&D can be shown using the Head Count (HC) indicator or Full Time Equivalent (FTE) indicator. The HC indicator reports the number of R&D employees in terms of physical persons regardless of whether they are focussing on R&D activities full-time or part-time. That is why employee numbers according to the HC indicator are overestimated, especially in the university and government sector, where many employees work in several fields or are only involved in R&D activities part-time. In comparison, the FTE indicator converts the number of employees to full-time positions devoted solely to R&D activities. Although the FTE indicator has its limitations, it nevertheless best describes the actual time R&D employee spend on R&D activities.

Figure 5.1 shows how the number of R&D employees by (HC) has evolved, and the proportion of research, technical and other workers to the total number of employees. In the reference period, save 2016, one can see a year-on-year increase in R&D employee numbers. The threshold of 100 000 employees was exceeded in 2015. In the year after, however, the number fell back below this line, only to cross it again in 2017 (exactly 107 733 persons). In 2018, this number grew again to 113 447 employees. While in 2016, 19 out of every 1 000 employees in the Czech Republic worked in R&D, this number was 20.2 in 2017 and 20.9 in 2018.

The FTC indicator followed the same trends as the HC indicator (i.e. a year-on-year increase except in 2016). According to the FTE indicator, 74 969 people worked in R&D in 2018.

As the figure below shows, researchers comprise the highest proportion of R&D employees (55%), technical workers a stable 30% and all other R&D workers 15%.

Figure 5.1: Evolution of employees and proportion according to work activity (2005–2018)



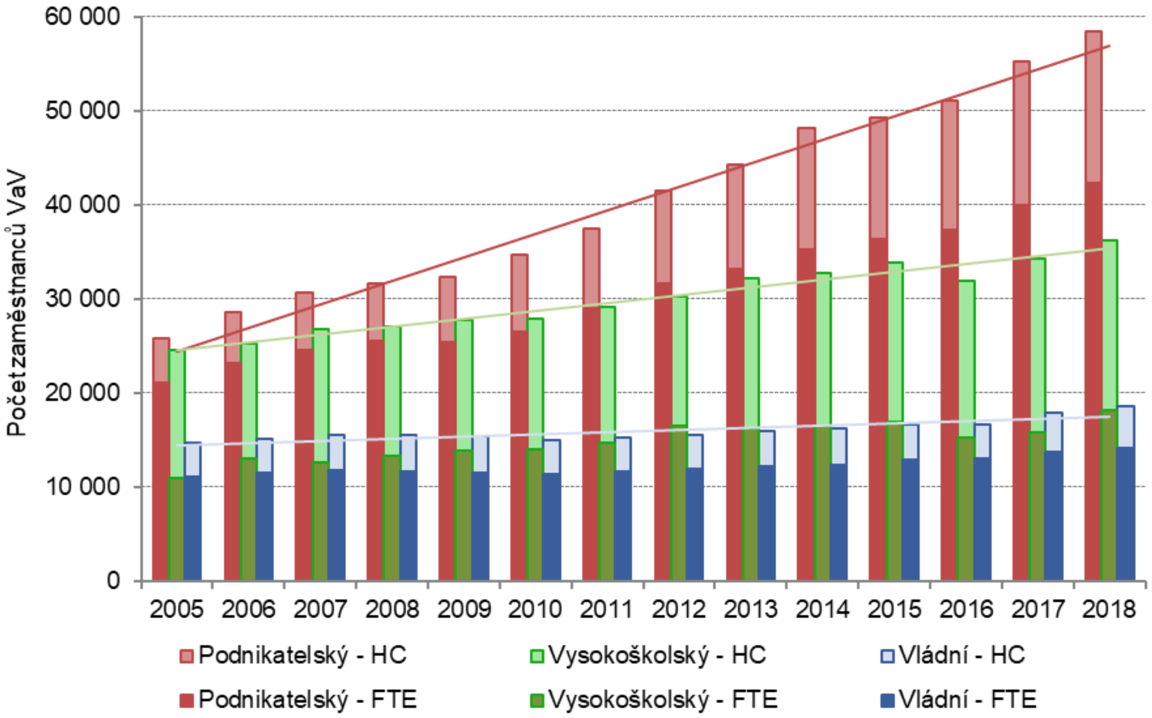
R&D employees (abs)
R&D employees- subcategories (%)
R&D employees (abs)
Researchers (%)
Technicians (%)
Other (%)

Source: CZSO

Figure 5.2 shows the evolution of R&D employees by R&D activity sector according to both the HC and FTE indicators. Figure 2 clearly shows that the greatest number of R&D employees throughout the entire reference period can be found in the business sector. In 2018, most R&D employees worked in the business sector (HC 58 409, FTE 42 349). This was followed by the university sector (HC 36 177, FTE 18 226) and the government sector (HC 18 598, FTE 14 163). CZSO reporting also includes the private non-profit sector. The numbers in this sector are marginal (HC 263, FTE 232). According to the HC indicator, 51.5% of all R&D employees worked in the business sector (FTE 56.5%), 31.9% in the university sector (FTE 24.3%) and 16.4% in the government sector (FTE 18.9%). The biggest differences between the proportions of employees according to the HC indicator and according to the FTE indicator are apparent in the university sector. This can be explained by the complicated system of R&D activity reporting,[43] but it could also be due to the high prevalence of part-time work in this sector.

Figure 5.2 also shows the linear connecting line of the HC indicator. From this perspective, the business sector is growing the fastest and the government sector is the most stable (only a slight positive trend).

Figure 5.2: Evolution of the number of R&D employees by R&D execution sector 2005–2018



Number of R&D employees
Business – HC/FTE
University – HC/FTE
Government – HC/FTE

Source: CZSO, straight line – HC trend linear connecting line

Table 5.1 shows an international comparison of the number of R&D employees in the EU 28 for 2010 and 2017 according to both the FTE and HC indicators, and for 2017 also the relative expression of the proportion of RDI employees to all employees for 2017 according to the FTE indicator. It is important to be aware that the absolute numbers indicated in Table 1 are substantially influenced by the population size of each country.

[43] When converting to FTE, only the workload that pertains to R&D is included. Other activities, such as lessons, are not reported, and this causes substantial differences between the HC and FTE indicators.

Germany is in first place among the EU 28 in terms of the number of FTE R&D employees (681 600). The Czech Republic (69 700) is just behind Austria (77 900). The order according to the HC indicator varies little from the order according to the FTI indicator.

The growth of each indicator between 2010 and 2017 is more relevant. Poland saw the greatest increase in the number of R&D employees according to the FTE indicator (76%), followed by Ireland (54%) and Bulgaria (41%). Conversely, some of the EU 28 recorded a drop in R&D employees (Finland -12%, Lithuania -6%, Spain and Latvia -3%). According to HC indicators, the number of employees grew the most in Bulgaria (55%), the Netherlands (48%), Ireland (39%) and the Czech Republic (38%). A drop in HC values can be seen in the case of Finland (-9%), Estonia (-8%) and Spain (-5%).

From the point of view of the proportion of R&D employees to all employees for 2017 (using FTE), Denmark ranks the highest at 2.31%, followed by Finland at 2.04%, Luxembourg at 1.97%, Austria at 1.86% and Belgium at 1.82%. In the Czech Republic, the proportion is 1.37%. At the other end of the imaginary scale is Romania at 0.39%, Cyprus at 0.40%, Latvia at 0.62%, Malta at 0.68% and Croatia at 0.73%.

Table 5.1: Number of R&D employees compared internationally (2010, 2017)

	2010		2017		
	FTE	HC	FTE		HC
			abs	% of all employees	
EU 28	2 541 885	3 793 265	3 067 954	1.39	:
Germany	548 723	:	681 552	1.68	915 857**
France	397 756	523 648	434 670	1.64	:
Great Britain	350 766	524 333	424 510	1.38	695 925*
Italy	225 632	348 215	291 516	1.30	435 283*
Spain	222 022	360 229	215 713	1.16	341 809*
Poland	81 843	129 792	144 103	0.90	171 610*
Netherlands	100 544	127 154	138 292	1.65	187 750*
Sweden	77 418	:	87 720	1.81	138 620**
Belgium	60 075	88 803	83 441	1.82	113 576**
Austria	59 923	:	77 880	1.86	126 171**
Czech Republic	52 290	77 903	69 736	1.37	107 734
Denmark	56 623	84 562	63 243	2.31	90 862
Portugal	47 616	91 917	54 995	1.22	103 680*
Finland	55 897	79 979	48 999	2.04	72 387*
Greece	:	:	48 226	1.31	96 018**
Hungary	31 480	53 991	40 432	0.92	54 636*
Romania	26 171	39 065	32 586	0.39	44 386*
Ireland	19 722	33 630	30 316	1.43	46 752**
Bulgaria	16 574	20 823	23 290	0.76	32 306*
Slovakia	18 188	28 128	19 011	0.76	33 252*
Slovenia	12 940	17 972	14 713	1.56	20 022*

	2010		2017		
	FTE	HC	FTE		HC
			abs	% of all employees	
Croatia	10 859	18 459	11 778	0.73	18 632*
Lithuania	12 315	18 913	11 520	0.88	22 355*
Estonia	5 277	10 074	6 048	0.97	9 234*
Latvia	5 563	9 174	5 378	0.62	11 028*
Luxembourg	4 972	:	5 322	1.97	6 505**
Cyprus	1 302	2 628	1 485	0.40	3 091*
Malta	1 102	1 807	1 481	0.68	2 408*

Source: Eurostat, ranked according to FTE values 2017 | data for 2016, **data for 2015*

5.2 Researcher Numbers

The following chapter pertains only to researchers as a category of R&D workers. Table 5.2 provides an international comparison of the number of researchers according to both the FTE and HC indicators in 2010 and 2017 and, at the same time, the proportion of researchers to all employees (according to FTE 2017). Just as in Table 1, the absolute number of researchers should be viewed in connection with the population size of each country.

In terms of the absolute number of researchers according to FTE in 2017, Germany is in first place (413 500), followed by Great Britain, France, Italy and Spain. At the bottom of this ranking are Malta (900), Cyprus and Luxembourg. The Czech Republic ranks somewhere in the middle of the EU 28 (39 200). The order would not differ greatly when making the comparison using the HC indicator for 2017.

Poland reports the highest relative change in the number of researchers between 2010 and 2017 in terms of FTE (77.6%), followed by the Netherlands (58.8%), Malta (52.3%), Sweden (46.1%) and Ireland (44.1%). Conversely, Romania reported the highest negative change in the number of researchers (-11.4%), followed by Latvia and Finland (both -10.6%) and Spain (-1.1%). The Netherlands enjoyed the greatest relative growth in the number of researchers between 2010 and 2017 in terms of the HC indicator (76.8%), followed by Bulgaria (49.1%), Ireland (47.2%), Malta (38.4%) and the Czech Republic (37.8%). Conversely, Romania reported the greatest negative change (-9.5%), followed by Estonia (-8.6%), Finland (-6.0%) and Spain (-2.4%).

Relatively speaking, the countries leading the EU 28 table in terms of the proportion of researchers to all employees (FTE 2017) are Denmark (1.7%), Finland and Sweden (both 1.5%), Belgium (1.2%) and Austria (1.1%). At the bottom of the table are Romania (0.2%), Cyprus (0.3%), Latvia and Malta (both 0.4%) and Croatia (0.5%).

Table 5.2: Number of researchers compared internationally (2010, 2017)

	2010		2017		
	FTE	HC	FTE		HC
			abs	% of all employees	
EU 28	1 602 748	2 429 084	1 973 773	0.89	2 864 683**
Germany	327 996	:	413 542	1.02	586 030**
Great Britain	256 585	394 755	289 674	0.94	510 980*
France	243 533	324 551	288 580	1.09	:
Italy	103 424	149 807	136 204	0.61	185 916*
Spain	134 653	224 000	133 195	0.71	218 680*
Poland	64 511	100 934	114 585	0.71	132 547*
Netherlands	53 703	64 829	85 300	1.02	114 589*

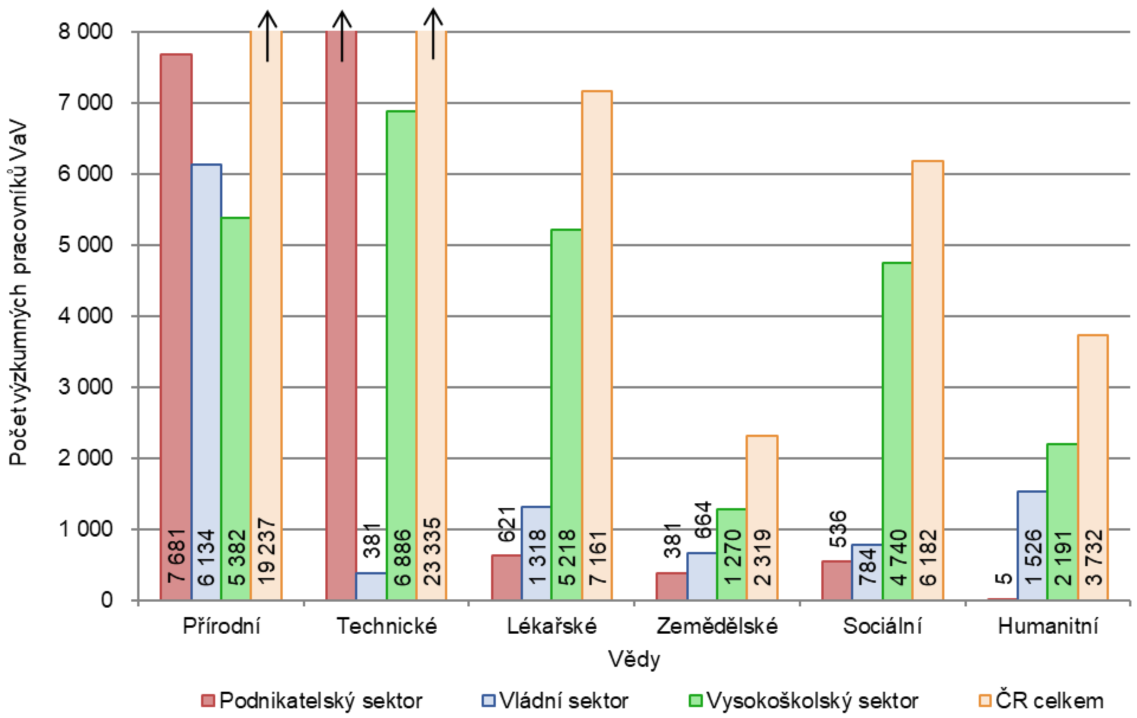
	2010		2017		
	FTE	HC	FTE		HC
			abs	% of all employees	
Sweden	49 312	:	72 033	1.49	108 761**
Belgium	40 832	59 403	56 067	1.22	73 709**
Austria	36 581	:	47 519	1.14	78 051**
Denmark	37 435	54 813	45 428	1.66	61 961
Portugal	41 523	80 259	44 938	1.00	85 780*
Czech Republic	29 228	43 418	39 181	0.77	59 789
Finland	41 425	57 163	37 047	1.54	53 752*
Greece	:	:	35 185	0.96	60 736**
Hungary	21 342	35 700	28 426	0.65	38 915*
Ireland	14 176	20 801	20 421	0.96	30 612**
Romania	19 780	30 707	17 518	0.21	27 801*
Slovakia	15 183	24 049	15 226	0.61	26 720*
Bulgaria	10 979	14 138	15 094	0.49	21 081*
Slovenia	7 703	11 056	9 293	0.99	11 282*
Lithuania	8 599	14 056	8 709	0.67	17 746*
Croatia	7 104	12 527	7 815	0.49	12 951*
Estonia	4 077	7 491	4 674	0.75	6 845*
Latvia	3 896	6 517	3 482	0.40	7 400*
Luxembourg	2 613	:	2 732	1.01	3 134**
Cyprus	905	1 776	1 015	0.27	2 178*
Malta	587	1 062	894	0.41	1 470*

*Source: Eurostat, ranked according to FTE 2017 values | * data for 2016, ** data for 2015*

Figure 5.3 shows researcher numbers in the various scientific fields by execution sector in 2018. The indicated numbers are expressed using the HC indicator. In terms of the number of researchers, the most important sectors are the university sector (25 687 researchers) and business sector (25 275 researchers). The government sector employs just 10 807 researchers. The private non-profit sector (not included in the figure) employs 197 researchers. In the most numerous university sector, the greatest number of researchers work at public and state-run universities (22 978 researchers). Teaching hospitals employ 2 144 researchers and private universities 565 researchers. Most researchers in the business sector are employed by foreign-owned companies (13 945 researchers), private domestic companies (10 438 researchers) and public enterprises (893 researchers). Of the researchers employed by the government sector, 61% are employees of the AS CR (6 582 researchers), 18% are employees of departmental research facilities (1 979 researchers) and less than a thousand researchers are employed by libraries, archives and museums, with a similar situation in healthcare and other facilities.

In terms of scientific fields, most researchers carry out their work in the technical sciences (23 335 researchers) and the natural sciences (19 237 researchers). In the business sectors, most researchers carry out their work in the technical sciences (16 051 researchers). Researchers in the university sector also focus mainly on the technical sciences (6 886 researchers), and researchers in the government sector focus mainly on the natural sciences (6 134 researchers).

Figure 5.3: R&D researcher numbers in the Czech Republic by execution sector and scientific field (2018)



Number of R&D researchers

Natural
Technical
Medical
Agricultural
Social
Humanities

Sciences

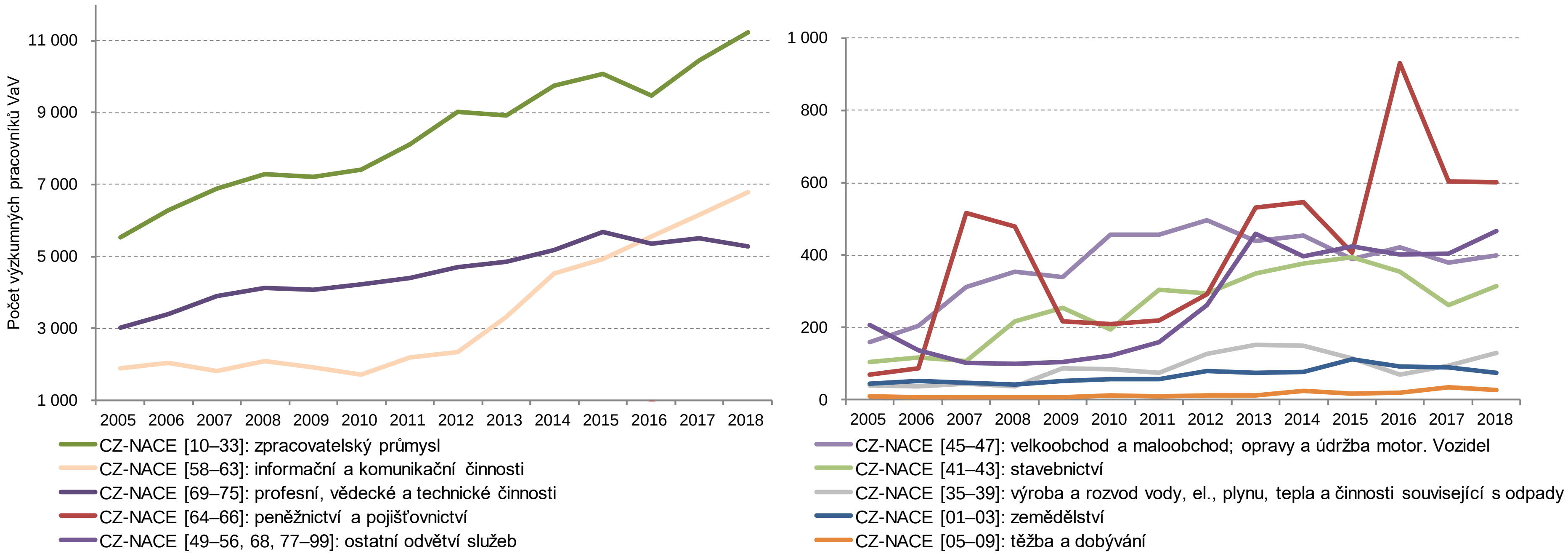
Business sector
Government sector
University sector
CR total

Source: CZSO

Within the busines sector, use of the CZ NACE classification system to determine the number employees is more exact. Figure 5.4 thus shows the number of researchers in the business sector according to the various groups under CZ NACE using the HC indicator. Figure 5.4 clearly shows that, over the entire reference period, the greatest number of researchers were active in manufacturing (11 219 researchers in 2018). Over time, this sector reported substantial growth in the researcher numbers (5 542 researchers in 2005). Relative growth is even greater in the information and communication sector, in which 1 879 researchers were active in 2005 but as many as 6 774 in 2018. The sector with the highest growth in terms of researcher numbers is finance and insurance. While in 2005 this sector employed 70 researchers, in 2018 this number was almost nine times higher (602 researchers).

As mentioned above, manufacturing enjoyed the greatest number of researchers in 2018 (11 219 researchers), followed by information and communication (6 774 researchers) and other professional, scientific and technical activities (5 270 researchers). Of the other sectors, which are shown on the right-hand side of Figure 5.4 for greater clarity, the finance and insurance sector has the greatest number of researchers (602); conversely, mining and quarrying has the fewest (26).

Figure 5.4: Number of RDI research workers in the business sector according to CZ NACE (2005–2018, expressed by HC)



Percentage of R&D researchers

CZ-NACE [10-33]: Manufacturing
CZ-NACE [58-63]: Information and communication
CZ-NACE [69-75]: Professional, scientific and technical activities
CZ-NACE [64-66]: Financial and insurance activities

CZ-NACE [49-56, 68, 77-99]: other service sectors
CZ-NACE [45-47]: Wholesale and retail trade; repair of motor vehicles and motorcycles
CZ-NACE [41-43]: Construction
CZ-NACE [35-39]: Electricity, gas, steam and air conditioning supply
CZ-NACE [01-03]: Agriculture
CZ-NACE [05-09]: Mining and quarrying

Source: CZSO

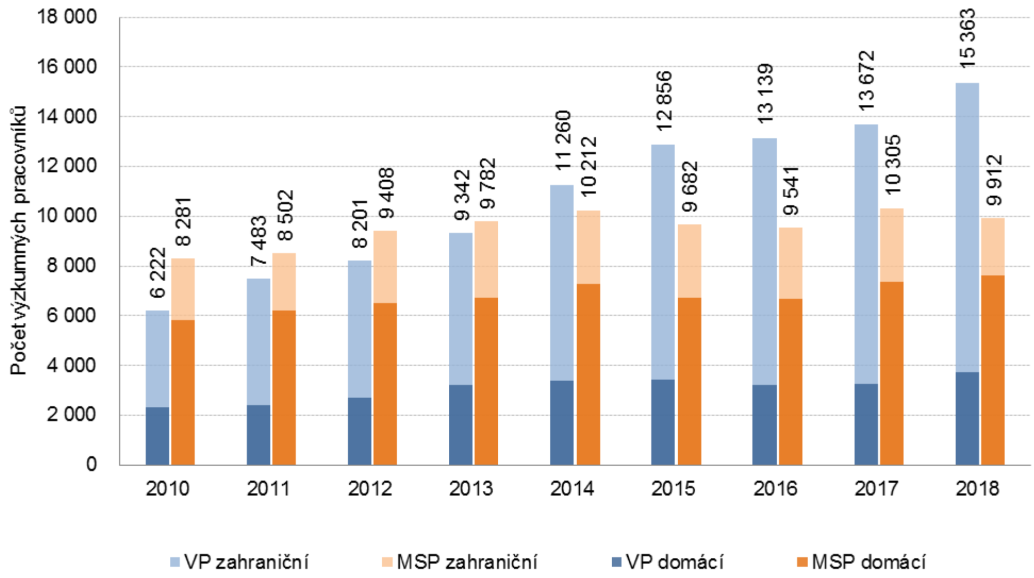
The issue of researchers in the business sector can also be analysed from the point of view of enterprise ownership. Enterprises can be divided by domestic and foreign control as well as by size. The size category can be set by number of employees, i.e., SMEs have up to 249 employees and large enterprises (LEs) 250 or more employees. Both classifications connected to the number of researchers in the business sector are depicted in Figure 5.5.

As Figure 5.5 clearly shows, there were over 2000 more researchers in SMEs in 2010 than in LEs in 2010. Developments in later years naturally led to a greater number of researchers in LEs (in 2013, the number of researchers at SMEs and LEs was practically the same) and since 2014, the number of researchers working in LEs has exceeded the number of those working in SMEs. Between 2010 and 2018, the number of researchers working in LEs increased 2.5 times. In comparison, the increase in the case of SMEs was only 20%. In 2018, the number of researchers in LEs was 15 400 and in SMEs 9 900.

From the point of view of enterprise ownership, there is a slight increase in the number of researchers in foreign-controlled LEs. The number of researchers in foreign-controlled LEs grew from 3 900 in 2010 to 11 600 in 2018. Domestic LEs also registered an increase in researchers (an increase of 1 400 to 3 700 in 2018). Changes in the case of SMEs are not so substantial: in the case of domestic SMEs, the number of researchers grew from 5 800 to 7 600, and in the case of foreign-controlled SMEs, the number of researchers fell from 2 400 to 2 300.

A closer analysis of the development of researcher numbers in relation to the enterprise size and ownership categories is not possible based on available data. For a detailed analysis, it would be necessary to track the development of each business entity over time. Generally, the development can be explained by the movement of researchers between the various categories (based on a variety of reasons), a weakening of the position of SMEs in favour of LEs or, conversely, the development of SMEs into LEs, their acquisition by foreign investors etc.

Figure 5.5: Evolution of researcher numbers by enterprise ownership and size (HC)



Number of researchers
LEs foreign
SMEs foreign
LEs domestic
SMEs domestic

Source: CZSO

5.3 Gender

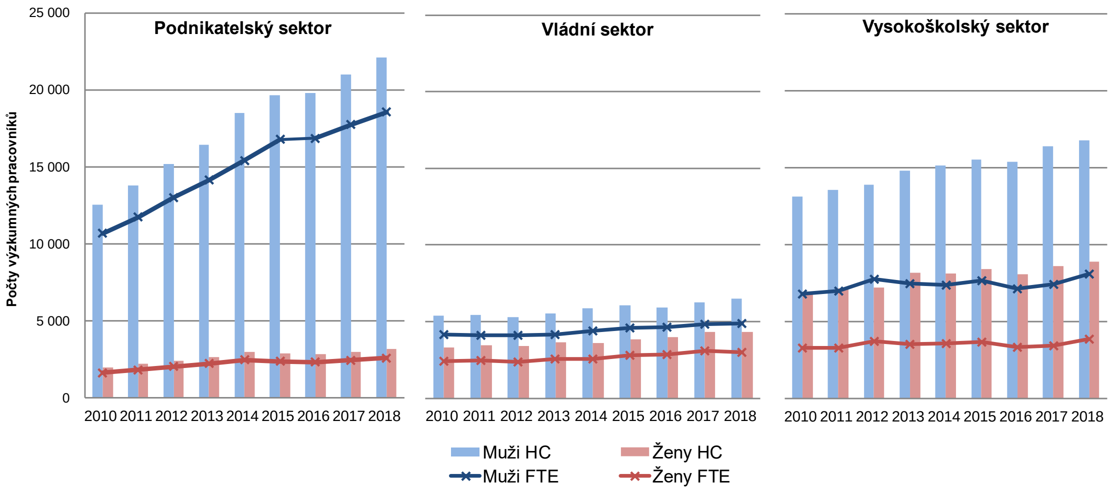
Figure 5.6 shows how male and female researchers are represented in each R&D execution sector over the period of 2010–2018. The proportion of female researchers to the total number of researchers in 2018 was 23.1% according to the FTE indicator and 26.5% according to the HC indicator.

The greatest disproportion between the representation of men and women over the entire reference period is in the business sector. According to the HC indicator women comprised only 12.5% of researchers in the business sector in 2018, the same as in 2017. In the base year of 2010, this share was 13.6%, i.e., the number of male researchers in the business sector grew faster than the number of women.

The highest relative representation of female researchers is in the government sector. Here, women comprise 40% of all researchers according to the HC indictor (in 2010, this share was 38%) and 38.2% according to the FTE indicator (in 2010, this share was 36.5%).

The representation of female researchers in the university sector is 34.7% according to the HC indicator (in 2010, this share was 34.3%) and 32.3% according to the FTE indicator (in 2010, this share was 32.7%).

Figure 5.6: Number of researchers in the Czech Republic by gender (2010–2018)



Number of researchers

Business sector
Government sector
University sector

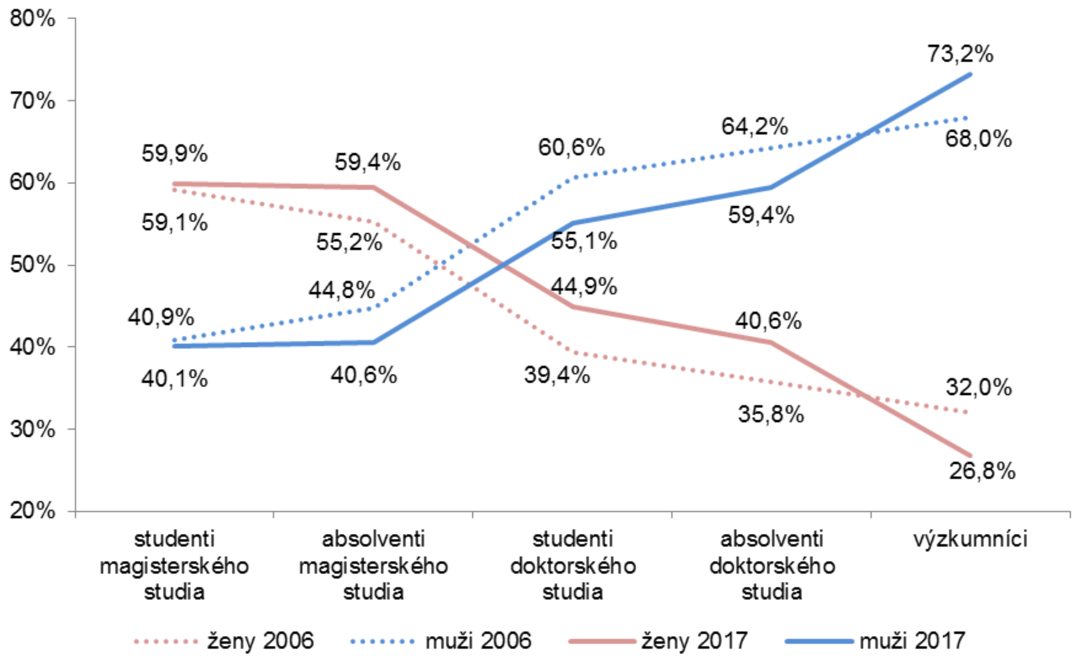
Men HC/FTE
Women HC/FTE

Source: CZSO

Figure 5.7 shows the representation of men and women at the various milestones along the path from a Master's degree, through a Doctoral degree, to research work (in percentage of HC for 2006 and 2017). The increasing divergence between the representation of women and men is apparent immediately. While women make up most of the students and graduates of Master's programmes, men predominate in Doctoral programmes. An even greater difference can be seen between the representation of women and men in research activities.

From the point of view of number of researchers, the technical and natural sciences are the most significant, as two-thirds of Czech researches are active in these fields. In terms of the representation of women in each field of science, the widest gap between men and women can be seen in the technical sciences. Only 13.2% of women (and 86.8% of men) are active in the technical sciences and 25.1% in the natural sciences. The representation of women in the humanities, agricultural and social sciences hovers around 41%. The greater proportion of women can be found in the medical sciences, with women comprising 48.2% in 2017 (men 51.8%).

Figure 5.7: Representation of women and men at each stage of an ideal scientific career path (HC %)



Master’s students
Master’s graduates
Doctoral students
Doctoral graduates
Researchers

Women 2006/2017
Men 2006/2017

Source: Position of women in Czech science, Monitoring Report for 2017 (NKC – gender and science)

Table 5.3 shows the proportion of women among R&D workers and among researchers for 2010 and 2017 in the EU 28. The countries are ranked according to the HC indicator in both parts of the table in 2017. In terms of both the proportion of women among R&D workers and the proportion of women among researches, the Czech Republic ranks near the bottom of the EU 28. The situation in the Czech Republic is the same for both the HC indicator and the FTE indicator.

Within the EU 28, Latvia has the greatest proportion of women among R&D workers (FTE 53.3%, HC 54.6%), followed by Lithuania (FTE 49.5%, HC 53%) and Croatia (FTE and HC both 50.6%). In the Czech Republic, the proportion of women among R&D workers is 28.1% according to the FTE indicator and 30.2% according to the HC indicator. The only EU 28 countries with a lower share are Austria, the Netherlands and Luxembourg (there is no data for France). Generally speaking, countries that have a low number of R&D workers rank at the top and, conversely, countries with a higher number of R&D workers report a lower proportion of women (see Table 5.1).

According to the proportion of women among researchers, the Czech Republic ranks even lower (FTE 23.1%, HC 26.8%). Of the EU 28, only the Netherlands (no data for France) is behind the Czech Republic in terms of the proportion of women among researchers (according to HC). As with the proportion of women among R&D workers, the proportion of women among researchers in the EU 28 is highest (according to HC) in Latvia (52.2%), Lithuania (51.6%) and Bulgaria (49.1%). According to the FTE indicator, Bulgaria would rank first (53.8%), followed by Latvia (50.1%) and Croatia (48.3%). As with the proportion of women among R&D workers, it can be said that the proportion of women among researchers is highest in countries with a lower number of researchers (see Table 5.2).

When making a qualitative assessment of whether this is good or bad, the fact that (excluding the Czech Republic) the seven countries where the proportion of women among R&D workers is less than 30% are countries that cannot be seen as backward or unsuccessful – i.e., the Netherlands, France, Germany, Malta, Luxembourg and Austria – is embarrassing. These are countries with a long history of free choice of education and career, so the proportion of women employed in R&D may indicate how interested women are in this kind of profession, an issue that the Czech Republic is also contending with.

Table 5.3: Proportion of women among R&D workers and researchers compared internationally (2010, 2017)

R&D workers – women					Researchers – women				
	2010		2017			2010		2017	
	FTE	HC	FTE	HC		FTE	HC	FTE	HC
Latvia	48%	50%	53%*	55%*	Latvia	47%	51%	50%*	52%*
Lithuania	53%	53%	49%*	53%*	Lithuania	51%	51%	47%*	52%*
Croatia	51%	50%	51%*	51%*	Bulgaria	50%	49%	54%*	49%*
Bulgaria	53%	52%	48%*	48%*	Croatia	49%	47%	48%*	48%*
Estonia	44%	47%	45%*	47%*	Romania	44%	44%	45%*	46%*
Romania	46%	45%	45%*	46%*	Estonia	41%	43%	41%*	44%*
Portugal	43%	43%	43%*	43%*	Portugal	44%	44%	43%*	43%*
Greece			40%**	43%**	Slovakia	42%	42%	40%*	41%*
Slovakia	44%	44%	41%*	42%*	Spain	38%	38%	39%*	40%*
Cyprus	40%	40%	41%*	41%*	Great Britain		38%		39%*
Spain	40%	40%	40%*	41%*	Greece			66%**	38%**
Poland		41%	36%*	39%*	Cyprus	37%	36%	37%*	37%*
Hungary	38%	41%	34%*	38%*	Poland	38%	39%	34%*	36%*
Denmark	35%	36%	39%	38%	Denmark	31%	33%	35%	36%
Sweden			30%**	37%**	Ireland	33%	34%	49%**	35%**
Belgium	34%	36%		36%**	Italy	35%	34%	36%*	35%*
Great Britain		37%		36%*	Slovenia	35%	36%	33%*	35%*
Slovenia	36%	38%	34%*	35%*	Belgium	32%	33%	14%*	34%**

R&D workers – women				
	2010		2017	
	FTE	HC	FTE	HC
Ireland	33%	37%	35%**	34%**
Finland		34%		34%*
Italy	34%	36%	33%*	33%*
Germany			27%**	32%**
Malta	25%	30%	27%*	32%*
Czech Republic	30%	33%	28%	30%
Austria			24%**	30%**
Netherlands			28%*	27%*
Luxembourg			26%**	26%**
France	24%	29%		

Researchers – women				
	2010		2017	
	FTE	HC	FTE	HC
Sweden			27%**	34%**
Finland		32%		33%*
Hungary	30%	32%	27%*	31%*
Austria			23%**	29%**
Luxembourg			28%**	29%**
Malta	26%	28%	27%*	29%*
Germany			23%**	28%**
Czech Republic	25%	28%	23%	27%
Netherlands			27%*	26%*
France	19%	25%		

*Source: Eurostat, ranked according to HC 2017 | * data for 2016, ** data for 2015*

6 Research Infrastructures

In recent years, the Czech Republic has reacted to the increasing importance of research infrastructures as one of the vital components of the Czech national research and innovation system and has taken several steps toward creating a stable environment for their construction and operation and investing further into their development.

6.1 Financial Instruments Supporting Research Infrastructure

In past years, financial instruments have been developed to contribute to building and developing research infrastructure systems in the Czech Republic. Support for research infrastructures from public resources can be divided into three groups: (i) Operational programmes co-financed from the SB, (ii) Special-purpose support programmes and groups of grant projects focused on building infrastructures and developing them further and (iii) Financial instruments focused on supporting the operation of RDI infrastructures and ensuring their sustainability. In addition to these financial instruments, institutional support of the long-term conceptual development of research organisations contributes substantially to the development of research infrastructure.

Table 6.1: Financial instruments of special-purpose support for the development of RDI infrastructures in the Czech Republic in 2005–2022 (in the case of common financial instruments, planned costs of running projects are indicated)

Provider	Programme code in RDI IS	Name of financial instrument/programme	Start	End	Aggregate costs over entire execution period (CZK mil.)	Allocated support over entire execution period (CZK mil.)	Actual utilised support until 2018 (CZK mil.)
Operational Programmes co-financed from the SB							
MEYS	ED*	Operational Programme Research and Development for Innovations (priority axes European Centres of Excellence and Regional Research and Development Centres)	2008	2015	42 027	6 292	6 233
	EF**	Operational Programme Research, Development, Education (selected calls)	2014	2020	15 378	14 597	9 154

Provider	Programme code in RDI IS	Name of financial instrument/programme	Start	End	Aggregate costs over entire execution period (CZK mil.)	Allocated support over entire execution period (CZK mil.)	Actual utilised support until 2018 (CZK mil.)
Programmes of special-purpose support and groups of grant projects focused on building infrastructures and their further development							
MEYS	1M	Research Centres (National Research Programme)	2005	2011	6 723	5 932	4 321
	LC	Basic Research Centres	2005	2011	4 072	3 164	2 407
	LR	Information – Basis of Research	2013	2017	1 991	1 017	1 017
CZSF	GB	Projects for Support of Excellence in Basic Research	2012	2018	3 079	3 063	3 112
	GX	Grant Projects of Excellence in Basic Research EXPRO	2019	2030	1 571	1 511	0
TA CR	TE	Competence Centres	2012	2019	9 070	6 180	5 407
	TN	National Competence Centres	2018	2026	2 182	1 711	0
Total special-purpose support programmes					**28 688**	**22 578**	**16 263**
Financial instruments focused on supporting operation of RDI infrastructures and ensuring their sustainability							
MEYS	LM	Large RDI infrastructure projects	2010	2022	12 565	10 513	8 430
	LO	National Sustainability Programme I	2013	2020	16 962	7 141	5 982
	LQ	National Sustainability Programme II	2016	2020	6 105	3 453	2 032
Total instruments for operating RDI infrastructures and ensuring their sustainability					**35 632**	**21 107**	**16 445**
Total financial instruments of support for RDI infrastructures in the Czech Republic (national programmes)					**64 320**	**43 685**	**32 708**

Source: RDI IS, date of export: 7 October 2019 | In the case of financial instruments that continue even after 2018, RDI IS data is taken from 7 October 2019; in the case of unfinished projects and their related Total Costs and Support Allocated from the SB, planned expenditure issued for executing already commenced projects are taken into account (allocated resources for 2019 and planned for coming years).

** in the case of RDI OP, only data from priority axes 1 and 2 are taken into account; in 2015, 26 new projects for the development of some centres built in previous years were financed.*
*** in the case of OP RDE, the list shows projects supported as part of these seven calls, which can be considered part of the financial instruments for the support of RDI infrastructures:*

02_15_003 – Support of Excellent Research Teams (only with the IF designation)
02_15_008 – Phased Projects
02_16_014 – Building Expert Capacities – Technology Transfer
02_16_040 – Strategic RDI Proceedings at National Level I (CzechElib)
02_15_006 – Teaming (HiLASE Centre of Excellence)
02_16_013 – Research Infrastructures
02_16_017 – Research Infrastructures for Education Purposes

In 2018, these two calls were announced. They can be considered part of the financial instruments for the support of RDI infrastructure
02_18_046 – Research Infrastructures II02_18_072 – Research e-infrastructures

Table 6.1 provides an overview of financial instruments supporting RDI infrastructures realised in the Czech Republic since 2005. These funds can be viewed as finances that contributed to the creation or development of research infrastructures in the Czech Republic. Total costs for the duration (i.e. until 2022) of grant and programme projects supporting infrastructures amounted to CZK 64.3 bn. and actual utilised support from the SB until 2018 amounted to CZK 32.7 bn. Until 2018, public funding for research infrastructures was drawn from two operational programmes: OP RDI and OP RDE. The allocated funding for ongoing OP RDE projects amounted to CZK 14.6 bn. (i.e. EU+SB), and 142 projects linked to RDI are being realised (list of calls – see the note under Table 6.1). A further five special-purpose programmes and two grant projects aimed at building infrastructures and developing them further were identified. The providers of this support are: MEYS, GA CR and TA CR. In 2017, the Information – Basis for Research programme ended. Building on this project is the National Centre for Electronic Information Sources – CzechElib (see the call Strategic Management of RDI on National Level I – OP RDE). Support from Projects Supporting Excellence in Basic Research ended in 2018. Their successors are the EXPRO Grant Projects of Excellence in Basic Research. Other programmes currently running are the Competence Centres and the National Competence Centres (NCCs), which are being implemented by TA CR. Large Research Infrastructures are considered to be the centre of support from public resources for the operation of research infrastructures, and the special-purpose National Sustainability Programme I and II are considered an important addition to support for the development and sustainability of the research infrastructure. The text then discusses European Centres of Excellence and Regional Research and Development Centres as well as Large Research Infrastructures.

6.2 European Centres of Excellence and Regional Research and Development Centres

An important condition for the development of science in the Czech Republic is the internationalisation of the R&D environment, which is tied in particular to cooperation on international projects and the work of researchers abroad in European Centres of Excellence and Regional Research and Development Centres. The fact these research centres contribute to the greater involvement of Czech institutions in international projects is documented, inter alia, by the discovery that centres supported by OP RDI comprise a high proportion of recipients in the role of coordinator of projects realised as part of H2020.

The centres were created from projects financed from PA 1 and PA 2 of OP RDI, and some of these centres can be considered unique research infrastructures.[44] Centres that were created from projects financed from PA 1 of OP RDI carry out world-class R&D. Centres financed from

[44] Definition according to Article 2(91) 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, where they need not always be large research infrastructures approved by the government.

PA 2 of OP RDI constituted, from the perspective of the Czech Republic, "Regional Research and Development Centres"; however, several of them nevertheless attain at least national importance with substantial international overlap. In the Czech Republic, these centres are part of specialised R&D centres that have been in the process of being built since 2005.

FUNDING OF EUROPEAN CENTRES OF EXCELLENCE AND REGIONAL RESEARCH AND DEVELOPMENT CENTRES

According to the Act on Support for Research, Experimental Development and Innovation, these centres can be funded using special-purpose financial instruments and institutional support. Resources from OP RDI were a substantial source of funding. They exceeded CZK 42 bn. and were used to build and develop 48 centres. The financial sustainability of European Centres of Excellence and Regional Research and Development Centres is guaranteed until 2020 from several sources.

Costs are paid from the MEYS heading, from SB research, experimental development and innovation expenditures, specifically from the activity of special-purpose expenditure through the help of the National Sustainability Programme (NSP I and II) and Large Research Infrastructure Projects, all in line with Section 3(2)(d), Section 4(1)(e) and Section 7(5) of Act No. 130/2002 Coll., on Support for Research, Experimental Development and Innovation. Special-purpose support funds from the SB to support RDI are also allocated by other providers under their programmes. For example, GA CR administers the programme entitled "Project for Support of Excellence in Basic Research", and TA CR used to provide funds from the programme entitled "Competence Centres" and now provides them through the programme entitled "National Competence Centres".

TA CR announced the NCCs programme in mid-2018. This programme is aimed at supporting long-term cooperation between the research and application spheres and strengthening the institutional foundation of applied research. The programme aims synergistically to link already existing, successful centres that were established using support from TA CR (Competence Centres), GA CR (Centres of Excellence) and operational programmes (particularly "RDI Centres") with other research centres and units to form a single integrated system, i.e., NCCs. The programme should substantially strengthen the segment of research organisations focused on applied research and motivate relevant existing research facilities with the aim of concentrating their research and technological capacities into NCCs, where first-class applied research will be carried out according to the needs of the application sphere. The programme objectives are as follows: to increase the efficiency and quality of the results of applied research and transfer technology in key fields with a prospective for growth, increasing the competitiveness of businesses; and to strengthen the excellence and the application relevance of research organisations. The estimated duration of the programme is nine years (2018 to 2026). Total programme expenditures from the SB amounted to CZK 7 184 mil. The first public tender for the selection of projects for the programme was announced in 2018, with the provision of support commenced the same year. The first public tender will support projects to be implemented by

2020, with the possibility of two-year extension, i.e., until 2022. Announcement of the second public tender is planned for 2020 with support as of 2021, with the possibility of obtaining support for as much as a six-year project.

Research organisations operating European Centres of Excellence or Regional Research and Development Centres can utilise institutional support for the long-term development of research organisations. These centres are also supported by non-public funds, i.e., from the business activities of research organisations or from foreign funds. Foreign public resources usually take on the form of international collaborative projects funded, e.g., from the 7th RP, the H2020 programme or EEA and Norwegian Funds, provided these projects are realised at least in part by a European Centre of Excellence or a Regional Research and Development Centre.

LONG-TERM SUSTAINABILITY OF EUROPEAN CENTRES OF EXCELLENCE AND REGIONAL RESEARCH AND DEVELOPMENT CENTRES

The consequences of the originally planned change in funding sources with an impact on total income, which ensued from the survey conducted by the MEYS in 2018,[45] should not be significant. This change should have been mainly a result of termination of NPS and the TA CR Competence Centres projects. In 2018, however, TA CR announced the first NCC call, which should reduce this shortfall.

According to the above survey of 48 centres, about a fifth (10) expect a reduction in total income in 2021, which can be attributed to the termination of NSP subsidies. Conversely, almost half of the centres (23) are expecting their total income to grow by more than 10% in 2021, which may be caused by a second NCC call, administered by TA CR, under preparation. The anticipated absence of income for centres from NSP will be compensated for example through institutional support at ROD or through income from foreign public sources. In the case of most centres, the effort to diversify income is noticeable; nevertheless, due to the specific nature of each of the centres, it is not possible to generalise the various items.

No major changes in the method of integration in the case of centres is expected even after 2021. Most centres will continue to function as an independent division or organisational unit that is part of a research organisation (called host institution by the MEYS). The organisational change will be carried out only at one centre. ELI will be transformed in connection with the creation of the ELI-ERIC consortium.

In the case of expenditures, an increase in investment costs related especially to the need for ongoing innovation of acquired technology and renewal of aging technology is expected along with higher maintenance costs. The recipients further mention a slight growth in expenditure in all items, even with regard to inflation and the anticipated rise in wages. There was mention of the possibility of reducing staff or decreasing workloads if cost-reduction is necessary.

[45] Presented at the 335th meeting of RVVI on 27 April 2018.

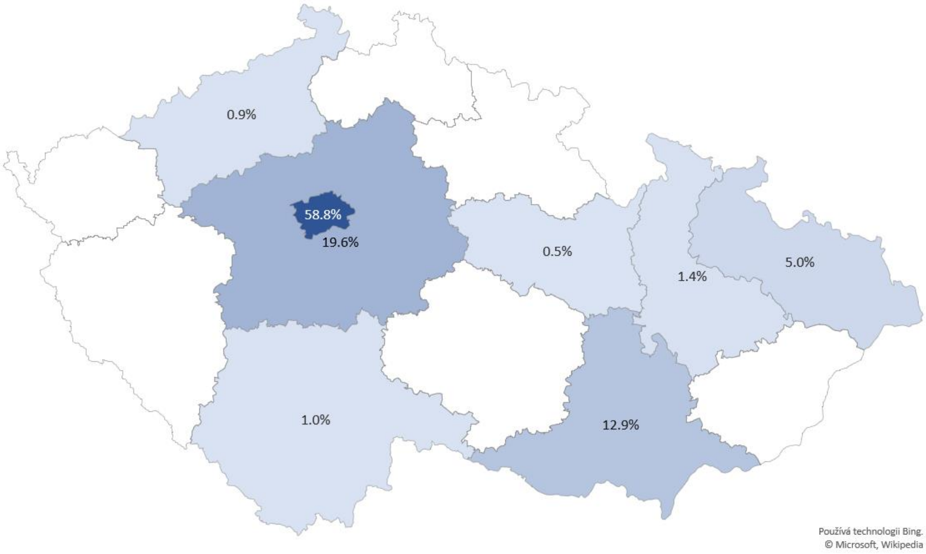
Institutional support, international grants and income from executed OP RDE and NCC projects are among the most important budgetary sources that should replace NSP. Ensuring the operation of RDI centres will remain the full responsibility of the host institution and all their available sources, including ROD.

6.3 Large Research Infrastructure

According to Section 2(2)(d) of the Act on the Support for Research, Experimental Development and Innovation, Large Research Infrastructure is defined as “research infrastructure required by research facilities to carry out comprehensive R&D that is highly demanding financially and technologically, approved by government and established for use by other research organisations as well.” Large Research Infrastructures contribute substantially to increasing the efficiency of support for research, development and innovation from public funding. They are unique facilities achieving exceptional levels of knowledge and technology. Operations and other investment development are ensured by the host institutions, which provide access to their facilities to potential users from the research community and the industrial sector on an open-access principle. In general, it is possible to typologically differentiate the research, development and innovation capacities built in 2007–2015 using OP RDI and partially OP PC [Prague Competitiveness] according to their primary purpose and focus, i.e., according to “in-house R&D facilities” and “Large Research Infrastructures”, entirely independent of whether they are capacities operated by universities, research institutions or other legal entities, public or private. “In-house R&D capacities” are generally capacities used by their hosting research organisations to carry out their own research, development and innovation, i.e., to generate their own research, development and innovation results. On the other hand, Large Research Infrastructures are unique facilities that are used by potential users from research organisations and even the private sector, essentially eliminating the need to purchase expensive instruments even in other institutions, thereby contributing to improving the effectiveness of financing. In technologically demanding fields, they ensure the competitiveness of R&D.

The OP RDE programme built on the mentioned programmes in 2016–2022, where a series of specific calls for support in funding Large Research Infrastructures was announced. Figure 6.1 below provides an overview of Large Research Infrastructures for 2016–2019 and their distribution across the regions by host institution.

Figure 6.1: Regional distribution of research infrastructures and allocated support from the SB for 2016–2019



Source: RDI IS | Note: Number of LRIs in each region: Prague (34); Central Bohemia (8); South Bohemia (1); Ústí nad Labem (1); Pardubice (1); South Moravia (11); Olomouc (1); Moravia Silesia (1).

The important role of Large Research Infrastructures consists in providing open access to their unique facilities, expertise and related services, but mainly their characteristic of strategic and longer-term investment. The MEYS, which is the central public administration body of the Czech Republic responsible for supporting Large Research Infrastructures, set up a special advisory body in 2010 to carry out the respective agenda: the Council for Large Research Infrastructure, which acts as its primary consultancy body. In the previous period, the Czech Republic became a member of 14 legal entities with the legal form ERIC (e.g., BBMRI ERIC, CERIC-ERIC). The Czech Republic is also involved in the construction, operation and utilisation of international research infrastructures that are established and operated based on international public law.

Facilities operated by research infrastructures are basically divided into three groups: "single-sited" research infrastructures located in one place; distributed research infrastructures, which include a greater number of facilities found in various locations; and virtual research infrastructures. Research infrastructures are also divided by life-cycle into research infrastructures in their preparatory phase, implementation or construction phase, operating phase and decommissioning phase. All these types of research infrastructures – with the exception of decommissioned research infrastructures – are found even in the national research and innovation system of the Czech Republic. In the Czech Republic, facilities that are operating for the purpose of ensuring the Czech Republic's involvement in international research infrastructure abroad are a specific kind of Large Research Infrastructure project. The purpose of such Large Research Infrastructure projects is to ensure the Czech Republic's share in the construction or upgrading of technological facilities of international research infrastructure in the form of development and "in-kind" supply of experimental facilities (e.g., CERN). If such international research infrastructure is managed by the legal form of an international organisation established according to international public law or ERIC, all other commitments relating to the membership of the Czech Republic (e.g., the payment of mandatory membership fees) are already guaranteed by the MEYS as the relevant public administration body for the Czech Republic, which also then becomes the entity performing membership duties in the international legal entity on behalf of the Czech Republic.

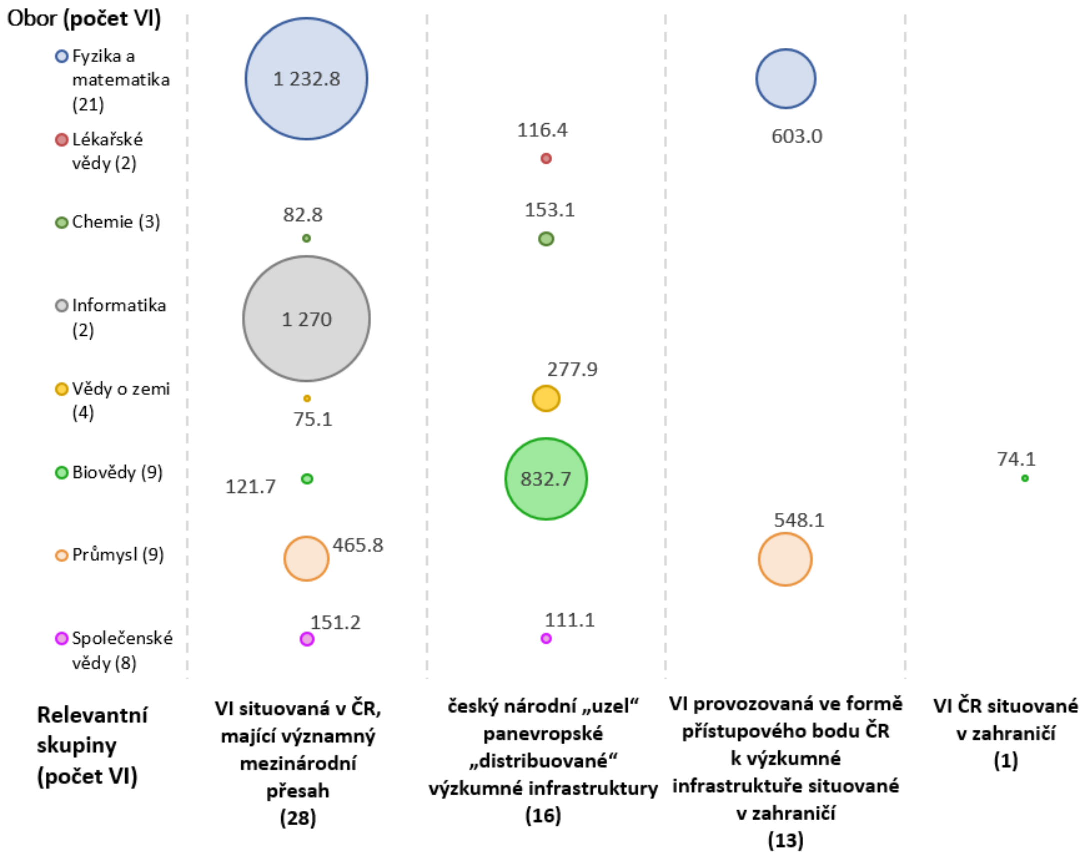
There also exist international research infrastructures that do not have the legal form of ERIC or of international organisations established based on public law; instead, they are established based on the legal framework of their host countries (e.g., the Jules Horowitz Reactor). Their member state does not enter into these legal entities, nor does it have any mandatory membership obligations to the respective legal entity (e.g., payment of membership fees). In such cases, the Large Research Infrastructure project is in some way an “access point” to the international research infrastructure, where the Large Research Infrastructure project promoter arranges for the Czech user community those matters that (in the case of ERIC legal entities or international organisations established based on international public law) are arranged directly by the MEYS for the Czech Republic as a member state of such legal entities.

A specific kind of Czech research infrastructure that is not financed from the Large Research Infrastructure support scheme, but by a different legislative financing framework, are LRIs, where the Czech Republic is a member state (e.g., CERN, EMBC, EMBL, ESA).

ESRF (European Synchrotron Radiation Facility), ILL (Institut Laue-Langevin) and European XFEL (European X-Ray Free Electron Laser Facility) are all examples of the situation where – with regard to the legal nature of these international entities, which deviates from the attributes of international intergovernmental organisations established according to international public law or the ERIC legal framework – the involvement of the Czech Republic in international research infrastructures is not secured in the form of major infrastructure projects. The Czech Republic’s involvement in these facilities is thus secured directly by the research community.

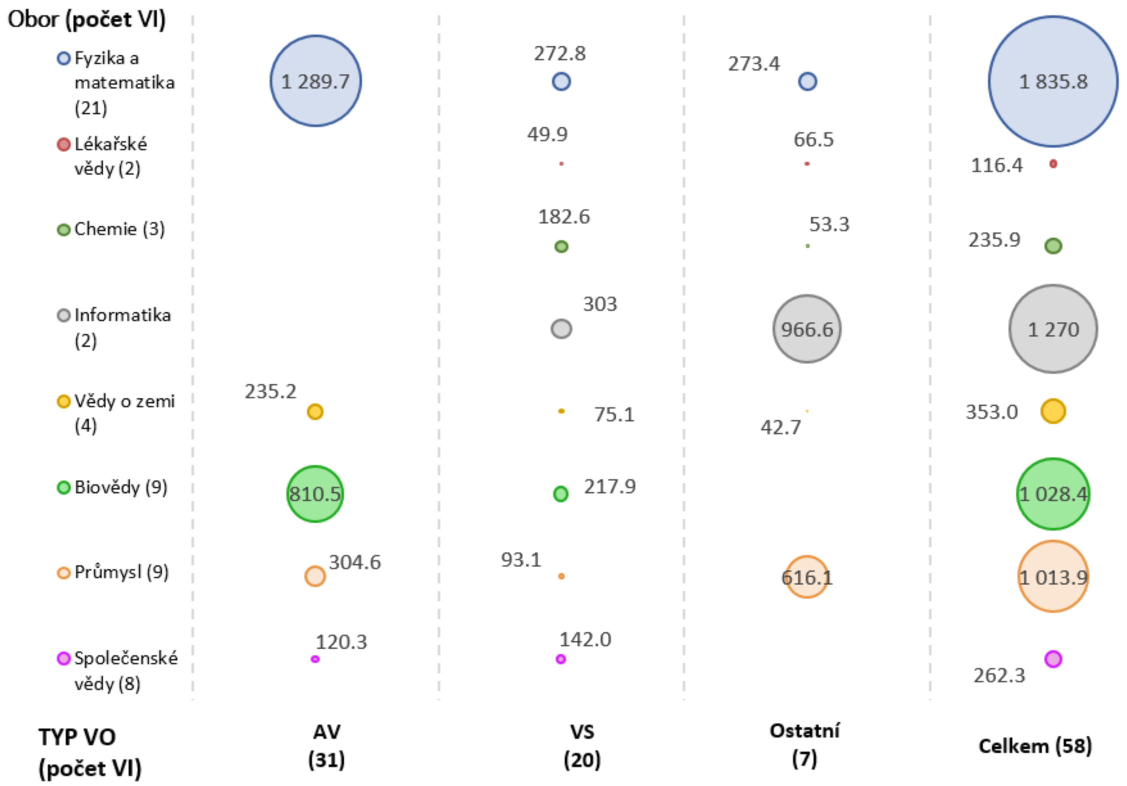
Figure 6.2 provides an overview of Large Research Infrastructures by field and relevant group under the Czech national RDI system and is based on the 2015 update of the Roadmap of Large Research Infrastructures.

Figure 6.2: Overview of Large Research Infrastructures, structured by field and relevant group under the Czech national RDI system and allocated support from the SB for 2016–2019



Field (Number of RIs)
Physics and Mathematics
Medical Sciences
Chemistry
Computer Science
Earth Sciences
Biosciences
Industry
Social Sciences

Relevant groups
(number of RIs)
RIs situated in CR with significant international reach
Czech national “hub” pan-European “distributed” research infrastructures
LI operated in the form of an access point for CR to research infrastructures situated abroad
CR LIs situated abroad



Field (Number of LIs)
Physics and Mathematics
Medical Sciences
Chemistry
Computer Science
Earth Sciences
Biosciences
Industry
Social Sciences

RO TYPE
(number of LI)
AS
UNI
Other
Total

Source: RDI IS and MEYS data | Note: The figure at the top is based on the Roadmap of Large Research Infrastructures from 2015. A new roadmap was approved in 2019. The Czech Republic is a member of 14 ERIC legal entities.

Large research infrastructure operating costs are paid for from the MEYS chapter of the SB related to research, experimental development and innovation expenditure, specifically special-purpose activities of Large Research Infrastructure Projects (code LM). The MEYS is continuing to count on this funding in 2020–2022. In the case of investment costs, financing from ESIF funds, specifically OP RDE, is expected in 2020–2022 based on an assessment of two calls (Research Infrastructure II and Research e-Infrastructure).

The total annual amount of the special-purpose support provided by the MEYS will be CZK 1 890 mil. in 2020–2022. The difference between the approved expenditure framework of special-purpose support for large research infrastructures stipulated by Czech Government Resolution No. 309 of 16 May 2018 proposing expenditure of the Czech SB for research, experimental development and innovation for 2019 with a medium-term view to 2020 and 2021 and long-term view to 2025 (CZK 1 720 mil.) and the above-mentioned aggregate amount of MEYS special-purpose support (CZK 1 890 mil.) will be paid by way of including claims from unutilised expenditures earmarked for this purpose by the MEYS. The expert advisory body for the MEYS is the Council for Large Research Infrastructure (LRI Council), which was established in 2010. The LRI Council associates all relevant stakeholders in large research infrastructures in the Czech Republic, i.e., the representatives of the MEYS, the LRI Council, the Czech Rectors Conference, the Council of Universities, the AS CR and the most important large infrastructures operated in each scientific field and branch. Its activities comprise cooperation with the MEYS on preparing the methodological framework for assessment, responding to proposals to commence or terminate membership in ERIC legal entities and, as a professional advisory body, drawing up various opinions for the MEYS.

In 2019, the LRI Council established the LRI WG, aimed at defining both research infrastructure and large research infrastructure in order to set up a model for their funding and required contribution after 2022. On 4 February 2019, the government approved the document entitled “Innovation Strategy of the Czech Republic 2019–2030”. “Innovation and research centres” are one of the pillars of this strategy. Stakeholders focused mainly on one of the pillars of this strategy: “creating a mutually complementary capacity funding scheme for RDI from institutional support for the longer-term conception development of research organisations and large research infrastructures on the one hand and, on the other, instruments supporting long-term strategic cooperation of the public research sector and industrial sector in the form of National Competence Centres”.

CZECH ROADMAP OF LARGE RESEARCH INFRASTRUCTURES

The Czech Roadmap is based on the ESFRI Roadmap, which was first drawn up in 2006. It was last updated in 2018 and the next update is planned for 2021. The ESFRI roadmap includes European research infrastructures for which the proposals have either been successfully implemented by the host countries or are in various stages of preparation or construction, and places them in the context of the European research institutes landscape in the form of an analytical study. The Czech Roadmap of Large Research Infrastructures provides a strategic model of support for large research infrastructures in 2016–2022, which places emphasis on the effective use of funds from the Czech SB and from ESIF, specifically from OP RDE. This is a model of mutually compatible and highly effective utilisation of both these budgetary sources. It contains basic information about all 48 large research infrastructures from physical sciences, energy science, environmental sciences, biomedicine, social sciences, the humanities and ICT earmarked for support from Czech public funds until 2022.

The latest update of the Czech Roadmap from 2019 was carried out in connection with the approval of large research infrastructures and their financing until 2022. The Czech Roadmap of Large Research Infrastructures thus only shows larger research infrastructures that, in line with the respective Czech Government Resolution, will receive guaranteed funding from the MEYS in the form of special-purpose support until 2022 and will thus also be eligible for inclusion in the complementary OP RDE call for the payment of their investment costs.

OUTLOOK TO 2023+ FOR FINANCING OF LARGE RESEARCH INFRASTRUCTURES

In 2021, the large research infrastructures in the Czech Republic will be evaluated and new proposals will be made. This evaluation will serve as a tool for obtaining independent expert documentation for the Czech Government to make informed political decisions on support for large research infrastructures from Czech public resources in 2023–2029. In the long-term proposal submitted by the MEYS for Czech SB expenditures on research, development and innovation in 2022–2025, the anticipated unavailability of ESIF after 2022 will also be taken into account. In the resources allocated to special-purpose support, the MEYS is counting on a budgetary allocation for the payment of the investment costs of large research infrastructures, which do not have to be paid until 2022 utilising ESIF resources through OP RDE.

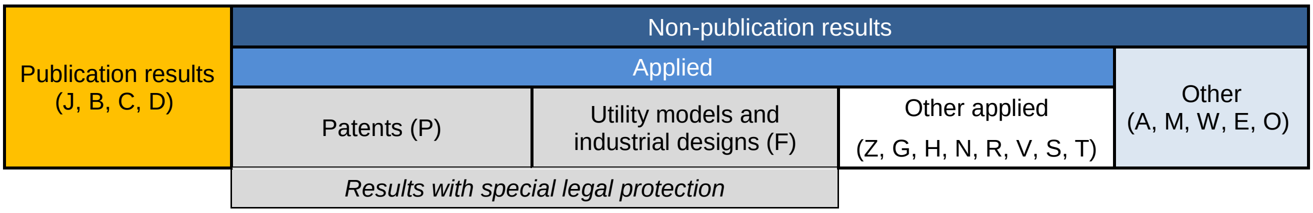
In the case of newly submitted proposals for large research infrastructures, a so-called “gap analysis” will be carried out, followed by an ex-ante evaluation. The objective of this analysis is to map the socio-economic demand for new, large research infrastructures and to determine the areas where the Czech Republic will identify demand. Based on the outputs of such international evaluation, a budgetary framework for financing large research infrastructures in 2023+ will be drawn up in 2022 at the time the Czech SB for research, development and innovation for 2023 and its medium-term outlook for 2024–2025 is going to be prepared. It is assumed that large research infrastructures will, as of 2023, be financed over seven-year periods from Czech public resources, i.e., similarly to the way EU framework programmes for research, development and innovation and the instruments of the EU cohesion policy are implemented over seven-year periods.

So far there are two options for arranging support from Czech public resources after 2022 for large research infrastructures. In the first option, the MEYS suggests the payment of operating costs using expenditures form the Czech SB for research, development and innovation from the MEYS special-purpose support resources earmarked for large research infrastructure and of investment costs utilising ESIF resources. In the second option, the MEYS counts on the payment of operating and investments costs using SB expenditure for research, development and innovation from the MEYS special-purpose support earmarked for large research infrastructures.

7 Results of Research and Development

Results constitute important proof of execution of R&D activities. Depending on the type of executed activity (basic or applied research, experimental development, innovation) and its objective, results of different character arise. For analytical purposes, results can be divided by character into publication and non-publication results. These can be further divided up into applied results and other results (Figure 7.1). **Publication results** are usually connected to basic research in particular, although new findings are also published in applied research. The most valued published results are those of world-class quality. As regards **non-publication applied results,** they are most often created through applied research and experimental development. In the case of most of these results, their sustainability in practice with commercialisation possibilities is expected, especially because the creation of such results is emphasised in strategic RDI documents, such as the National RDI Policy for 2016–2020.

Figure 7.1: Types of results of R&D defined in the Czech Republic



Result codes are shown in brackets. The result code list is set out in Annex 3.

In the Czech Republic, RDI results greatly affect how research organisations are evaluated. In terms of the effective use of funding, it is particularly necessary to monitor the proportion of specific types of results to their total number and level of quality or, as the case may be, their potential for practical use. The quality of publication results can, in the case of articles in periodicals, be inferred from the level of such periodicals[46] and the degree to which specific articles are cited, which usually testifies to the use of the findings therein by other authors in related R&D activities. Such an indicator of quality is missing in the case of monographs and articles in proceedings. The quality of applied results is assessed mainly in the framework of MODULE 1 (see Methodology 2017+), the aim of which is to motivate research organisations to carry out first-class research when compared internationally. Another objective is motivation to carry out research with a high potential for the application of results in practice. The evaluation principle is assessment of selected results by a panel of experts in terms of quality, originality and significance compared

[46] This is due to registration in recognised global databases, by bibliometric indicators determined based on the total number of articles in a certain periodical and their citation impact, e.g. impact factor, Article Influence Score. For some fields, such as the Humanities, the necessary bibliometric indicators are often missing; it is therefore appropriate to take into account other/alternative qualities when evaluating them.

internationally. What is important is the contribution that the applied results bring in the form of their practical application. In the case of patents, their contribution can be inferred from the financial resources generated from the sale of licences; however, the sale of licences is not always the aim of patent protection, as often it is an effort to protect a unique procedure or technology to allow it to be used further in the originator's institution.

RDI IS result data provide a comprehensive overview of RDI productivity in the Czech Republic. In connection with the nature of the support for conducted RDI (institutional or special-purpose – for more details see Chapter 2 – Funding Research and Development from the State Budget), the financial instruments of public funding for RDI can be assessed partially; however, it is also necessary to keep in mind the basic limitations connected to the use of result data:

- Under the Act on Support for Research, Experimental Development and Innovation, the submission of RDI data into RDI IS is mandatory only for beneficiaries of support from the public budgets for research, development and innovation. Information about results in the business sector are thereby substantially limited.
- Most of the above types of results cannot be understood as results in the true sense of the word, as the aim of research, be it basic or applied, is not the creation of publications, but the acquisition of new knowledge. Publication is a method of disclosing a finding, i.e., its dissemination. Similarly, a patent, utility model or industrial design is not the primary objective of applied research or experimental development, but a form of protection of new findings. From the analytical point of view, it is a basic indicator testifying to the level of execution of the research, but it cannot be used to directly measure the efficacy of R&D activities.
- R&D become a true contribution only upon the application of new findings, either already published or legally protected, not by the creation of publications, patents, utility models and industrial designs.

In 2018, evaluation on the national level according to Methodology 2017+ took place, and complete reports were published on the updated RDI IS website. Evaluation on the national level takes place uniformly for the entire research, development and innovation system. Four types of reports are produced: evaluation of selected results in Module 1[47]; bibliometric analyses in Module 2[48]; and classification by research organisation and by field for both modules (Module 2 also contains detailed commentaries by Expert Panels). The reports are intended for providers to allow them to study and review them in depth. The reports as a whole serve as the starting point for tripartite negotiations for updated indicative scaling of research organisations. The results of the

[47] MODUL 1 – Evaluation of selected results: Field reports http://hodnoceni18.rvvi.cz/www/nebiblio; Report for RO http://hodnoceni18.rvvi.cz/www/nebiblio [cit. 2019-11-30].

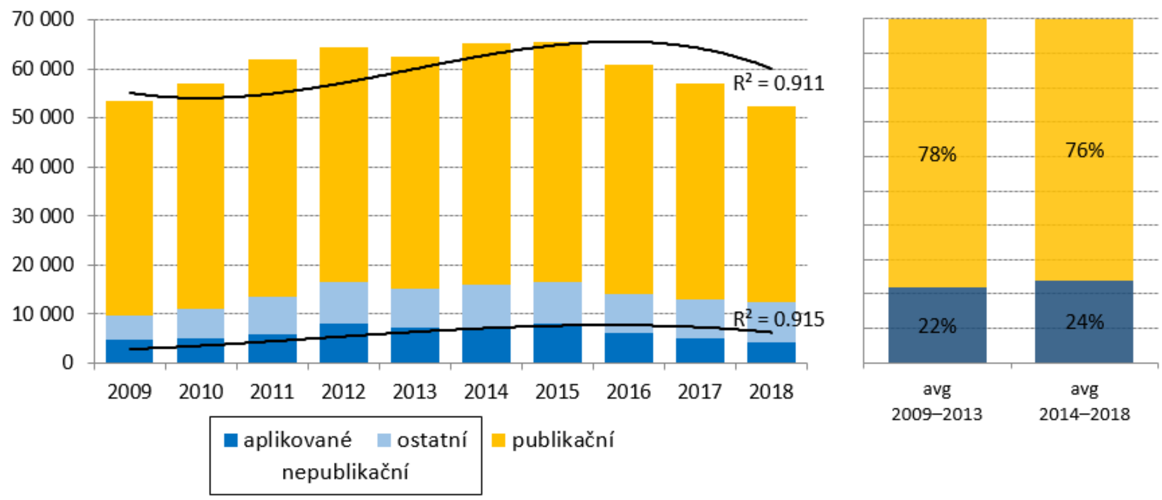
[48] MODUL 2 – Bibliometric analyses: Field reports http://hodnoceni18.rvvi.cz/www/biblio-obory; Reports for RO http://hodnoceni18.rvvi.cz/www/biblio-vo [cit. 2019-11-30].

evaluation represent, in accordance with Methodology 2017+, one of the supporting documents for funding the respective RO. The reports are further intended for research organisations, as they constitute a source of information for management, provide information about the quality of their research compared nationally and, in the case of Module 2, are compared globally and vis-à-vis production in the EU 15 countries. Publication of analysed input data allows for a more in-depth analysis to the necessary degree of detail.

7.1 Types of Results and Their Numbers over Time

Figure 7.2 clearly shows the evolution of results in the Czech Republic based on data from RDI IS over a 10-year period, specifically from 2009 to 2018. In the reference period, the evolution of the number of results trended predominantly upwards; nevertheless, in the last three years, it is possible to see a drop in the number of results. The drop in the number of results in 2016–2018 was caused by a drop in type D publication results (articles in proceedings – a decrease of approximately 1 600 in 2016 and 2017 and a decrease of about 1 200 in 2017 and 2018). A decline can also be seen in non-publication results, especially in 2016 and 2017 in the case of type V results (research reports – a decrease of approximately 1 000 in 2016 and 2017). A low proportion of non-publication results to the total number of results has long been seen; nevertheless, if we compare the average proportion of non-publication results calculated over two five-year periods (2009–2013 and 2014–2018), it is possible to see that the proportion of non-publication results to total results grew by two pp (from 22% to 24%).

Figure 7.2: Numbers of publication and non-publication results in the Czech Republic in 2009–2018 and their average relative representation in 2009–2013 and 2014–2018

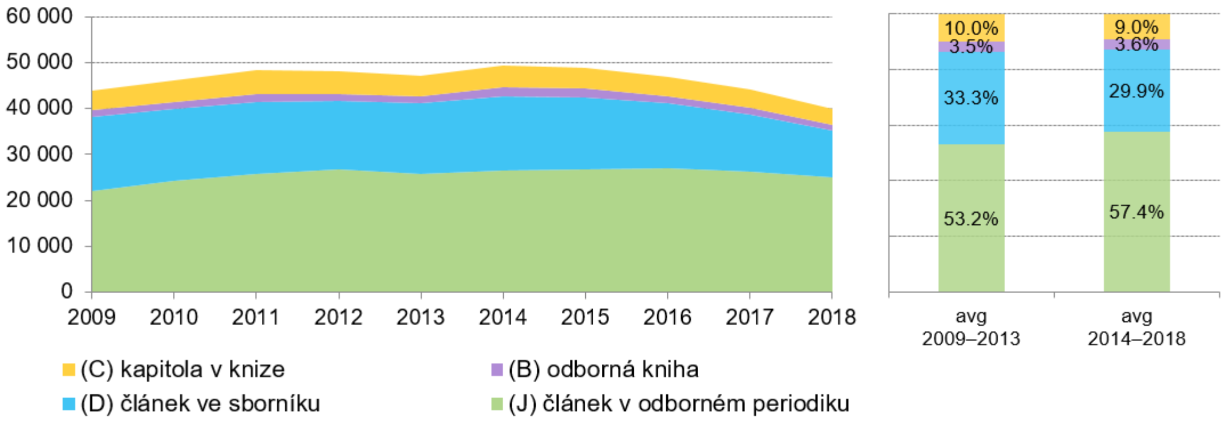


Applied
Other
Non-publication
Publication

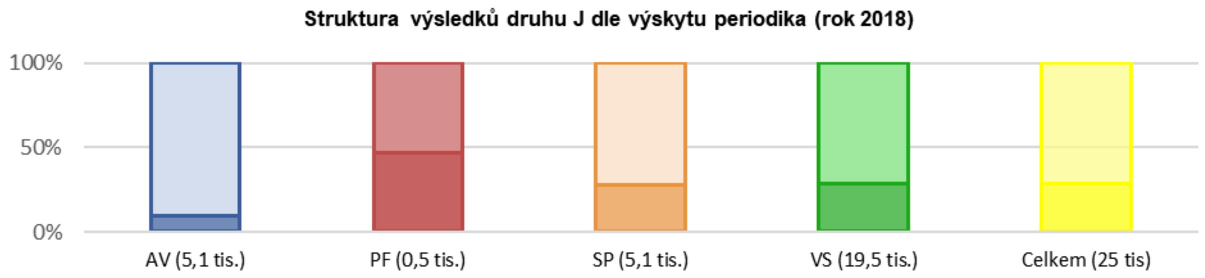
Source: RDI IS, status of database as at 30 June 2018, data exported on 31 July 2019

As regards the types of publication results (Figure 7.3), peer-reviewed scientific articles (type J) have been prevailing in recent years. From 2009 to 2016 their number grew by about a quarter to 27 000 in 2016. This was followed by a decline to just under 26 000 in 2017 and 25 000 in 2018. In 2018, reviewed scientific articles comprised almost 63% of publication results (in 2016 this was almost 58%). The number of articles in proceedings (type D) fell gradually in 2009–2013 from 16 100 to 15 300; in 2018, they were at their minimum with 10 200. In the past, articles in proceedings constituted the greatest number of publication results but were gradually overtaken by reviewed articles for the most part. This can also be seen based on a comparison of the average share of type J and D results calculated over two five-year periods (2009–2013 and 2014–2018): the proportion of type D results fell by almost 3.5 pp (from 33.3% to 29.9%) in favour of the proportion of type J results (from 53.2% to 57.4%). The growing proportion of reviewed scientific articles in total published results may indicate that the quality of publication results is growing. Changes in the approach towards evaluating research organisations, where increasing emphasis is being placed on publication in top journals, probably contributed substantially to this. The proportion of type B results was practically constant over time, which can be interpreted as the production of these results being less sensitive to changes in evaluation methodology; this may also be due to the time needed to complete results of this type.

Figure 7.3: Types of publication results and their numbers in the Czech Republic in 2009–2018 and their average relative representation in 2009–2013 and 2014–2018



(C) Chapter in book
(D) Article in proceedings
(B) Scientific book
(J) Article in scientific journal



Structure of type J results by occurrence of periodical (2018)
AS, LP, GO, UNI, Total

Source: RDI IS, status of the database as at 30 June 2019, data exported on 15 July 2019
The structure of type J results contain data in the structure of results applied in 2018. The top of the columns express the proportion of articles published in WoS and Scopus indexed journals; the bottom expresses the proportion of articles published in other reviewed periodicals. ***AS*** *– public research institutions established by the AS CR pursuant to Act No. 341/2005 Coll.;* ***UNI*** *– Universities (public, state and private);* ***GO*** *– organisations co-funded by the state, organisational units of the state and public research institutions other than the institutions of the AS CR and public universities;* ***LP*** *– legal and natural persons, individual and institutions not falling under any of the above groups, e.g., joint-stock companies, limited-liability companies, publicly beneficial companies, foundations, civic associations.*

Figure 7.3 also shows the structure of type J results according to occurrence in periodicals and according to type of research organisation that contributes to the creation of the result. It is apparent that over 70% of all articles are published in journals indexed in the WoS or Scopus databases. Universities (UNI) are the largest producers of type J results in all types of periodicals; government organisations (GO) contributed to the creation of a comparable number of articles as the AS CR, with teaching hospitals being the largest contributors of articles in the GO category; the LN group (i.e. predominantly companies) contributed the fewest articles (500) compared with other groups. If we focus on the proportion of publications indexed in the WoS and Scopus databases to all reviewed articles produced by each respective group in 2018, the institutions of the AS CR substantially surpass universities (over 90% of articles in WoS and Scopus are by AS CR institutions compared to 7% by universities); this difference may also be influenced to a certain extent by the disciplines focused on by AS CR institutions and universities. In the case of universities, just as in the case of organisations co-funded by the state and businesses, a greater proportion of publications are found in other reviewed periodicals. In the case of businesses that focus on R&D, there is a tendency to publish in other reviewed periodicals as well, and that may be related to the effort of these entities to disseminate the results of research into practice because, similarly to conference proceedings, Czech reviewed periodicals in particular may be more accessible and utilisable by national experts, the public and manufacturing. However, this may also indicate a persistent effort to publish only partial results or results of little interest in an easier way, with entities possibly being motivated to opt for such an approach due to the system for evaluating research organisations that was in place until 2016. If it continues to persist, the new Methodology

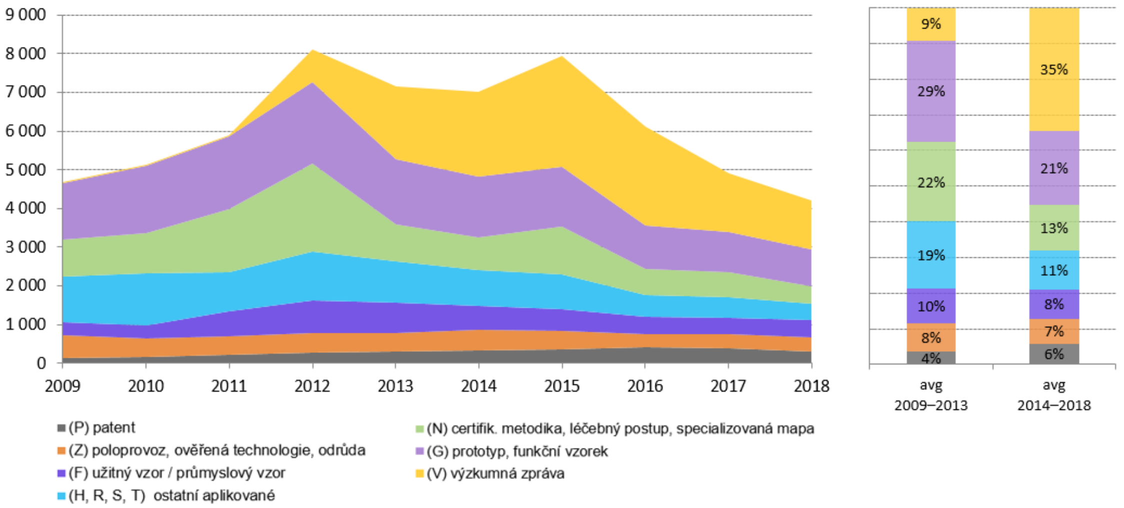
2017+ can be expected to eliminate this practice. There is insufficient information on the further use of publications by other entities, especially producers and manufacturers, to differentiate whether this is a positive effect (dissemination of knowledge into practice) or a negative one (publication at any cost) and assess all the consequences (fragmentation of knowledge across several publications of less renown, making it impossible to obtain protection of intellectual property etc.).

Figure 7.4 provides a detailed overview of the development of the number of non-publication applied results and clearly shows that in recent years, the number of research reports (type V) suffered the biggest drop (by 1 000 in 2016 and 2017 and 300 in 2017 and 2018). The number of certified methodologies, medical procedures and specialised maps (type N) also dropped (by 200 in 2017 and 2018). One type of applied result that saw growth in 2018 was type F – utility model, but this growth was only in the double digits. The number of patents grew year-on-year until 2016, but in 2017 and 2018 there was a decline (from 407 in 2016 to 373 in 2017 and 308 in 2018). Despite the past growth in the number of patents, the proportion of results with special legal protection, i.e., patents (type P) and utility models and industrial designs (type F), was low across the entire 2008–2018 period (average growth was 13% for the 2009–2013 period and 14% for 2014–2018). The low production of patents in the Czech Republic is also apparent from international comparisons (see Chapter 8 – Innovation Performance of the Czech Economy and International Comparison Thereof). The Czech Republic lags behind the European average, e.g. Austria registers more than twice the value.

The structure of each type of applied result also changed in the 2009–2018 period (right-hand side of Figure 7.4). The greatest share of non-publication results in 2018 comprised research reports (type V; approximately 1 300), followed by prototypes and functional models (type G; approximately 1 000); in 2014–2018, these two types of result comprised more than 55% of the total production of non-publication applied results. Research reports began appearing in greater numbers in 2012, when research reports summarising the results of applied research products began to be included in this type, whereas in previous years, only research reports on secret research were included. In 2011 and 2012, there was a sudden rise in the number of type N results (this included the results of Methodologies Certified by the Authorised Authority and Specialised Maps with Technical Content), with their number growing from 1 000 in 2010 to 1 700 in 2011 and 2 300 in 2012. These increases in the number of results were linked particularly to activities tied to SUR and then to expiring special-purpose projects, especially in the case of MA and MI projects. A further jump in type N results occurred in 2015, specifically from 800 in 2014 to 1 200 in 2015 – in this case, the increase was caused by results linked to special-purpose support activity, specifically TA CR, MI and MC programme projects. Between 2009 and 2018, the proportion of patents grew by 2 pp (the average proportion over the 2009–2013 period was 4% and over the 2014–2018 period 6%); on the other hand, the proportion of type Z (semi-operations, verified technology, variety) results fell (the average proportion for the 2009–2013 period was 8% and for the 2014–

2018 period 7%), as did the proportion of type F (utility model/industrial design) results (the average proportion for the 2009–2013 period was 10% and for the 2014–2018 period 8%). Growth in the share of patents can be considered positive, but this should be supplemented by increased revenue from licences.

Figure 7.4: Types and number of applied results in the Czech Republic in 2009–2018 and their average representation in 2008–2013 and 2014–2018

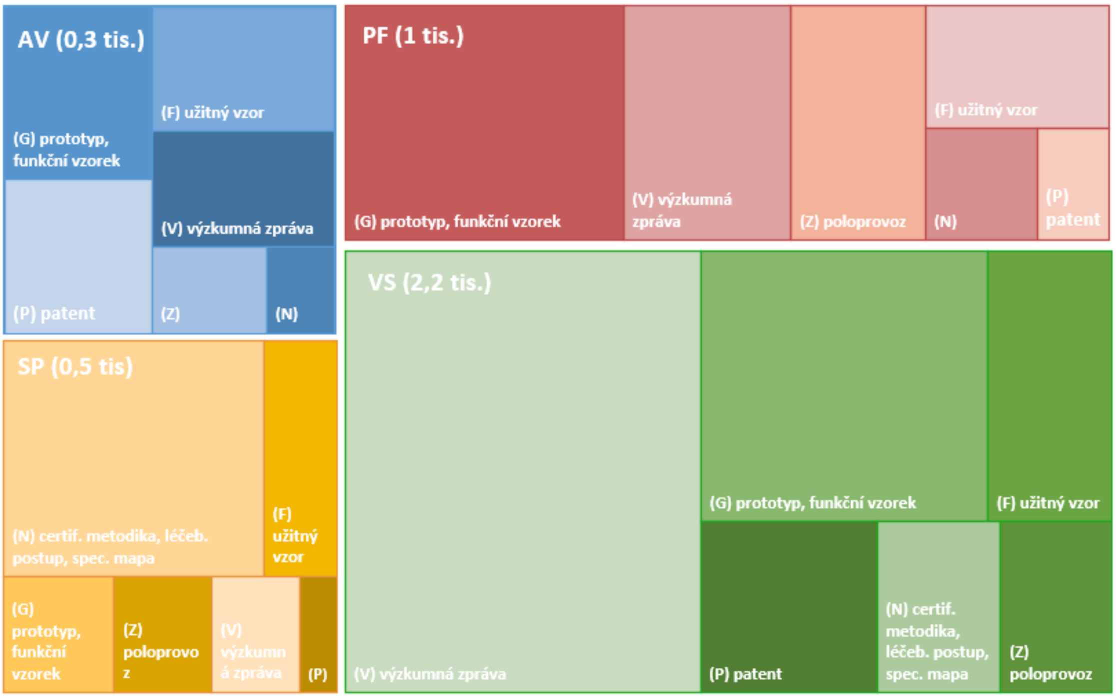


(P) patent
(Z) pilot operation, verified technology, variety
(F) utility model/industrial design
(H, R, S, T) other applied
(N) certif. methodology, medical procedure, specialised map
(G) prototype, functional sample
(V) research report

Source: RDI IS, status of database as of 30 June 2019, data exported on 15 July 2019

Furthermore, Figure 7.5 shows the production of results according to type of research organisation; it is apparent that universities are the largest producer thanks to the production of type V results (research reports – over 1 000 results). PF entities (i.e. predominantly businesses) are the second largest producer; they focused most on the production of type G results (protypes and functional models). A little over 500 non-publication applied results were created by departmental workplaces (SPs); they focused on the creation of type N (certified methodology, medical treatments, specialised maps) results (more than half of their results). In terms of absolute values, AS CR institutes created the smallest number of non-publication applied results (295), focusing their production on three types of results: G – prototypes, functional models (24%); P – patents (21%) and F – utility models (21%).

Figure 7.5 Structure of non-publication applied results by research organisation (2018)



AV – AS
PF – LP
SP – GO
VS – UNI

(P) patent
(Z) pilot operation, verified technology, variety
(F) utility model/industrial design
(H, R, S, T) other applied
(N) certif. methodology, medical procedure, specialised map
(G) prototype, functional sample
(V) research report

Source: RDI IS, status of database as at 30 June 2019, data exported on 15 July 2019
***UNI** – universities (public, state and private); **GO** – organisations co-funded from the State budget and public research organisations outside AS CR institutes and public universities; **LP** – legal and natural persons, individuals and institutions not falling under any of the above groups, civic associations. The brackets beside the name of the RO category states the absolute numbers of results for applied results without H, R, S, T. Type S and T results are private categories used for applied research results until 2006 or 2007.*

The structure and number of results are dependent on the currently running special-purpose support programmes; the production of results is determined by the formulated objectives and form requirements for the type of outputs of these research activities. That is why it is extremely important to evaluate special-purpose support in all phases of the programme cycle (evaluation of the programme proposal, interim evaluation, evaluation of expired programmes and evaluation of impacts). Changes in the reported number of each type of applied result probably also relate to modifications in the way results are projected in the evaluations of research organisations. For example, type N results (certified methodology, medical and conservation procedures, specialised maps) and type F results (utility model, industrial design) were awarded points in the past. Points began to be awarded to these types of results in 2007, which is probably why their numbers started to grow in the subsequent period. From 2013 to 2016, in addition to type P results (patents) and some type Z results (varieties and breeds), which continued to be awarded points, applied research began to be awarded points based on the financial volumes of contractual research. Points for certified methodologies, utility models and industrial designs were not subsequently awarded, by analogy; that is why in recent years their numbers again began to fall. The above facts may indicate undesirable intentional efforts to create results under any circumstance; the creation of non-publication applied results thus probably reflected the needs of the economic sector.

7.2 Field Structure of Results and Its Changes Over Time

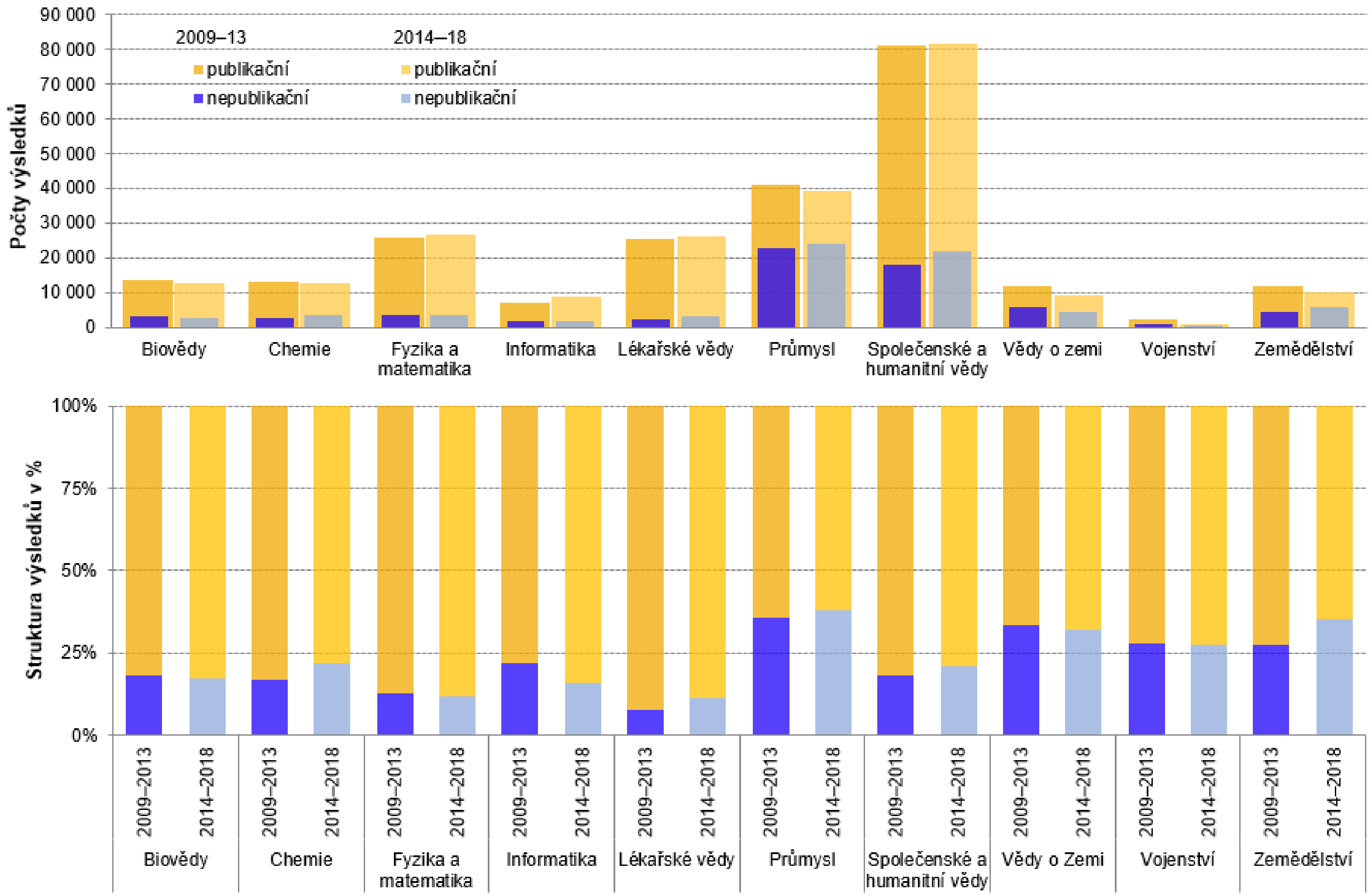
Figure 7.6 shows the number of results categorised by field group. This figure also demonstrates the time dynamic in the form of a comparison of two consecutive five-year periods. Clearly the biggest number of results is created in the Humanities and Social Sciences. The second most important field group in terms of the number of results is Industry[49]. The Medical Sciences are also relatively highly represented. A slightly growing trend in the total number of publications is apparent in Physics and Mathematics as well as in Computer Science; conversely, a falling trend can be seen in the Biosciences, Agriculture, Chemistry, Earth Sciences and Military. The number of publications in Chemistry and the Military has been relatively even over time. Most fields saw slight growth in non-publication results, which could indicate a gradual change in the focus of research toward topics more aligned to operational applications. In the Industry field group, the proportion of non-publication results is the most important and amounts to almost 40%. Of the other field groups, the relatively highest proportion of non-publication results can be found in the Agricultural Sciences (35.5%) and in Earth Sciences (32.3%); conversely, the smallest proportion can be found in the Medical Sciences (up to 11.3%) and in Physics and Mathematics (11.9%). The proportion of non-publication results to the total number of results fell in three fields: Physics and Mathematics, Computer Science and the Medical Sciences. In the case of Computer Science, the decrease in this proportion is the most marked. The above-mentioned facts are influenced by the method used to collect data into RDI IS, which is linked to the public support of R&D; data about R&D results funded purely from business sources is, therefore, missing.

[49] This is a group of fields recorded in RDI IS beginning with the letter J. According to the field classification introduced by the *Methodology for Evaluating the Results of Research Organisations and Evaluating the Results of Expired Programmes (valid for 2013–2016),* these are Technical Sciences minus the fields BC – Management Theories and Systems, BD – Information Theory, DH – Mining Industry including Coal Mining and Processing, GB – Agricultural Machinery and Buildings, FS – Medical Facilities, Instruments and Equipment and KA – Military.

Figure 7.7 then provides an overview of publication and non-publication results from the point of view of the new classification of scientific fields according to the Frascati manual (FORD[50]). Since 2017, all newly commenced projects use this classification of scientific fields; for the purpose of this analysis, all 2018 results have been converted to the field group classification system using a code converter. The greatest portion of non-publication results is clearly in the field groups of Agricultural Sciences and Engineering and Technology, which corresponds to the high proportion of non-publication results in Industry and the Agricultural Sciences. A low proportion of non-publication results was seen in the Natural Sciences and Medical and Health Sciences groups, which also corresponds to the findings from the previous Figure 7.6, where the Biosciences and Medical Sciences had a low proportion. One the benefits of the new classification is that it allows monitoring over social sciences and the humanities (SSH), which had not been possible under the previous classification system.

[50] As in the case of any classification, it is necessary to take into account the fact that differences may arise between field groups due to the non-homogeneity of the various field groups. The FORD classification comprises six field groups, which on a lower level comprise fields (FORDs). Group fields are then composed of five to 11 fields.

Figure 7.6: Creation of publication and applied results in the Czech Republic according to scientific field and their change over time



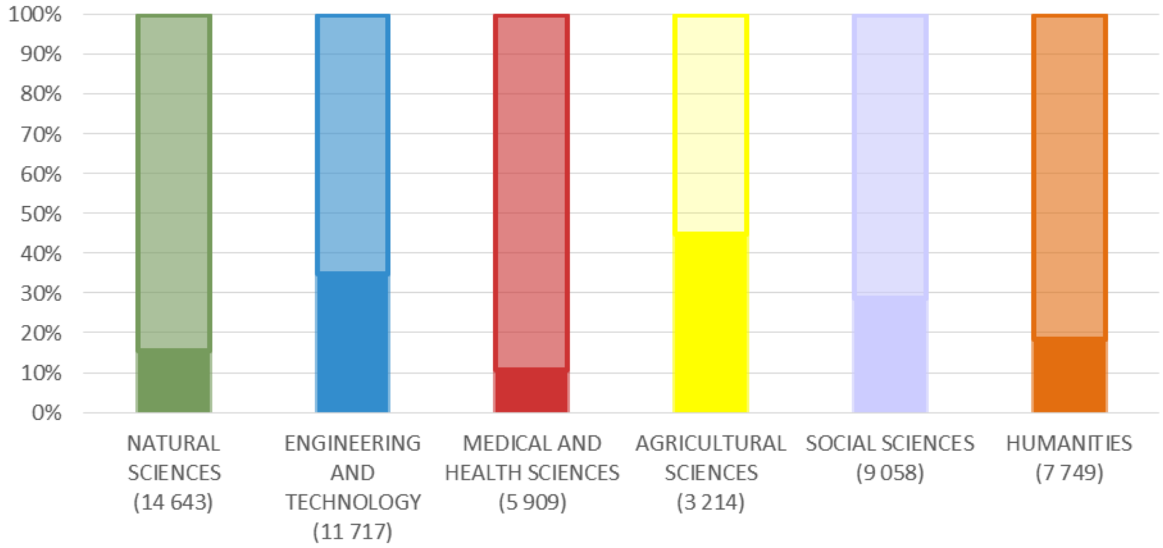
Publication
Non-publication
Number of results

Structure of results in %

Biosciences
Chemistry
Physics and Mathematatic
Computer Science
Medical Sciences
Industry
Social Sciences and Humanities
Earth Sciences
Military
Agriculture

Source: RDI IS, status of the database as at 30 June 2019, data exported on 15 July 2019

Figure 7.7: Publication and non-publication results in the Czech Republic according to FORD field groups (2018)



Source: RDI IS, status of database as at 30 June 2019, data exported on 15 July 2019

The dark areas (bottom) of the column graphs constitute the proportion of non-publication results in the respective field group; the light areas represent the proportion of publication results; the brackets under the names of the field groups contain the absolute number of results for the respective field group.

7.3 Quality of Results and Their International Comparison[51]

In terms of the quality of created publications, it is necessary, alongside monitoring the proportion of each type with respect to one another, also to monitor the detailed classification of the reviewed articles according to indexation in global databases. It is important to keep in mind that comparison of the structure of publications is, among other things, influenced by the fields that universities and AS CR institutes focus on. The greatest number of articles indexed in WoS or Scopus are created at universities (Figure 7.3). These institutes produce the greatest number of reviewed articles and employ the greatest number of researchers, as is apparent from Chapter 5 – Human Resources in Research and Development. In the case of universities, it is interesting to note that the field Educational Sciences (see Figure 7.9) has the lowest normalised citation index (NCI) and is one of the fields where the change in number of publications in 2014 and 2018 was negative; i.e., the number of publications in this field fell (by 10%). It can be inferred from this finding that universities focus more on what is taught than on teaching itself.

[51] The field bibliometric analysis drawn up by the Department of the Council for Research, Development and Innovation and commented on by Expert Panels is one of the supporting materials used for evaluating research organisations according to the 2017+ Methodology under Module 2. The primary supporting materials for this module are bibliometric analyses drawn up in detail for each research organisation and sent to research organisations in connection with the publication of these field reports. The overall RO evaluation (which, due to the small scope of available supporting material, will only be informational in nature) will be carried out based on the results of Modules 1 and 2 or by other procedures under Methodology 2017+.

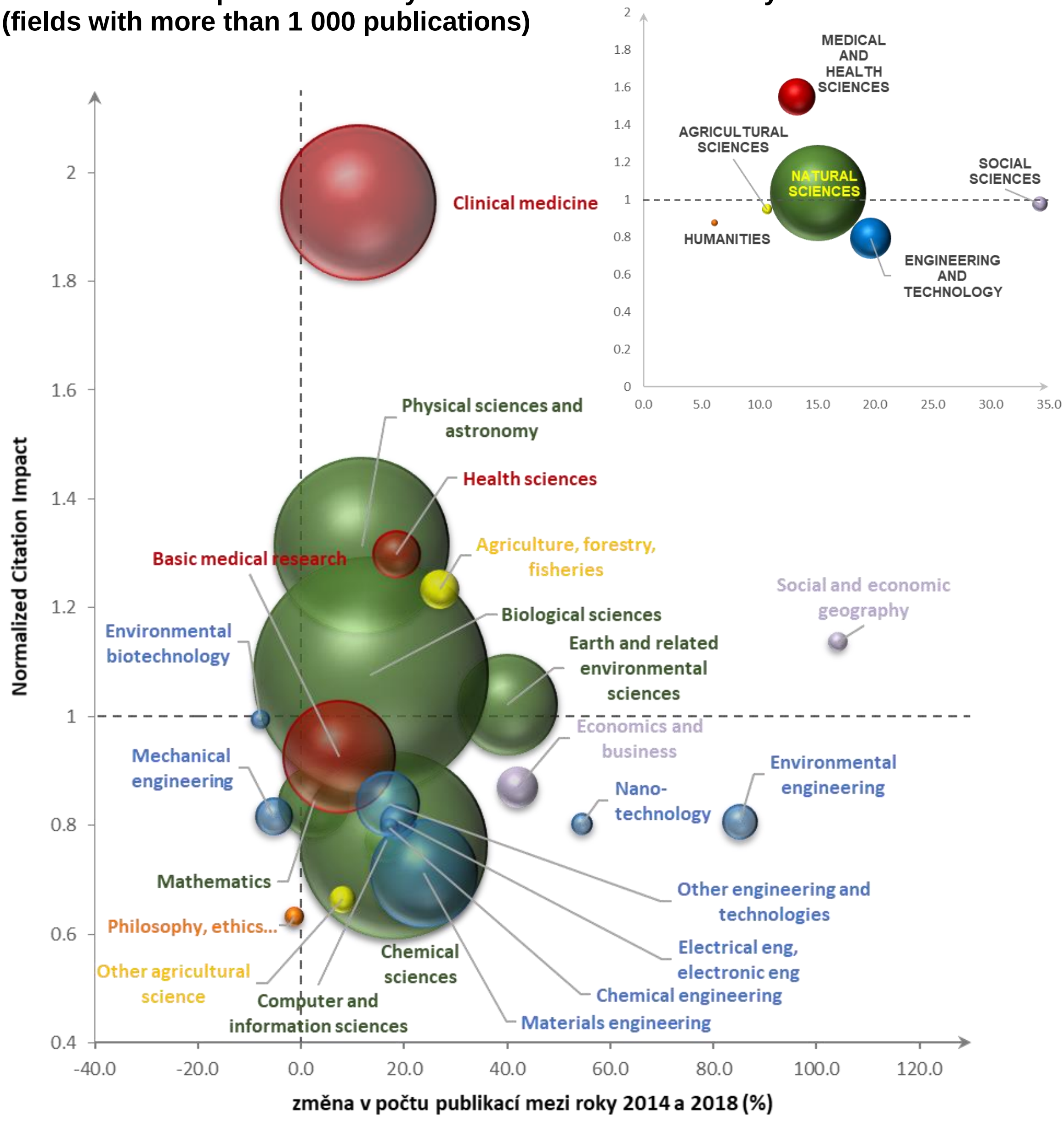
If we focus on the quality of the articles in WoS periodicals measured by their actual citation impact in the international context, the Czech Republic reports a positive trend. In some field groups and fields, the Czech Republic is above the world average and the number of first-rate publications is growing year-on-year. Figures 7.8 and 7.9 show changes in the number of articles by Czech authors and co-authors in the 2014–2018 period and, at the same time, their citation impact (as at March 2019), both on the level of field groups and on the level of FORD fields. The differences between the fields are, to a certain extent, influenced by the existence of national journals indexed in the WoS database. The greatest increase in the number of publications in WoS occurred in 2014 and 2018 on the level of the following field groups: Social Sciences (almost a 35% increase), Engineering and Technology (almost a 20% increase) and Natural Sciences (approximately a 15% increase) – see the top right-hand corner of Figure 7.8 for more details.

The most marked growth in the number of publications in fields represented in over 1 000 publications during the reference period occurred in Social and Economic Geography (104%), Environmental Engineering (85%), Nano-technology (55%) and Economics and Business (42%). The most important fields in terms of the absolute number of articles by Czech authors in WoS over the reference period are Biological Sciences (almost 14 000 articles over five years), Chemical Sciences (over 11 000), Physical Sciences and Astronomy (over 10 000) and Clinical Medicine (almost 9 000). In the case of Clinical Medicine and Physical Sciences and Astronomy, these are also publications with a substantially above-average citation impact (NCI has almost 1.9 in the case of Clinical Medicine and approximately 1.3 in the case of Physical Sciences and Astronomy). It is likely that Clinical Medicine's high citation impact is also thanks to the membership of researchers in international consortia. Figure 7.10 shows the number of publications in each field by number of authors. In these fields, 62 articles with over 100 authors were published in the reference period, which, compared to the 1 744 articles published in the Natural Sciences with 100 or more authors, may appear negligible; however, these medical articles have a citation index almost 19 times higher than the world average.

Based on a comparison of NCI values at field level, it can be said that most fields are below the world average (index lower than 1). This applies mainly in the case of fields that are smaller in terms of the number of publications, as only three fields have an index higher than 1 (Figure 7.9). Two fields with an above-average citation impact and more than 1 000 publications in the reference fields are Health Sciences (NCI = 1.3) and Agriculture, Forestry, Fisheries (NCI = 1.2). All fields belonging to the Engineering and Technology group report a citation impact below the world average. Relatively small fields in terms of the number of publications (Figure 7.9) are doing quite well according to the citation index: History and Archaeology (NCI = 1.5), Art (NCI = 1.4) and Other Humanities (NCI = 1.3). A slightly below average citation impact (index 0.8 to 1) is recorded in most fields, e.g., Environmental Biotechnology, Basic Medical Research and Economics and Business. The citation impact is slightly below average in the smaller fields of Psychology, Media and Communication and Animal and Dairy Science. A low citation impact (NCI between 0.6 and

0.8) is recorded in the larger fields of, for example, Philosophy, Ethics and Religion and Other Agricultural Science and Mathematics. It is important to keep in mind that citation impact can be influenced by the different publication habits of certain fields, such as in Mathematics or Social Sciences, where it is customary to publish in the form of monographies.

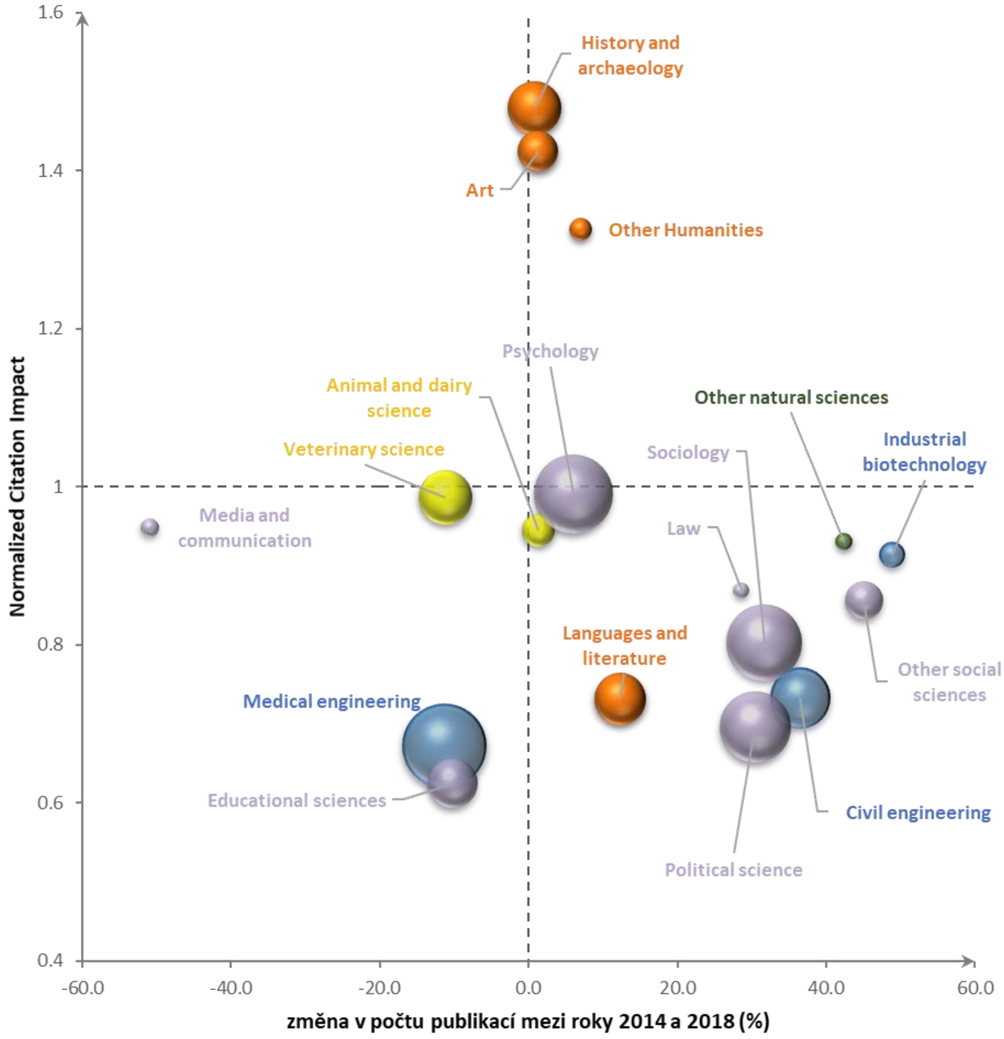
Figure 7.8: Number of publications by Czech authors in WoS by field and their citation impact (fields with more than 1 000 publications)



Change in the number of publications between 2014 and 2018 (%)

Source: WoS; article and review type publications for the 2014–2018 period in WoS Core Collection and ESCI periodicals are classified; field classification according to OECD (Frascati Manual)
Includes publications where at least one author has "Czech" indicated in the address (co-authorship is not taken into account).
Classified according to field groups where there were at least 1 000 publications in the reference period.
Horizontal axis: Index of change in the number of publications in 2014 and 2018: (2018–2014)/2014 in %. | Vertical axis: Normalized Citation Impact as at 29 March 2019 (normalised on the level of various fields with subsequent index aggregation; in the event that publication pertains to various fields, an arithmetic average is applied); the value y = 1 roughly corresponds to the world average. The bubble area expresses the number of publications in the 2014–2018 period.

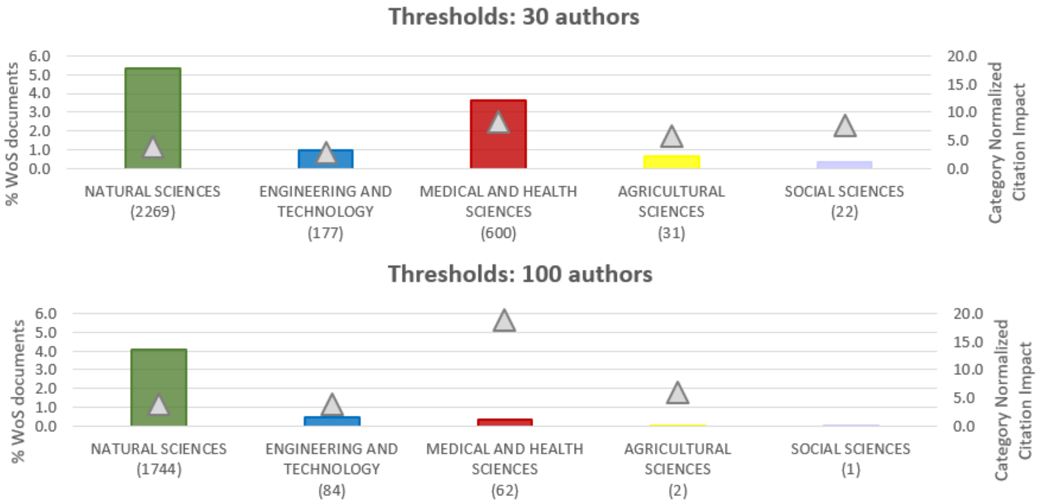
Figure 7.9: Number of publications by Czech authors in WoS by field and their citation impact (fields with less than 1 000 publications)



Change in the number of publications between 2014 and 2018 (%)

Source: WoS; article and review type publications for the 2014–2018 period in WoS Core Collection and ESCI periodicals are included | The horizontal axis and vertical axis are expressed in the same way as in Figure 7.8.

Figure 7.10: Publications by Czech authors in WoS by field according to number of authors

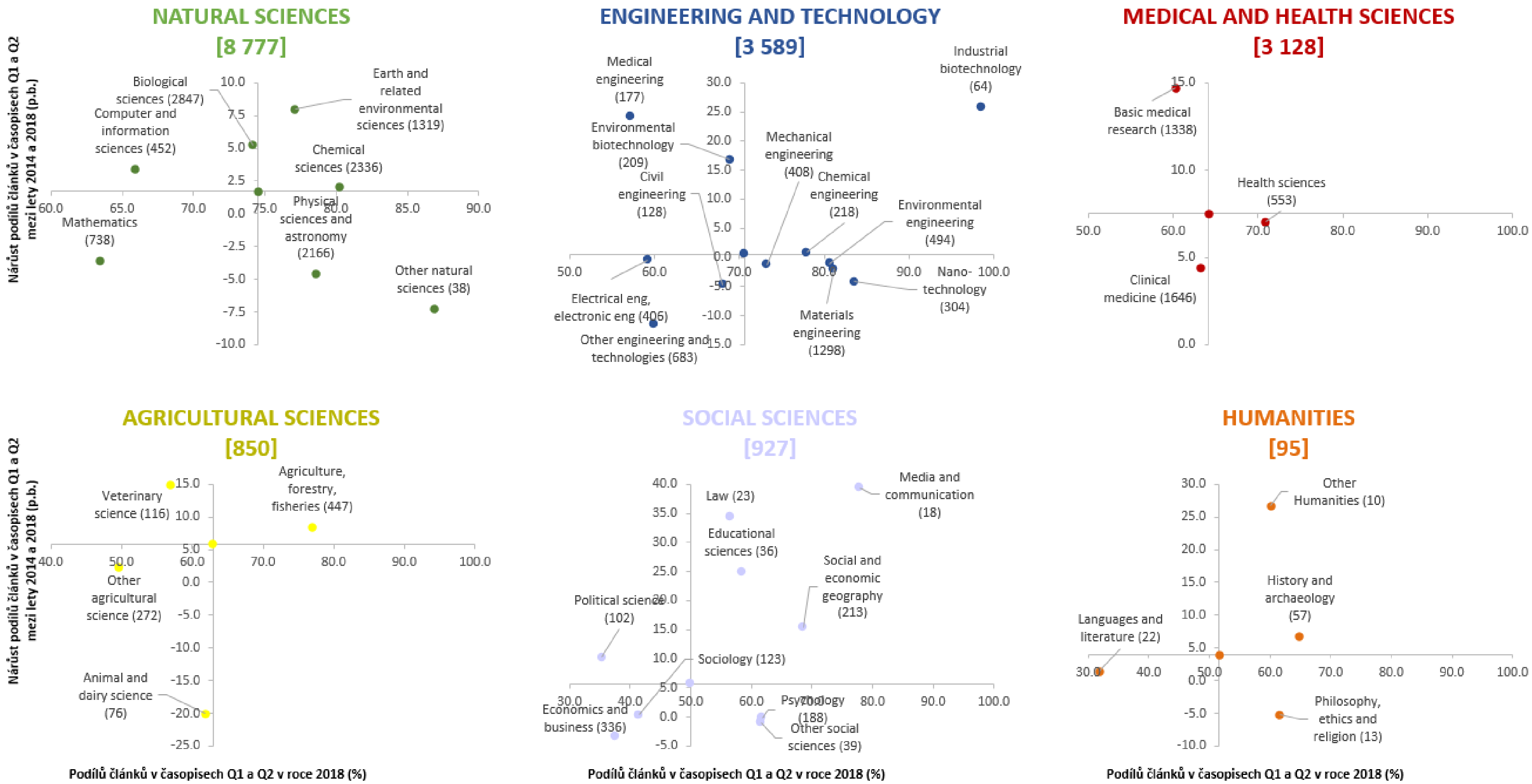


Source: WoS; includes article and review type publications for the 2014–2018 period in WoS Core Collection and ESCI periodicals; field classification according to OECD (Frascati Manual)

Another possible way to measure the publication performance of each field is to track the development of the proportion of articles published in periodicals with an impact factor (documents in JIF journals) with a focus on the production of articles in journals in the top two quartiles (documents in Q1 and Q2 Journals). Figure 7.11 shows the proportion of articles published by Czech authors in journals found in the top two quartiles in 2018 according to the six main FORD groups, with the number of articles in journals with IF in the respective group of fields or individual fields shown in brackets. The intersection point corresponds to the performance rate of the FORD field group as a whole.

As in Figures 7.8 and 7.9, in Figure 7.11 one can see the differences in the size of each field group (number of documents from 100 to 8 800); a differentiation that pertains to both the number of articles in JIF journals and the proportion of articles published in journals in the top two quartiles occurs inside each group of fields. Most publications can be found in the first three FORD groups (see Figure 7.11, top row). A positive trend in the growth of the proportion of articles in journals in both monitored quartiles can be seen at field group level. In the case of the Engineering and Technology group, this growth was close to zero; in the case of the Humanities group (bottom right-hand graph), the disintegration into different fields is rather illustrative, because it is a very small field from the perspective of number of articles; moreover, with regard to its specifics it is very difficult to set “traditional” bibliometric indicators for the fields (see, e.g., the lack of observation in the case of the Art field).

Figure 7.11: Evolution of the proportion of articles in WoS published in Q1 and Q2 journals (2014–2018)



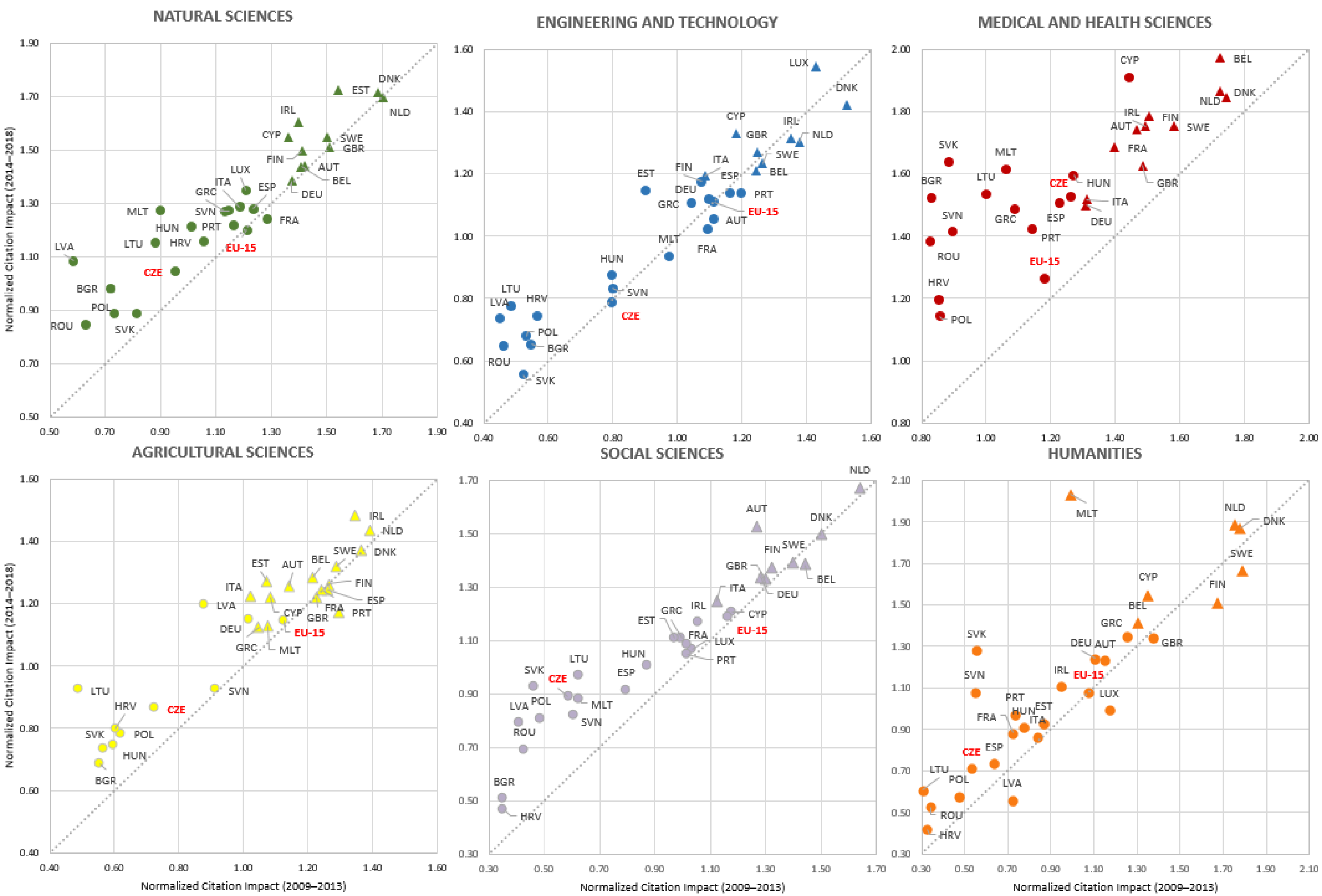
Increase in proportion of articles in Q1 and Q2 journals between 2014 and 2018 (p.p.)
Proportion of articles in Q1 and Q2 journals in 2018 (%)

Source: includes article and review type publications for the 2014–2018 period in WoS Core Collection and ESCI periodicals; field classification according to OECD (Frascati Manual) | WoS data include content indexed as at 30 August 2019. The brackets contain the total number of articles in the respective field or sub-field published in journals with IF; e.g., in the case of Mathematics, the brackets contain the value of 738; thus, in 2018, 468 articles were published in journals ranked in Q1 and Q2.

Figure 7.12 shows the evolution of NCI in each EU Member State by scientific field group between two periods: 2009–2013 and 2014–2018. If the values are found above the diagonal, NCI values have grown over time; the triangle indicates the production of publications in especially top-rated journals (see the legend under the graph). The citation impact in the **Natural Sciences** group has grown in the Czech Republic and hovers around 1; in the EU 15, the average citation impact hovers around 1.3. Denmark, the Netherlands and Estonia enjoy great success in this respect. In the Czech Republic, the **Engineering and Technology** group has an NCI equal to 0.8 of the world average and has not changed much over time; unfortunately, the Czech Republic is one of the weaker states even in this group. **Medical and Health Sciences** in the Czech Republic exceeds the EU 15 average in terms of the NCI. The NCI of articles in 2014–2018 exceeds the value of 1.5 times the world average; in the Czech Republic, the growing citation impact of Czech work is also favourable, where its sudden jump can be seen. A sudden jump can also be seen in the case of other EU Member States (SVK, LTU and CYP, for example). The most successful countries in this respect include Estonia, Luxembourg and Lithuania, all of which have an NCI value greater than two in 2014–2018 (outside the chosen scale in the graph). Czech work in **Agriculture Sciences** shows a citation impact nearing 0.9, which is slightly below the world average. Although a positive trend can be seen in citation impact, the Czech Republic is still lagging behind the EU 15. The citation impact in the **Social Sciences** in the last few years has been growing; however, it is still below the world average (NCI in 2014–2018 was around 0.9). In the **Humanities**, the position of the Czech Republic compared to other countries is very weak, and although the NCI grew, the Czech Republic has not been able to catch up to neighbouring countries like Slovakia and Hungary. Malta has recorded a very sharp rise in the NCI.

In international comparisons, it is evident in the evolution of NCI for each field group that the Czech Republic is one of the countries lagging behind the EU 15 average; only in the case of Medical and Health Sciences has the Czech Republic exceeded the EU 15 average. It is also evident that countries like Luxembourg, Denmark and the Netherlands enjoy a strong position in almost all scientific groups. In the Humanities, the Czech Republic shows the worst results compared with other field groups (NCI = 0.7 in 2014–2018); this is a small group of fields compared with other groups. Currently this field receives public support in the form of a special-purpose aid provided by TA CR – ETA Programme for Applied Research, Experimental Development and Innovation in Social Sciences and Humanities. It will be interesting to observe developments in this scientific field in the context of the new evaluation of research organisation and implementation of Methodology 2017+.

Figure 7.12: Evolution of publications by Czech authors in WoS on the level of field groups compared with authors from EU countries



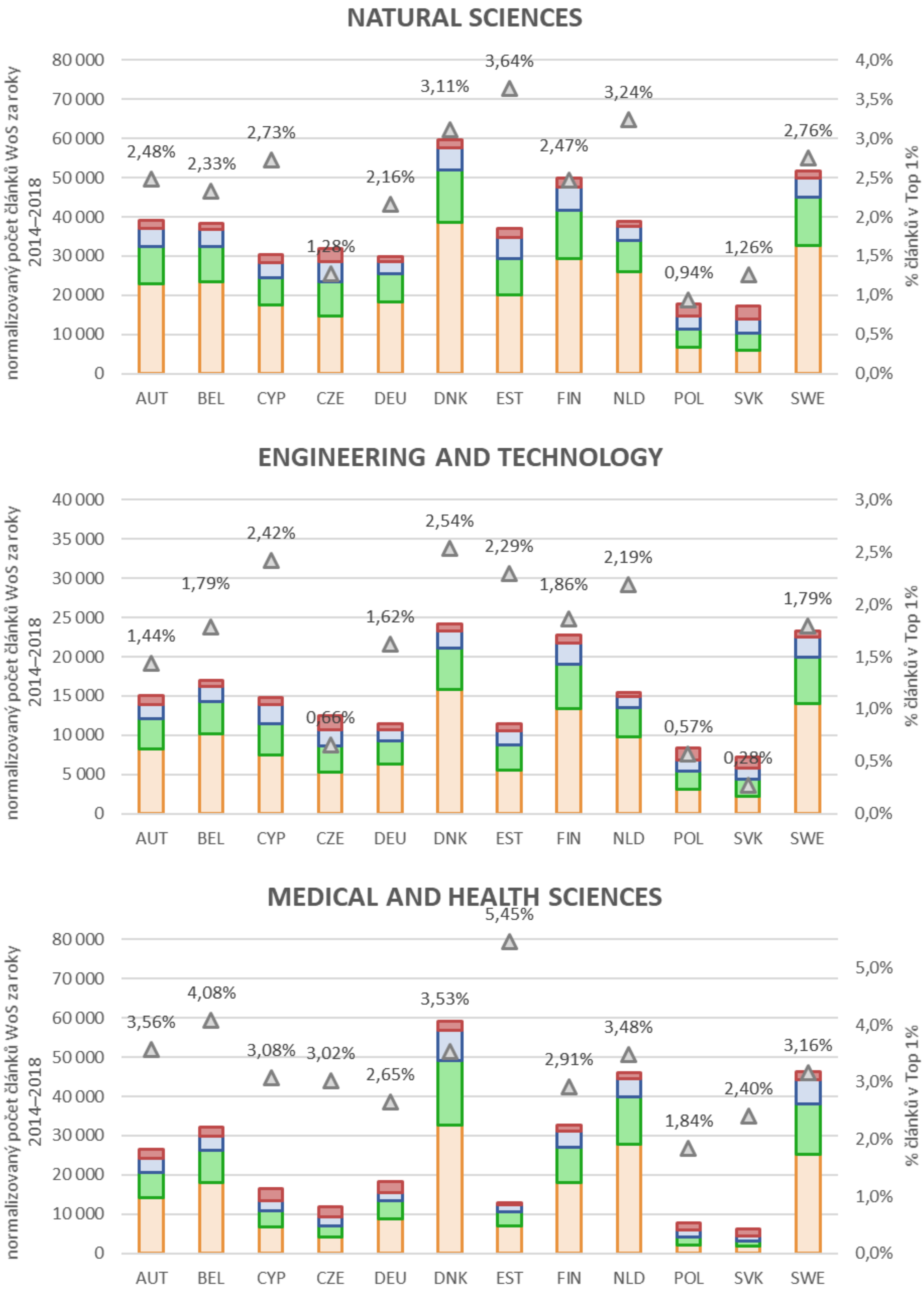
Source: WoS; includes article and review type publications for the 2009–2018 period in WoS Core Collection and ESCI periodicals: field classification according to OECD (Frascati Manual) | Includes publications where at least one author has the respective country indicated in the address (co-authorship not taken into account). Horizontal axis: NCI for 2009–2013 | Vertical axis: NCI for 2014–2018; NCI is determined as at 29 March 2019 (normalised on the level of each field with subsequent aggregation of the index; if a publication pertains to several fields, an arithmetic average is applied); the value of y = 1 corresponds roughly to the world average; the triangle reflects countries with the percentage of documents in the Top 10% of the most cited publications in the given field higher than 15%.

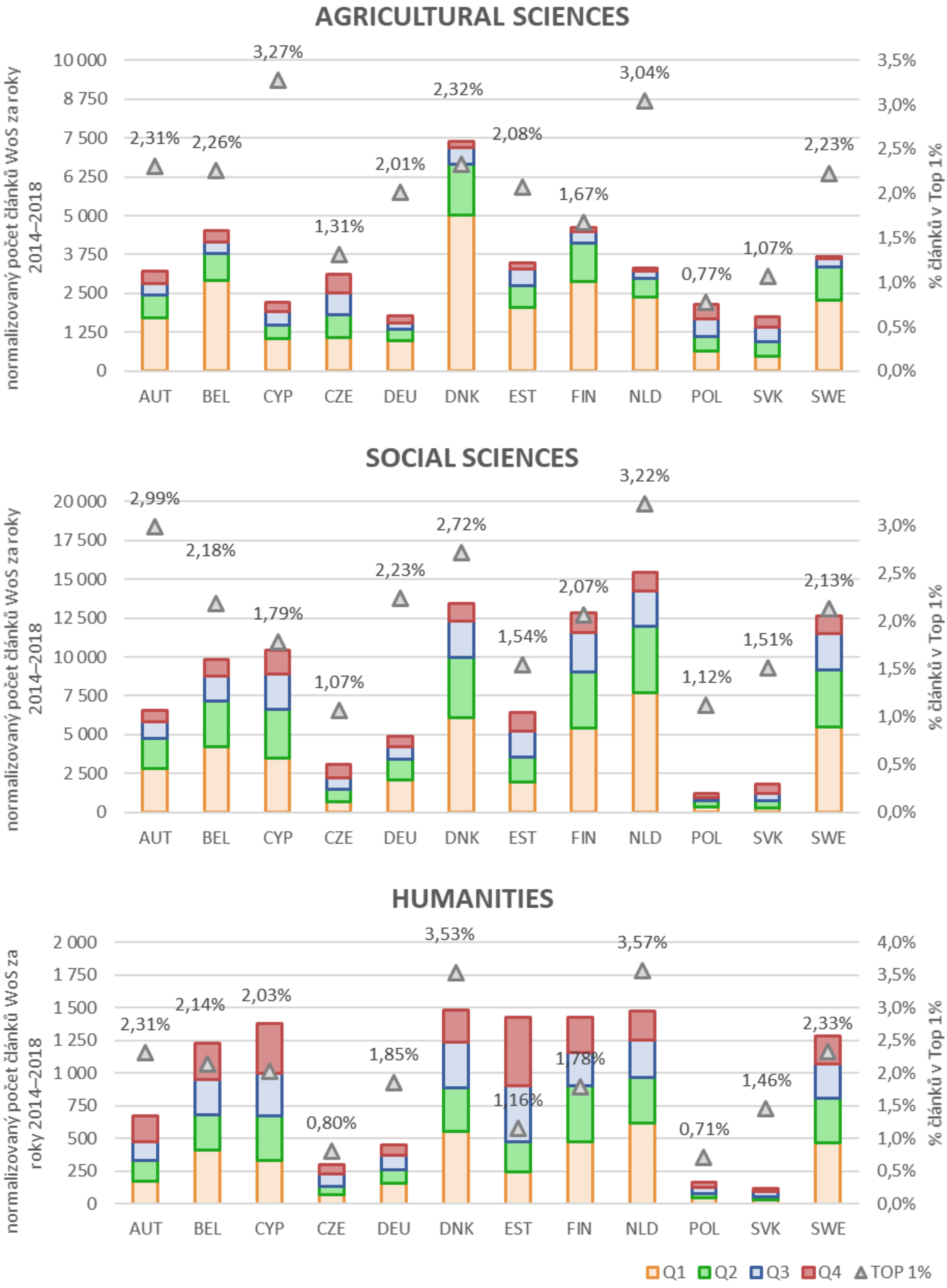
When evaluating the publication quality, it is also necessary to monitor the publication structure in terms of the journal citation impact and related publication strategy, which may differ from field to field. Figure 7.13 characterises this phenomenon on the example of field groups in the Czech Republic compared internationally. The figure clearly shows differences that correspond substantially to the international comparison of the actual publication citation impact (Figure 7.12) and to the breakdown of publications with 100 or more authors with a high NCI (Figure 7.10). In the case of more groups other than Natural Sciences and Engineering and Technology, the proportion of publications in each quartile is almost balanced in the Czech Republic; in the case of other countries (save Poland and Slovakia), i.e., Austria, Belgium, Denmark and the Netherlands, publications in the upper quartile of the most cited periodicals predominate markedly. In **Natural Sciences**, a relatively large portion of Czech articles is published in the upper quartile, but this is not enough for the citation impact of Czech authors, when compared internationally, to be at least on the EU 15 level (Figure 7.12); it is thus apparent that there is intense international competition in this field, and if the Czech Republic wishes to improve the quality of produced publications, the authors should focus their publication efforts on Q1 journals, thereby contributing to improving the performance of the respective field measured by, for example, the indicator of Top 1%[52] of the most cited publications in this field group (e.g., see Germany, Denmark and the Netherlands). In the field group **Engineering and Technology**, most articles by Czech authors are published in Q1 and Q2 journals. The proportion of work in journals in the bottom citation quartile is small; in this group, the situation is similar to that in the Natural Sciences, where the production of articles in the upper quartiles is relatively high but the NCI (compared with other countries) is very low. In other words, even in this field Western countries tend to dominate, and the publication rate of Czech authors measured by TOP 1% is also relatively low. Both these groups are among the biggest in terms of the number of FORDs; together they contain a total of 18 FORDs. In terms of number of publications and citation impact, they are heterogenous groups. In these field groups, major fields such as Physical Sciences and Astronomy (10 000 publications), Chemical Sciences (11 000 publications), Biological Sciences (13 000 publications) and Materials Engineering (6 000 publications) are represented in the Czech Republic; among the small to micro fields, Civil Engineering (700 publications) and Industrial Biotechnology (295 publications), for example, are represented. In the case of **Medical and Health Sciences**, despite the lower representation of articles in upper quartile journals, it holds that Medical and Health Sciences or, more specifically, Clinical Medicine belong to the most cited field groups in the Czech Republic, and the citation impact is high even in international comparisons (Figures 7.8 and 7.11), with the percentage of publications in the Top 1% of the most cited publications exceeding 3%. In **Agricultural Science**,

[52] Percentage of publications in the TOP 1% of the most cited publications is the normalised metric published by WoS reflecting performance in terms of the citation impact of the respective field in the respective year and for the respective type of document.

the Czech Republic is ranked among the medium-sized countries in terms of publications; in this group, the number of results created here are comparable to those in Austria. Compared with Austria, the Czech Republic has fewer publications cited in the upper quartile and in the top decile, which of course is reflected in NCI values (index AUT 1.3, CZE 0.9). Both **Social Sciences and Humanities** have a relatively low citation impact (measured by NCI), as a relatively large proportion of publications are ranked in the lower citation quartile within these fields.

Figure 7.13: International comparison of quality of publications in field groups in the Czech Republic by the citation response of periodicals





Normalized citation impact (WoS) for 2014–2018
% of Article in Top 1%

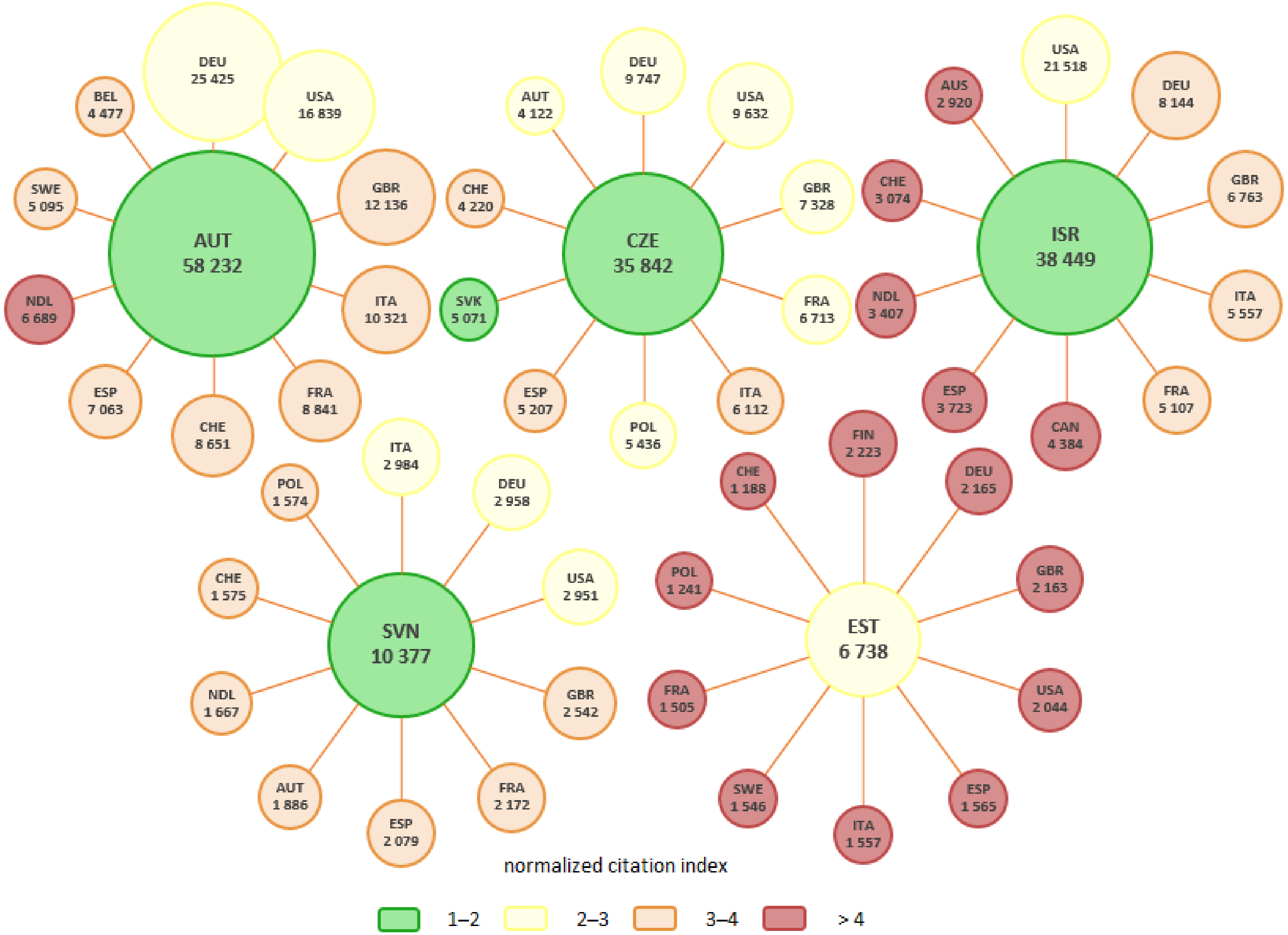
Source: WoS; includes article and review type publications for 2014–2018 in WoS Core Collection and ESCI periodicals/These are publications where at least one author has "Czech" indicated in the address. The numbers thus do not include co-authorship. In the event WoS classifies a journal in several fields, such result is included in each of these fields. For international comparisons, data from other medium-sized countries where the native language is not English (save New Zealand) were used. The numbers of articles for these other countries were normalised to the population size of the Czech Republic. The comparison does not take into account various levels of RDI support in each area and thus *does not express R&D productivity; it also does not take into account the importance of the impacted journals published in the Czech Republic. The percentage of publications in the TOP 1% of the most cited publications is normalised using the metric published by WoS reflecting performance in terms of the citation impact of the respective field in the respective year and for the respective type of document.*

It is also necessary to take into account whether impacted journals (indexed by WoS) are published in the Czech Republic in the specific field and whether the citations from these originate from other journals from the Czech Republic or from abroad. For example, in the field of Economics and Business, three impacted journals, which are mutually cited to a high degree, are published in the Czech Republic (of which two are in English). The result is a low citation response of Czech publication in this field compared to the world average (Figure 7.8). Similarly, an impacted journal with a low citation impact is published in Chemistry in the Czech Republic and is most often used by Czech authors to publish results in chemical research (about 500 articles out of a total of 11 000, i.e., 5.5%, were published in this periodical), which probably resulted in a low citation impact level against the world average (Figure 7.8).

The above-mentioned fact about the size and quality of field groups according to publication results (Figures 7.8 to 7.11) partially corresponds to the financial allocation of special-purpose support into field groups and individual fields (Figures 2.4 and 2.5 in Chapter 2 – Funding of RDI from the State Budget). The high support for projects in the Biological Sciences, Medical Sciences, Physics and Chemistry manifested itself in the higher number of publication outputs and, in the case of the Medical Sciences and Chemistry, also by their high quality. In the case of the Social Sciences and Humanities and Industrial Sciences financial allocations of special-purpose support may appear not to correspond to either the number or quality of results. The information may be distorted by the different coding of fields in RDI IS and in global citation databases (for more details, see Chapter 2 – Funding of RDI from the State Budget), or the publications could be the result of activities funded institutionally, with insufficient relevant data for a longer period of time to allow determination of financial allocation of institution support by field.

Another important measure of publication quality is the activity of Czech authors in international author collectives of scientific publications. This is, at the same time, one of the indicators of internationalisation of research. In the last five years the proportion of first-rate publications created in international collectives of authors increased in comparison with exclusively Czech publications. Whereas in 2014 only about 49% of 13 800 publications recorded in the WoS database were international, in 2018 this number was almost 56% of a total of 16 500 publications. As documented by Figure 7.14, the structure of countries with which Czech scientists cooperate on publications is favourable.

Figure 7.14: Publications of national authors created in cooperation with foreign partners – comparison of the Czech Republic with selected countries (2014–2018)

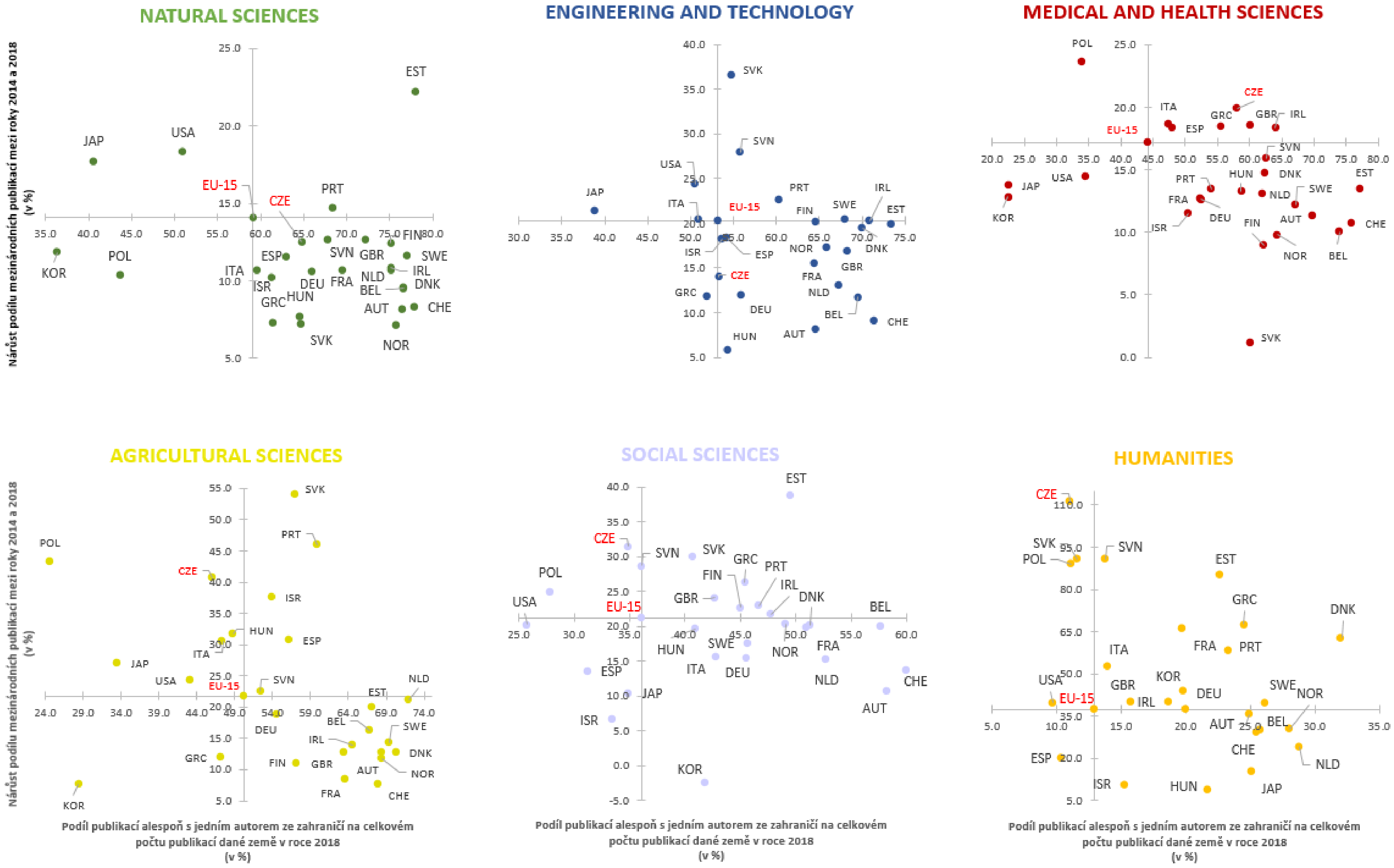


Source: WoS; includes article, review and letter type publications for 2014–2018 in WoS Core Collection and ESCI publications; field classification according to OECD (Frascati Manual) | The bubbles contain the number of publications created in 2014–2018 where authors from the home country worked with authors from the cooperating country.

In 2014–2018, the most international publications were created by Czech authors in cooperation with authors from Germany, followed by cooperation with colleagues from the USA and Great Britain. Publication of articles in cooperation with colleagues from Italy and Switzerland represented a relatively high NCI (between 3–4); nevertheless, the least celebrated publications in terms of NCI are created in cooperation with colleagues from Slovakia. The composition of countries with which colleagues from Austria work is similar to that of the Czech Republic; however, the NCI of these publications is higher. Compared with the EU average, the Czech Republic has relatively good results in international cooperation; i.e., it has good values in the case of the "Cooperation on international scientific publications" indicator (SII, Chapter 7). A more detailed analysis, however, shows that although cooperation does take place between Czech scientists and foreign partners, the Czech Republic does not always achieve satisfactory levels of quality in these publications (measured by the NCI). The Czech Republic should thus focus not only on increasing the number of publications created in international cooperation, but also on increasing the number of first-rate publications as does Estonia, for example, where the NCI exceeds the value of 4 in all the countries it works with.

As regards the extent of publication with foreign partners between the various countries (Figure 7.15), the Czech Republic was above the EU 15 average in Natural Sciences, Engineering and Technology and Medical and Health Sciences in 2018. In the last three field groups, the percentage of publications created under international cooperation may be behind the EU 15 average, but in the last five years a substantial proportional increase in the respective field groups occurred, which can be seen as positive. The greatest degree of cooperation by Czech authors was in Natural Sciences (approximately 65%); this field group has the greatest number of articles with the number of authors at 100 or more (see Figure 7.10). The second greatest degree of cooperation was recorded in Medical and Health Sciences (58%). Social Science and Humanities belong to fields with a very low proportion of publications created in cooperation with foreign partners (up to 20%). Examples of countries with a high proportion of publications with foreign cooperation are Switzerland, Belgium and Sweden. Conversely, countries that are rather closed in terms of the proportion of publications created in cooperation with foreign authors include Poland, Japan and South Korea.

Figure 7.15: Proportion of scientific publications created by international teams of authors in EU countries and selected OECD countries



Growth in proportion of international publications between 2014 and 2018

Proportion of publications with at least one author from abroad in total number of publications of the respective country in 2018 (%)

Source: WoS; includes article, review and letter type publications for 2014–2018 in WoS Core Collection and ESCI periodicals; field classification according to OECD (Frascati Manual)

7.4 Licences

The evaluation of research, development and innovation relies mainly on the number of various results. In the case of RDI results intended for application, their use can be expected to be interesting and relevant not only for their originator, but also for other groups of users. In such cases the originator of RDI results chooses a suitable form of protection, which then allows the regulation and stipulation of the conditions for the further use of these results. In the case of RDI results where the originator expects interest by other possible users in addition to application of these results within its own enterprise or by a designated user, the results are not published to the extent of technical details, but repeatedly usable results become the subject of legal protection such as patents, utility models or unpatented results such as technical procedures, know-how, industrial design, new varieties of plants or breeds of farm animals, etc.

In the event of real interest, relationships between the originator and another user of the results are set out in a licence agreement, which usually also contains the amount of the royalties for provision of the right to use the defined RDI results. The groups of patent protection and parts of patent licences are tracked generally and over the long term. It is, however, necessary to take into account that similar relationships, protection and licences also pertain to categories of applied RDI and intellectual property.

CZSO statistics ascertain the following: (i) anticipated interest in RID result – number of patent protection applications; (ii) actual interest in RDI result – number of concluded licence agreements; and (iii) market value of protected RDI result – the royalty amount.

According to summary results of the examination of licences for 2017 carried out by the CZSO, patent protection predominated among licensors. Table 7.1 shows the evolution in the number of patent licensors, patented licences provided and royalties received over time, i.e., in 2010–2017. The number of licensors, like the number of granted royalties, grew compared to 2010 by almost 50% in both cases. The drop in total received royalties per licence in 2017 and 2016 of more than 42% may thus be surprising, but this drop is caused by one PRI falling under the CSA, an institution that has been affecting general financial indictors related to licence revenue in the Czech Republic for several years already. For this reason, almost 94% of all royalties, from the point of view of royalty recipients, were allocated in the government sector. In 2010–2017, these revenues totalled CZK 16.6 bn.

Table 7.1: Patent licences in 2010–2017

Indicator	2010	2011	2012	2013	2014	2015	2016	2017	2017
Patent licensor									%
Total	53	58	71	73	67	75	72	81	100.0
Of which with new licence	18	23	28	30	40	20	19	25	30.9
Licensor's sector									%

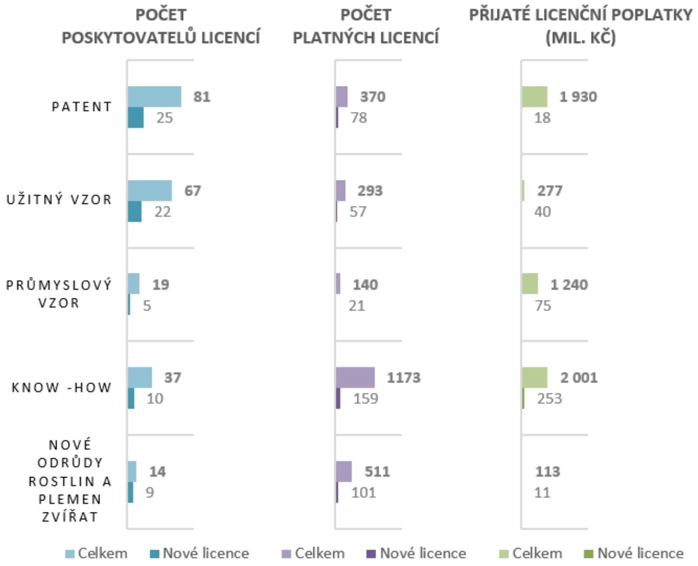
Indicator	2010	2011	2012	2013	2014	2015	2016	2017	2017
Busines	35	36	47	48	44	51	47	52	64.2
Government	11	11	11	11	11	12	10	12	14.8
University	7	11	13	14	12	12	15	17	21.0
Patent licences provided									%
Total	142	166	224	270	255	271	307	370	100.0
Of which with new licence	38	42	68	69	40	51	61	78	21.1
Total royalties received (CZK mil.)									%
Total	1 427	1 519	1 466	2 293	2 726	3 319	3 356	1 930	100.0
Of which for new licence	70	3	8	266	15	13	14	18	0.9
Royalty recipient's sector									%
Business	35	43	82	332	298	321	113	111	5.8
Government[53]	1 340	1 472	1 382	1 954	2 407	2 992	3 236	1 814	93.9
University	53	4	2	7	22	6	7	6	0.3

Source: CZSO

Figure 7.6 below shows issued valid licences by subject of licence agreement for 2017. The number of issued licences, the number of valid licences and the amount of received royalties in CZK mil. can be seen. The number of entities using licences granting the right to utilise technical solutions protected by **utility models** was the same as in 2016 (i.e. 67); however, the total number of granted licences grew (from 248 to 293), as did the amount of royalties received (from CZK 190 to 277 mil.). In the case of **industrial design**, the number of licensors did not change year-on-year (i.e. 19), but the number of licences provided grew (from 126 to 140). The amount of royalties has shown substantial fluctuations year-on-year (since 2013); in 2017, the amount fell by 33%. This situation is the same as in the case of patent licences. Since 2013, the number of granted licences for **unpatented inventions (know-how)** grew markedly, achieving more than a two-fold year-on-year increase in 2017 alone (from 510 to 1 173). This was caused to a certain degree by the specific use of this kind of protection, when, for example, a larger number of licences and know-how may be granted over a short period of time under large development projects. The number of licensors and even the amount of royalties saw only minimum year-on-year growth. Although licences from **new varieties of plants and breeds of animals** are provided by the same number of entities as in the previous year (i.e. 14), the total number of granted licences fell by more than 5% (from 541 to 511) and the amount of royalties received attained only 55% of the value attained in 2016.

[53] Received royalties in the government sector pertains mainly to the activities of the AS CR, specifically the Institute of Organic Chemistry and Biochemistry (IOCBC); according to the annual report of AS CR, the revenues from AS CR licences was CZK 1 820 mil. in 2017 and CZK 1 420 mil. in 2018.

Figure 7.16: Valid issued licences by subject matter of licence agreement for 2017



NUMBER OF LICENSORS
NUMBER OF VALID LICENCES
RECEIVED ROYALTIES

PATENT
UTILITY MODEL
INDUSTRIAL DESIGN
KNOW-HOW
NEW PLANT VARIETIES AND ANIMAL BREEDS

Total
New licences

Source: CZSO; drawn up by R&D Council

In 2017, PRI were the main beneficiaries of patent royalties (CZK 1.8 bn., i.e., just under 94%); the remaining royalties were received by the business sector (CZK 111 mil.; i.e., almost 6%). As regards licences provided for utility models, businesses clearly dominate. They have the greatest number of applications (39), granted licences (171) and collected royalties (CZK 266 mil.). Patent licences (and to a lesser degree even utility models) are most often provided by medium-sized enterprises (50–250 employees) and large enterprises (over 250 employees). The greatest beneficiaries of royalties are medium-sized enterprises (83% of patent licences) and large enterprises (91% of utility model licences). The vast majority of patents and utility model licensors were from the industry and services sector. Conversely, the agricultural sector showed only minimum activity even from the point of view of licences for plant varieties and animal breeds, with only two being registered in 2017.

Table 7.2 shows the structure of granted licences by licensor's region and the contractual partner's country. Half of all granted patent licences (185 out of 370) had licensors with their registered offices in Prague. In second place but quite a distance behind, with public universities contributing greatly (30 patent licences), are South Moravia and Moravia-Silesia, regions that have long had a high number of issued licences. The lowest number of issued patent licences was in the regions of Karlovy Vary and Usti nad Labem. From the point of view of utility model licences, the situation among the regions was more balanced, which is caused in part by a lower representation of universities and PRI among licensors. Protection in the form of utility models tends to be used by business enterprises. Again, licensors with headquarters in Prague predominated. In 2017, they were responsible for 80 licences granted for this type of industrial ownership. Close behind were those headquartered in South Moravia and Liberec. The statistics for 2017 show that most contractual partners who were granted patent or utility model licences hailed from the Czech Republic, with only 18.6% of patent licences and 16.7% of utility model licences granted to entities headquartered outside the Czech Republic.

Table 7.2: Structure of granted licences by licensor's region and contractual partner's country (2017)

Struktura poskytnutých licencí podke kraje poskytovatele					
na patenty			na užitné vzory		
Kraj	počet – licencí	počet – poskyto-vatelů	Kraj	počet – licencí	počet – poskyto-vatelů
Praha	185	10	Praha	80	6
Jihomoravský	58	4	Jihomoravský	53	5
Moravskoslezský	40	1	Liberecký	48	1
Královéhradecký	20	1	Moravskoslezský	39	2
Liberecký	19	2	Pardubikcý	18	2
Středočeský	11	1	Středočeský	17	1
Olomoucký	7	1	Ústecký	12	1
Zlínský	7	1	Zlínský	8	0
Pardubický	6	1	Vysočina	5	0
Jihočeský	5	1	Jihočeský	4	2
Plzeňský	5	0	Plzeňský	4	1
Ústecký	4	1	Olomoucký	4	1
Vysočina	2	1	Královéhradecký	1	1
Karlovarský	1	0	Karlovarský	0	0

Struktura poskytnutých licencí dle země smluvního partnera					
na patenty			na užitné vzory		
Země	počet – licencí	počet – poskyto-vatelů	Země	počet – licencí	počet – poskyto-vatelů
Česká republika	301	70	Česká republika	244	59
Německo	22	6	Slovensko	14	8
Spojené státy americké	20	4	Německo	5	4
Slovensko	3	3	Maďarsko	5	4
Indie	2	2	Rumunsko	4	3
Švýcarsko	2	2	Polsko	3	2
ostatní	20	9	Bulharsko	2	2
			Chorvatsko	2	2
			Rakousko	2	2
			Rusko	2	2
			ostatní	10	4

Structure of Awarded Licences by Region of Licensor	
For patents	For utility models

Region	Number		Region	Number	
	Licences	Licensors		Licences	Licensors
Prague			Prague		
South Moravia			South Moravia		
Moravia-Silesia			Liberec		
Hradec Králové			Moravia-Silesia		
Liberec			Pardubice		
Central Bohemia			Central Bohemia		
Olomouc			Ústí nad Labem		
Zlín			Zlín		
Pardubice			Vysočina		
South Bohemia			South Bohemia		
Plzeň			Plzeň		
Ústí nad Labem			Olomouc		
Vysočina			Hradec Králové		
Karlovy Vary			Karlovy Vary		
Structure of awarded licences by country of contractual partner					
Country	Number		Country	Number	
	Licences	Licensors		Licences	Licensors
Czech Republic			Czech Republic		
Germany			Slovakia		
United States of America			Germany		
Slovakia			Hungary		
India			Romania		
Switzerland			Poland		
Other			Bulgaria		
			Croatia		
			Austria		
			Russia		
			Other		

Source: CSA; drawn up by R&D Council

Table 7.3 breaks down the structure of received royalties by licensor's region and by beneficiary's country. In 2017, most royalties from patent licences were received by licensors headquartered in Prague (CZK 1.8 bn.). As already mentioned above, this dominance is caused mainly by one AS CR research institution. If we did not take this institution into account, Prague would be second to the Karlovy Vary region. These two regions belong to the most successful even over the long term (the last five years). Another successful region is Plzeň, even though local patent licensors did not report receiving any royalties in 2017. Prague was again the region to which the highest amount of utility model royalties was directed in 2017 (CZK 175.9 mil.), followed by Central Bohemia (CZK 65.1 mil.). These two regions have been frontrunners even over the long term (the last five years). The most royalties for newly concluded licence agreements were collected in Prague (CZK 36 mil. in 2017). This amount is a record compared to previous years.

Most foreign royalties for patent licences came from the USA (CZK 1.8 bn.), followed at a great distance by China (CZK 82.9 mil.). Czech licensors received a higher amount of royalties than the Czech Republic itself, although 81% of all provided patent licences "stayed" in the country. In 2017, most utility model royalties came from Russia (CZK 57 mil.). Russia and Ukraine (CZK 23.7 mil.) are the most important sources of royalties for utility models even over the last five years. In 2017, there was a substantial increase in utility model royalties from Slovakia.

Table 7.3: Structure of received royalties by licensor's region

Struktura přijatých licenčních poplatků podle kraje poskytovatele					
za patenty			za užitné vzory		
Kraj	tis. Kč		Kraj	tis.Kč	
	celkem	z toho nové		celkem	z toho nové
Praha	1 820 786	5 964	Praha	175 931	36 210
Královéhradecký	83 188	3	Středočeský	65 194	2 551
Vysočina	10 280	10 268	Liberecký	26 777	50
Liberecký	8 972	234	Jihomoravský	3 646	948
Jihomoravský	5 551	731	Vysočina	2 217	0
Moravskoslezský	666	9	Plzeňský	2 125	0
Olomoucký	610	210	Ústecký	531	437
Zlínský	100	100	Moravskoslezský	497	143
Ústecký	89	24	Pardubický	132	76
Karlovarský	61	0	Jihočeský	116	16
Jihočeský	40	20	Královehradecký	0	0
Středočeský	25	0	Olomoucký	0	0
Pardubický	22	0	Zlínský	0	0
Plzeňský	0	0	Karlovarský	0	0
Struktura přijatých licenčních poplatků podle země nabyvatele					
za patenty			za užitné vzory		
Země	tis. Kč		Země	tis.Kč	
	celkem	z toho nové		celkem	z toho nové
Spojené státy	1 790 991	492	Rusko	57 905	
Čína	82 915		Slovensko	49 820	35 798
Česká republika	34 071	2 574	Česká republika	34 679	1 837
Rusko	10 268	10 268	Velká Británie	27 247	
Dánsko	3 919	3 919	Ukrajina	21 974	
Japonsko	1 610		Chorvatsko	20 127	2 342
Německo	1 451	221	Rumunsko	18 939	66
Vietnam	555		Maďarsko	14 444	12
Indie	555		Bulharsko	12 606	
Singapur	555		Srbsko	7 630	
Malajsie	555		Nizozemsko	6 322	
Srí Lanka	555		Čína	1 657	
Thajsko	555		Švédsko	1 538	
Indonésie	555		Rakousko	1 066	
Filipíny	555		Indie	468	
Kambodža	555		Slovinsko	318	
Švýcarsko	89	89	Surinam	209	209
Itálie	71		Polsko	151	151
Slovensko	10		Německo	66	66

Structure of received royalties by region of licensor					
For patents			For utility models		
Region	CZK thousands		Region	CZK thousands	
	Total	Of which new		Total	Of which new
Prague			Prague		
Hradec Králové			Central Bohemia		
Vysočina			Liberec		
Liberec			South Moravia		
South Moravia			Vysočina		
Moravia-Silesia			Plzeň		
Olomouc			Ustí nad Labem		
Zlín			Moravia-Silesia		
Ústí nad Labem			Pardubice		
Karlovy Vary			South Bohemia		
South Bohemia			Hradec Králové		
Central Bohemia			Olomouc		

Pardubice			Zlín		
Plzeň			Karlovy Vary		
Structure of received licences by country of licensee					
Country	CZK thousands		Country	CZK thousands	
	Total	Of which		Total	Of which
United States			Russia		
China			Slovakia		
Czech Republic			Czech Republic		
Russia			Great Britain		
Denmark			Ukraine		
Japan			Croatia		
Germany			Romania		
Vietnam			Hungary		
India			Bulgaria		
Singapore			Serbia		
Malaysia			Netherlands		
Sri Lanka			China		
Thailand			Sweden		
Indonesia			Austria		
Philippines			India		
Cambodia			Slovenia		
Switzerland			Surinam		
Italy			Poland		
Slovakia			Germany		

Source: CZSO, drawn up by R&D Council

Czech patent statistics and the status of utilisation of intellectual property protection in the Czech Republic should also be seen through international comparisons (see Chapter 7 for more details). Patent statistics are usually part of “composite indicators” assessing the innovation performance of a country (e.g., SII, GII, IOI). This shows that the Czech Republic, in comparison with other countries, achieves relatively low and in fact unsatisfactory results in indicators related to intellectual property protection. That is why experts were asked to explain the causes of the insufficient use of intellectual property protection in the Czech Republic when the 2021+ National Research, Development and Innovation Policy was being drawn up. The causes of the insufficient utilisation of intellectual property rights included the following:[54]

- Lack of awareness about intellectual property protection in the education system (primary, secondary and post-secondary schools – information in education programmes, absence of teacher support, absence of intellectual property specialists with academic titles)
- Lack of awareness about intellectual property protection in the application sector – insufficient utilisation of intellectual property with commercial potential

[54] According to the Industrial Property Office: the assessment was based on claims heard during long-term communication with foreign partners and public and private stakeholders. Some of the following claims about the possible causes of insufficient utilisation of intellectual property rights cannot be backed by explicit data; they are, however, accepted by experts as the possible causes of insufficient utilisation of intellectual property rights.

- Insufficient use of intellectual property protection in science and research
- Existing public support for intellectual property protection without subsequent support for later commercial use in the form of licences
- Lack of motivation of research facilities to set motivational results for researchers to prevent illegal transfer, lack of motivation to introduce a licence policy
- Failure to utilise patent information when formulating research, development and innovation projects
- Failure to utilise patent information when assessing programmes and projects supported from public resources
- Absence of targets and measures supporting intellectual property protection in strategic and conceptual documents
- Absence of intellectual property specialists when formulating the conditions of support for intellectual property from public sources
- Persisting belief by some companies or entrepreneurs that they will not be able to afford the costs of patent protection
- The originators of a host of "non-Czech" patents are in fact Czechs – this fact may be due to the politics of international companies, where intellectual property is managed by headquarters and the related applications are filed in a different country other than the Czech Republic; another factor is that staff do not work in the Czech Republic; illegal transfer may be another factor
- Analysis of the sub-index of European Innovation Scoreboard (EIS) Intellectual Assets document that the Czech Republic lags behind in the frequency of intellectual property protection; it is highly likely that the State does not invest as much in activities tied to intellectual property protections as in other sub-indexes; no analysis of the State's investments in correlation to the EIS sub-indexes is available.

8 Innovation Performance of the Czech Economy and International Comparison Thereof

Effective innovation activities are an integral part of long-term and sustainable economic growth and competitiveness. During economic crises, innovation is deemed to be one way to minimise their negative impacts. For innovation to be successful, it needs a balanced system of support that is based on the optimum ratio of public and private investment, all in the framework of an effective relationship between business and academia. This interaction of all factors is based on first-class research facilities and maximum utilisation of the results of basic research.

This chapter focuses on the innovation performance of the Czech economy and its international comparison with selected countries. Innovation performance is measured through simple or composite indicators. Simple indictors are based on financial data, and their advantage is ease of calculation, simple interpretation and the possibility to compare innovation performance with other economies. On the other hand, simple indicators cannot identify the degree of contribution of each factor and component in achieving innovation performance. For a complete and determinative analysis of innovation performance, it is necessary to supplement the simple indicators with composite ones. These make it possible to break innovation performance down into individual factors and components and determine the degree of contribution of these composites to achieved innovation performance. Composite indicators can be built on up to several dozen sub-indicators; they are thus more sophisticated with respect to the possible analysis of innovation performance.

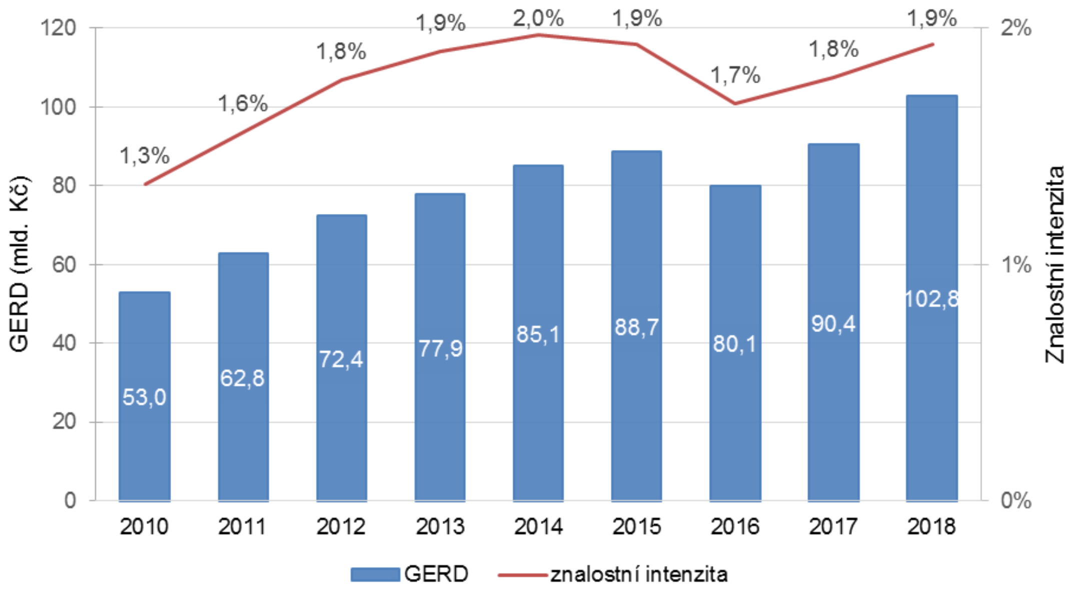
The following text determines the innovation performance of the Czech economy and the economies of selected countries according to a simple indicator (knowledge intensity) and composite indicators (SII, GII). The composite Innovation Output Indicator (IOI) and the CZSO survey of the innovation activities of enterprises are not contained in this chapter, as no new data has been published since the last Analysis of the Existing State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad in 2017.

8.1 Innovation Performance of the Czech Republic Based on Simple Indicators

Knowledge intensity is one of the basic and most frequently used simple indicators to determine the degree of innovation performance. Knowledge intensity is the ratio, expressed in percentage, of GERD to GDP. Some analyses may include expenditure on education in GERD.

Figure 8.1 shows the evolution of Czech GERD and knowledge intensity in 2010–2018. In the reference period, the absolute value of GERD fell only in 2016 and knowledge intensity fell year-on-year in 2015 and 2016. GERD first exceeded the value of CZK 100 bn. (CZK 102.8 bn.) within the reference period in 2018. In the last three years, the value of GERD has grown year-on-year by more than CZK 10 bn., and compared to the base year of 2010, has more than doubled. After several years of decline, knowledge intensity is returning to the levels of 2013–2015 (1.9%).

Figure 8.1: GERD and knowledge intensity – Czech Republic



GERD (CZK bn.)
Knowledge intensity

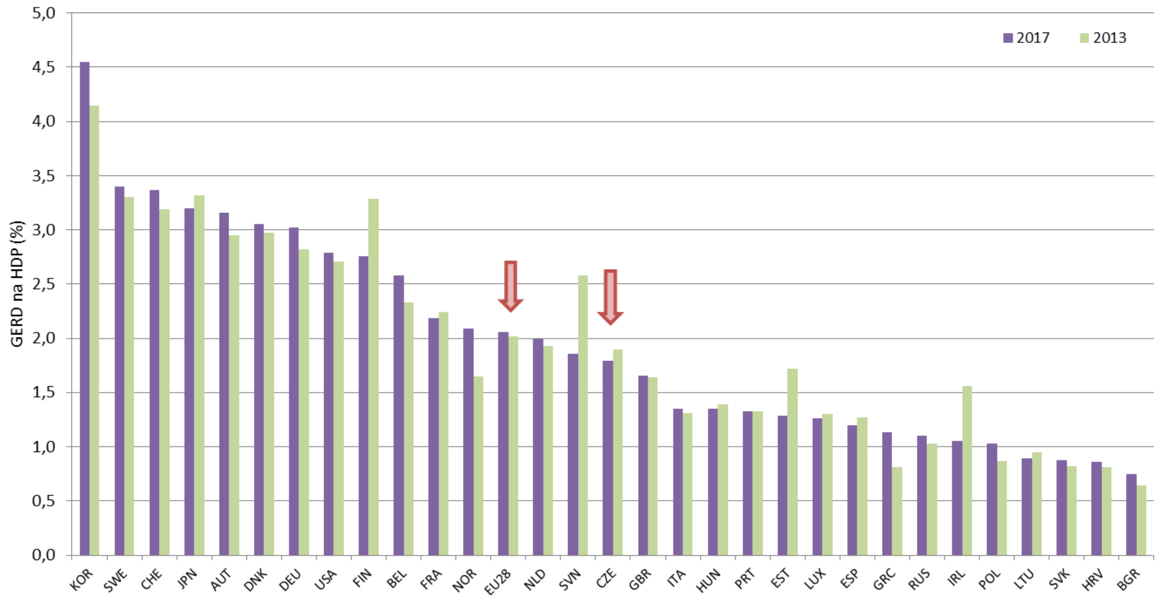
Source: CZSO, Research and Development

Figure 8.2 shows the knowledge intensity of selected countries in 2013 and 2017. In 2017, the Czech Republic was just behind the EU 28 average. In 2015, the Netherlands was positioned between the EU average and the Czech Republic. In 2016, the Czech Republic moved even further away from the EU 28 average but again got closer to it in 2017. Great Britain was behind the Czech Republic; conversely, Norway was above the average (in 2016 these countries, other than the Netherlands and Slovenia, were also between the EU 28 average and the Czech Republic). Countries such as Italy, Austria, Poland and Slovakia remain behind the Czech Republic. Of the analysed countries, South Korea, Sweden, Switzerland and Japan have the highest knowledge intensity. The greatest percentage growth in the value of knowledge intensity was registered by Greece (40%), Romania (28%) and Norway (27%); conversely, the greatest percentage drop in 2017 compared to 2013 was experienced by Ireland (-33%), Malta (-30%) and Slovenia (-28%). It can be seen from the above that the greatest percentage growth in knowledge intensity when comparing 2017 and 2013 was experienced by countries that had a low baseline. This is where the limitations of simple indicators, in terms of being statistically meaningful, come to light.

In 2017, GERD for the whole of EU 28 amounted to EUR 317.1 bn. The economies of Germany (EUR 99.1 bn., i.e., 31.3%), France (EUR 50.2 bn., i.e., 15.8%) and Great Britain (EUR 38.9 bn., i.e., 12.3%) contributed to this number the most. The Czech Republic's contribution to EU 28 GERD is 1.1% (EUR 3.4 bn.); in 2016, it was 1% (EUR 3.0 bn.). The contributions of other selected EU member states are as follows: Sweden 5.1%

(EUR 16.1 bn.), Austria 3.7% (EUR 11.7 bn.), Slovenia 0.3% (EUR 0.8 bn.) and Estonia 0.1% (EUR 0.3 bn.).

Figure 8.2: Knowledge intensity of the Czech economy and international comparison thereof



GERD per GDP (%)

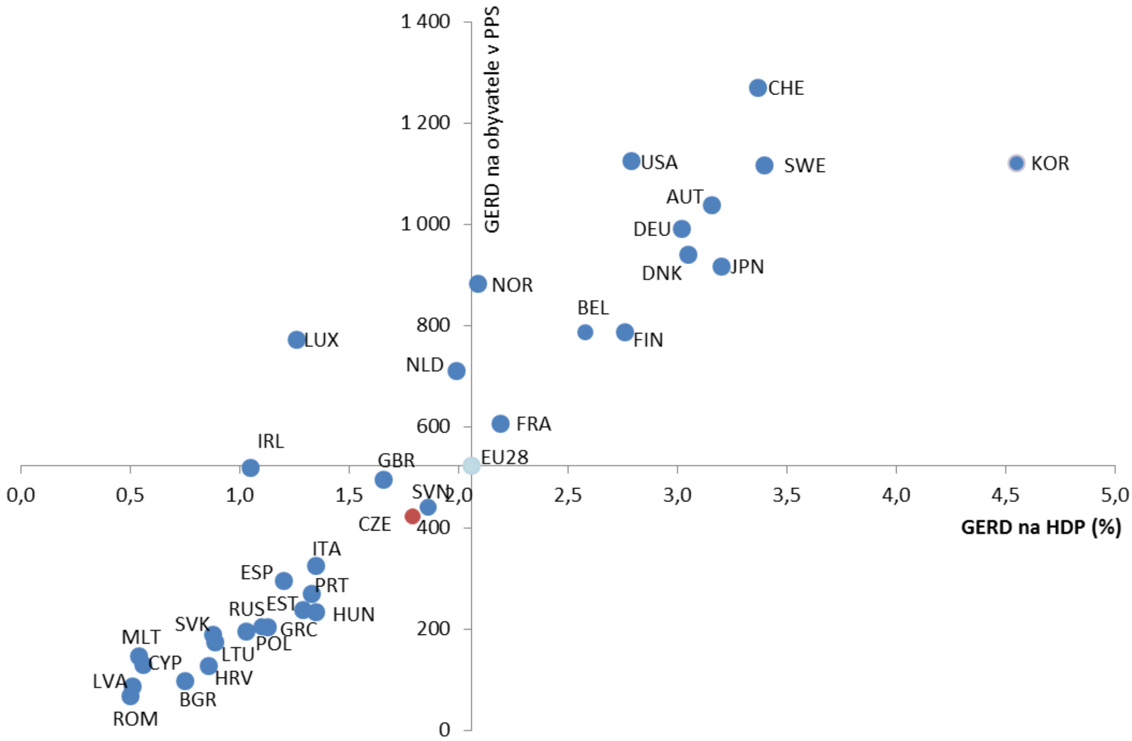
Source: Eurostat; OECD – MSTI database | For CHE, 2012 and 2015 data are shown; for RUS, 2015 data.

To increase the statistical significance of knowledge intensity, this indicator needs to be compared with the R&D expenditure per capita in the purchasing power standard (PPS). Figure 8.3 shows a comparison of selected countries by knowledge intensity and R&D expenditure per capita for 2017. PPS is expressed per capita in 2005 prices.

In 2017, the Czech Republic attained 80.9% of the EU 28 average in R&D expenditure per capital in PPS. Expressed in absolute terms, the Czech Republic registers R&D expenditure per capita in PPS at the level of 422.8 (in 2016, it was 381.1). To compare: the value for Sweden is 1 117.4; Austria 1 038.3; Slovenia 441.1 and Estonia 237.6. Within the EU 28, Sweden has the highest values (2.6 times higher than the Czech Republic).

It is also clear from Figure 8.3 that while South Korea has the highest knowledge intensity values, Switzerland has the highest after converting R&D expenditure per capita in PPS. The countries in the forefront in terms of knowledge intensity and GERD per capita in PPS are South Korea, Switzerland, Sweden, Austria, the USA, Japan, Denmark and Germany. On the other end of the scale are Romania and Latvia. The Czech Republic (together with Great Britain and Slovenia) is found just under the EU 28 average.

Figure 8.3: Comparison of countries by GERD per GDP and by R&D expenditure per capita (2017)



GERD per capital in PPS
GERD per GDP (%)

Source: own draft according to Eurostat and OECD – MSTI Database
Y axis− GERD per capita in PPS (RUS data from 2014; CHE data from 2015; USA, JPN, KOR data from 2016)
X axis − GERD per GDP in % (CHE and RUS data from 2015)

8.2 Innovation Performance Based on Composite Indicators

The following is a list of the composite indicators used most often:

- Summary Innovation Index (SII)
- Global Innovation Index (GII)
- Innovation Output Indicator (IOI) – see Analysis of the Existing State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad in 2017

SUMMARY INNOVATION INDEX (SII)

The EIS is published annually and serves to compare the innovation level of EU Member States and selected third countries. The latest EIS 2019 is based on data from 2018. Innovation performance in EIS is measured based on the composite indicator SII. SII comprises four main areas (Framework Conditions, Innovation Activities, Investment, Impact), which are then further divided into innovation groups and these in turn into individual indicators that are allocated various weights. Based on SII values, the evaluated countries are classified into four groups: Innovation Leaders, Strong Innovators, Moderate Innovators and Modest Innovators.

Figure 8.4 shows the SII value of the EU Member States for 2018 and its relative change in 2013 and 2018. The colours of each country correspond to the above-mentioned four groups. The Czech Republic is classified as a Moderate Innovator.

Compared to the previous year, there have been several changes in the way some countries are classified. Estonia has improved its standing from Moderate Innovator to Strong Innovator. Luxembourg and Great Britain have fallen from the Innovation Leaders group to the Strong Innovators group. Slovenia has also fallen from the Strong Innovators group to the Moderate Innovators group.

It is also apparent from Figure 8.4 that Romania has the lowest RII ranking for 2018 and the lowest relative change in SII in 2013 and 2018. Romania and Bulgaria are ranked as Modest Innovators.

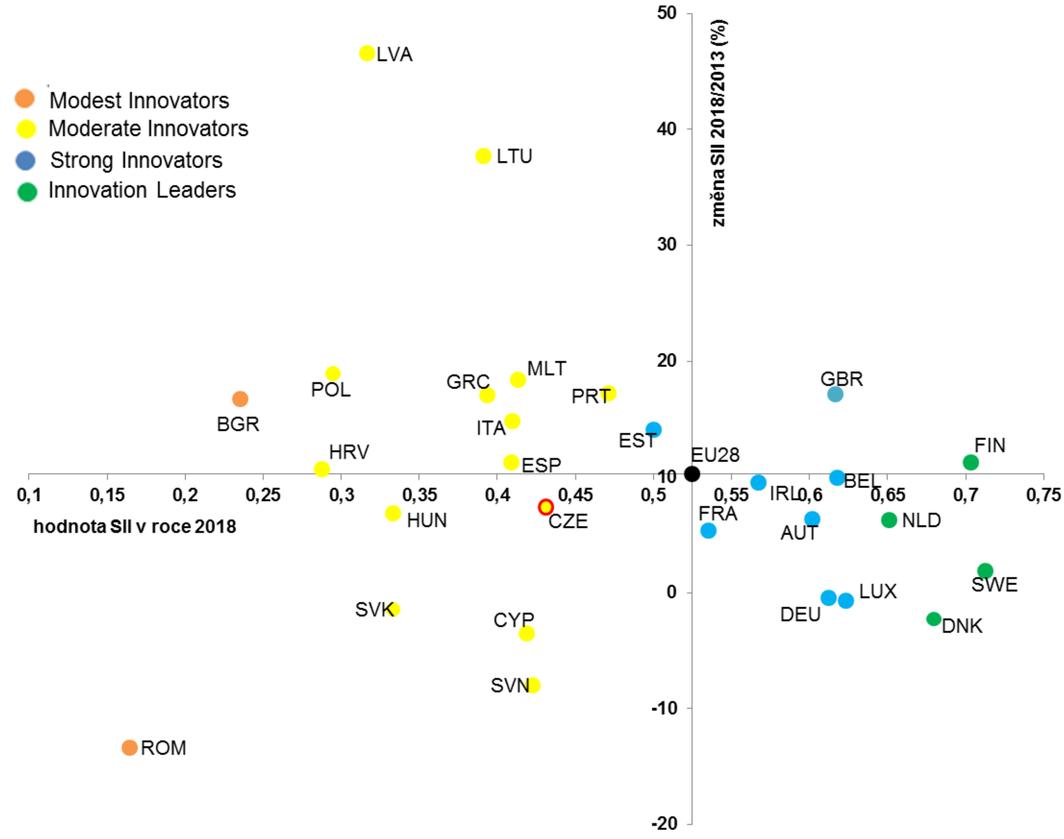
As mentioned above, the Czech Republic is ranked as a Moderate Innovator, attaining the highest SII values for this category in the past. In 2018, Portugal overtook the Czech Republic. The highest relative change in this group in 2013 and 2018 was recorded by Latvia (from 0.2 to 0.5). Innovation performance of countries in the Moderate Innovators group does not reach the EU 28 average.

Eight countries have been classified as Strong Innovators (Belgium, Germany, Estonia, Ireland, France, Luxembourg, Austria and Great Britain). These countries exceed or are close to the EU 28 average.

Finland, Denmark, the Netherlands and Sweden are considered Innovation Leaders. These countries substantially exceed the innovation performance of the EU 28 average.

As ensues from the conclusions of EIS 2019, the innovation performance of the EU is continuing to grow at a stable rate and the progress of recent years is fast and will continue to accelerate. Within the EU Member States, progress is substantially uneven. From the global perspective, the innovation performance of the EU 28 has surpassed the USA, but continues to lag behind Japan, Canada, South Korea and Australia. Compared to Japan and South Korea, the EU continues to fall behind, and the differences in performance are expected to keep increasing. Compared to Australia, Canada and the USA, the EU has improved its position. China’s innovation performance has been growing at twice the speed of the EU and is catching up to the EU. Conversely, Brazil, India, Russia and South Africa are continuing to maintain a substantial lead.

Figure 8.4: SII of the EU Member States for 2018 and its changes in 2013 and 2018



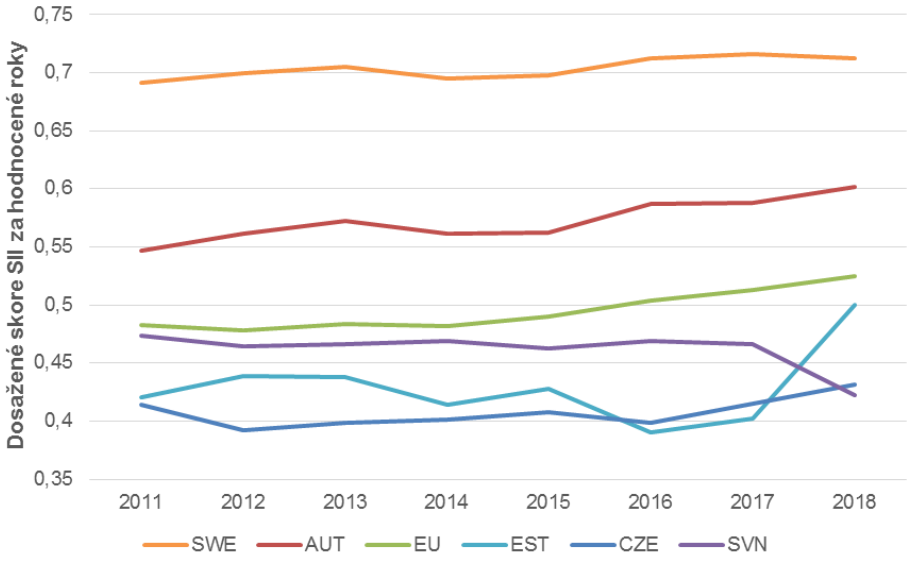
SII value in 2018
SII change 2018/2013 (%)

Source: Own draft according to EIS 2019
Colour differentiation of countries corresponds to the SII classification.

Figure 8.5 shows the development of SII between 2011 and 2018 for the Czech Republic, Austria, Sweden, Estonia, Slovenia and the EU 28. As already mentioned above, Sweden has long been attaining the highest SII values. Austria is hovering above the EU 28 average; conversely, the Czech Republic is below the EU 28 average, along with Estonia and Slovenia.

In the base year of 2011, the Czech Republic achieved close to the same SII values as Estonia. In the years that followed, SII values for the Czech Republic began to fall and in the case of Estonia they rose. In 2016 and 2017, the Czech Republic enjoyed greater SII values than Estonia. In 2018, the value of SII can clearly be seen rising for Estonia and falling for Slovenia. The Czech Republic thus achieved greater SII values than Slovenia but lower ones than Estonia. The following figures show the specific areas of SII.

Figure 8.5: Evolution of SII in 2011–2018 in the case of the Czech Republic and other selected countries



Attained SII score for evaluated years

Source: own draft according to EIS 2019

Figure 8.6 below depicts SII values for 2018 and SII subcategories in the case of the Czech Republic and selected countries. In most areas, Sweden achieves much higher values than other selected countries. Lower values are shown by Sweden only in the Innovators group (Austria has a higher value) and Sales Impacts (the EU 28 and the Czech Republic have the highest value). Sweden dominates all other selected countries in 'Innovation-friendly environment'.

The Czech Republic achieves lower values within the selected countries in the following areas: 'Human resources', 'Attractive research systems', 'Innovation-friendly environment', 'Linkages' and 'Intellectual assets'. Estonia has the lowest values in 'Firm investments' and 'Sales impacts'. Slovenia has the lowest values in 'Financing and support' and 'Innovators'. Austria has the lowest values in 'Employment impacts'.

Figure 8.7 shows each SII indicator in 2018 for the Czech Republic and selected countries.

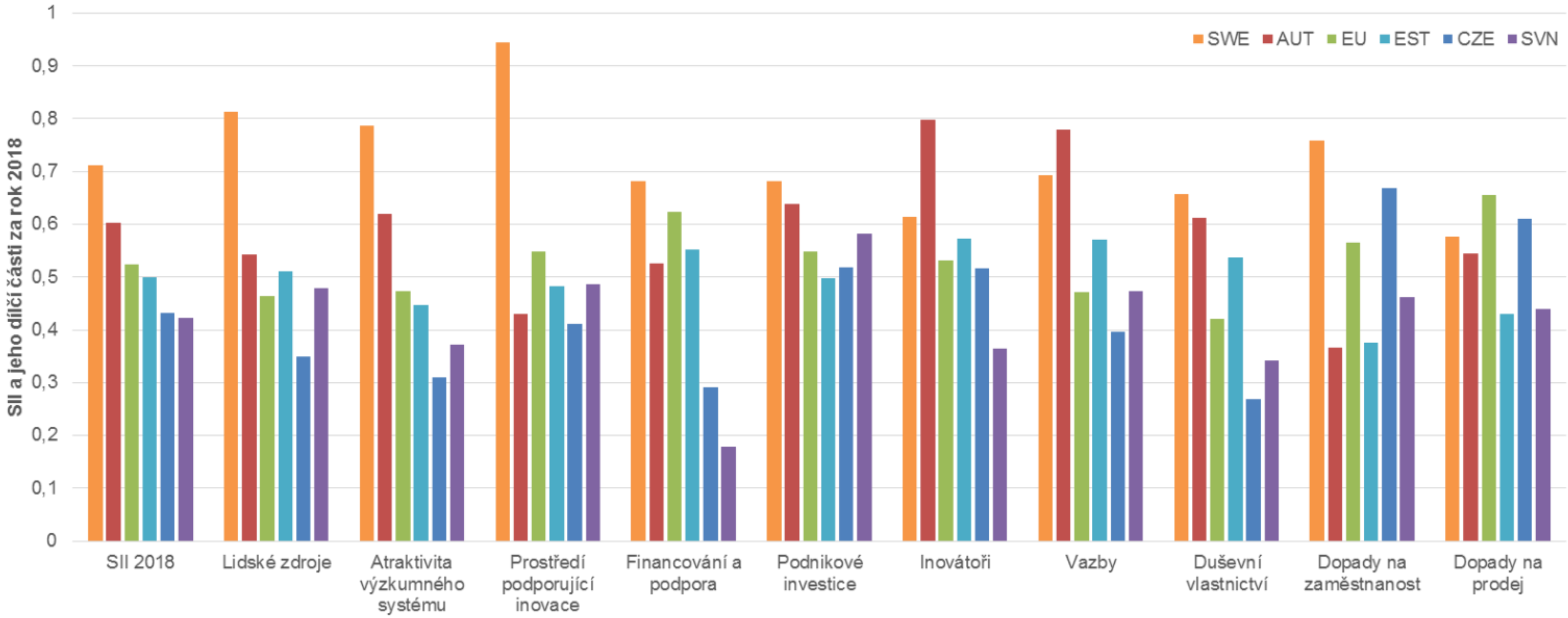
Of the eight indicator areas in total, three fall into the Framework Conditions category. Of the monitored countries, the Czech Republic has the lowest values in five Framework Condition indicators ('Population with completed tertiary education', 'Life-long learning', 'International scientific co-publications', 'Top 10% most-cited publications' and 'Broadband penetration'). Sweden, on the other hands, has the highest values in all Framework Condition indicators.

The second category is 'Investments', in which there are two areas of indicators out of a total of five. In most of these indictors, the Czech Republic achieves average values. Compared to the EU 28, the Czech Republic is furthest behind in the 'Venture capital investment' category. The majority of the Czech Republic's values approximate those of Slovenia.

The third area is 'Innovation activities', where there are nine indicator categories in three groups. In the 'Intellectual assets' group, the Czech Republic has the lowest values of all countries in the 'PCT patent application' and 'Trademark application' indicators. In the last indicator group, 'Intellectual assets', the Czech Republic is only ahead of Slovenia.

The last area is 'Impacts', which comprises five indicators divided into two groups. Out of the monitored countries, the Czech Republic achieves the highest values in one of the indictors in each of these groups. In 'Employment impacts', the Czech Republic ranks the highest of the monitored countries in the 'Employment in fast-growing enterprises of innovative sectors' indicator (Austria has achieved only 30% of the value achieved by the Czech Republic). Conversely, it ranked the lowest in the 'Employment in knowledge-intensive activities' indicator. In the 'Sales impacts' group, the Czech Republic has the highest value out of the monitored countries in the 'Medium and high-tech product exports' indicator (Estonia has just 58% of the value of the Czech Republic).

Figure 8.6: 2018 SII and its subparts comparing the Czech Republic and Selected Countries

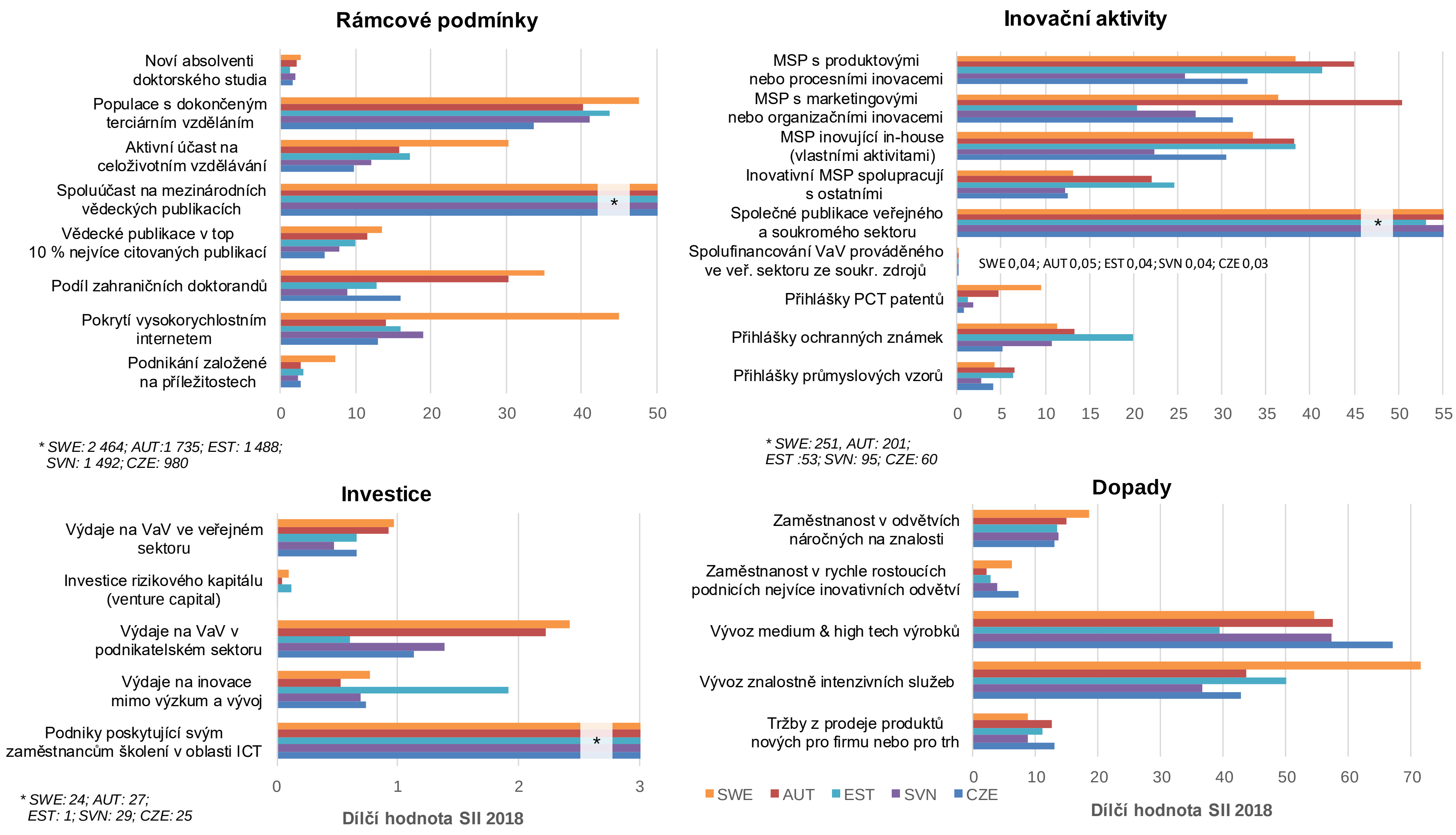


SII and its subparts for 2018
SII 2018
Human resources
Attractive research systems
Innovation-friendly environment
Finance and support
Firm investments
Innovators
Linkages

Intellectual assets
Employment impacts
Sales impacts

Source: own draft according to EIS 2019

Figure 8.7: Breakdown of 2018 SII and comparison of the values of the Czech Republic and selected countries



Framework Conditions
New doctoral graduates

Population with tertiary education
Lifelong learning
International scientific co-publications
Top 10% most cited publications
Foreign doctoral students
Broadband penetration
Opportunity-driven entrepreneurship

Innovation Activities
SMEs with product or process innovations
SMEs with marketing or organisational innovations
SMEs innovating in-house
Innovative SMEs collaborating with others
Public-private co-publications
Private co-funding of public R&D expenditures
PCT patent applications
Trademark applications
Design applications

Investment
R&D expenditure in the public sector
Venture capital investment
R&D expenditure in the business sector
Non-R&D innovation expenditures
Enterprises providing training to develop or upgrade ICT skills of their personnel

Impacts
Employment in knowledge-intensive activities
Employment in fast-growing enterprises of innovative sectors
Medium and high-tech product exports
Knowledge-intensive service exports
Sales of new-to-market and new-to-firm product innovations

2018 SII sub-value

Source: own draft according to EIS 2019

Even though the innovation performance of the Czech Republic is growing, Table 1 clearly shows that the Czech Republic is not keeping pace with the innovation performance of the EU. The performance of the Czech Republic compared with that of the EU 28 in 2018 is much higher only in the 'Employment in fast growing enterprises of innovative sectors' and 'Medium and high-tech product exports' indicators. Conversely, the Czech Republic achieved the worst values in the indicator 'Venture capital investment', where it achieves only 5% of the EU 28 values from 2018. The 'Intellectual assets' indicator group can generally be designated as an unsatisfactory area.

The second part of Table 8.1 captures selected countries according to the SII evaluation for 2018 only within the EU 28 and the evolution of performance in 2013 and 2018. From the red arrows, which depict a negative change of more than 5 pp in 2013 and 2018, it is clear that out of the selected countries, the Czech Republic has deteriorated in the fewest number of indicators. Conversely, the position of the Czech Republic in each of the indictors places it in the bottom half of the EU 28. The Czech Republic achieved its best placement (4th place) in the 'Medium and high-tech product exports' indicator. It achieved its worst placement (26th) within the EU 28 in the 'Venture capital investment' indicator.

Table 8.1: Relative performance of the Czech Republic and Selected Countries according to SII

	Relativní výkonnost ČR k EU 2018	Relativní výkonnost ČR k EU 2011		Pořadí v EU 28 dle SII za rok 2018 a změna mezi roky 2013 a 2018									
				ČR		Švédsko		Rakousko		Slovinsko		Estonsko	
	2018	2011	2018	Δ	pozice	Δ	pozice	Δ	pozice	Δ	pozice	Δ	pozice
SOUHRNNÝ INOVAČNÍ INDEX	**82,2**	**85,9**	**89,4**	↑	14	↗	1	↑	9	↓	15	↑	12
Lidské zdroje	**75,0**	**73,4**	**91,7**	↑	19	↗	2	↑	9	↗	13	↑	11
Noví absolventi doktorského studia	77,8	84,6	112,9	↘	15	↓	3	↘	9	↗	12	↑	20
Populace s dokončeným terciárním vzděláním	61,3	45,5	73,1	↑	24	↑	6	↑	17	↑	16	↑	11
Aktivní účast na celoživotním vzdělávání	88,8	92,7	90,6	↘	13	↗	1	↑	8	↓	10	↑	6
Atraktivita výzkumného systému	**65,3**	**48,8**	**73,6**	↑	18	↑	4	↑	8	↑	16	↑	13
Spoluúčast na mezinárodních vědeckých publikacích	91,0	73,8	132,3	↑	16	↑	2	↑	8	↑	11	↑	12
Vědecké publikace v top 10 % nejvíce citovaných publikacích	43,8	37,3	48,0	↑	20	↗	5	↗	11	↑	18	↑	13
Podíl zahraničních doktorandů	78,1	50,2	74,7	↑	12	↑	7	↑	8	↓	21	↑	15
Prostředí podporující inovace	**75,1**	**84,3**	**118,6**	↑	22	↑	3	↓	20	↓	17	↑	18
Pokrytí vysokorychlostním internetem	72,2	88,9	144,4	↑	22	↑	1	↑	20	↑	14	↑	18
Podnikání založené na příležitostech	78,1	81,2	101,1	↑	16	↓	3	↓	15	↓	19	↘	12
Financování a podpora	**46,7**	**84,6**	**51,1**	↓	18	↓	5	↑	12	↓	23	↓	11
Výdaje na VaV ve veřejném sektoru	96,0	70,1	88,8	↓	10	↓	2	↑	5	↓	18	↓	9
Investice rizikového kapitálu (venture capital)	5,0	101,7	6,5	↘	26	↑	11	↗	19	↓	27	↑	8
Podnikové investice	**94,4**	**104,6**	**112,6**	↑	9	↑	3	↑	5	↓	6	↑	11
Výdaje na VaV v podnikatelském sektoru	82,8	64,0	94,9	↑	10	↑	1	↑	2	↓	8	↓	19
Výdaje na inovace mimo výzkum a vývoj	89,3	134,6	104,3	↑	13	↑	10	↑	19	↑	15	↑	1
Podniky poskytující svým zaměstnancům školení v oblasti ICT	110,5	113,3	140,0	↑	13	↑	14	↓	8	↑	5	↑	23
Inovátoři	**96,9**	**105,4**	**88,0**	↘	16	↓	12	↑	3	↓	20	↓	14
MSP s produktovými nebo procesními inovacemi	94,9	99,0	92,1	↑	17	↓	11	↑	5	↓	20	↗	7
MSP s marketingovými nebo organizačními inovacemi	82,9	120,1	70,7	↓	17	↓	14	↑	2	↓	20	↓	23
MSP inovující in-house (vlastními aktivitami)	112,6	97,0	101,4	↑	15	↓	13	↑	7	↓	20	↑	6
Vazby	**84,1**	**71,5**	**87,3**	↑	14	↘	4	↑	1	↓	12	↑	9
Inovativní MSP spolupracují s ostatními	107,1	101,1	114,4	↑	12	↓	10	↑	5	↓	13	↑	1
Společné publikace veřejného a soukromého sektoru	73,0	71,4	85,6	↗	15	↑	2	↑	3	↓	11	↑	16
Spolufinancování VaV prováděného ve veřejném sektoru ze soukromých zdrojů	71,2	49,8	68,3	↑	14	↘	8	↑	5	↓	7	↑	9
Duševní vlastnictví	**63,8**	**50,7**	**62,1**	↗	20	↘	4	↓	7	↓	15	↑	8
Přihlášky PCT patentů	23,2	21,1	21,1	↘	19	↗	1	↓	6	↓	13	↓	17
Přihlášky ochranných známek	69,1	71,4	76,9	↓	22	↑	8	↘	5	↑	9	↑	4
Přihlášky průmyslových vzorů	100,0	64,3	92,2	↑	11	↓	10	↓	4	↓	19	↑	5
Dopady na zaměstnanost	**118,4**	**114,6**	**123,6**	↑	7	↘	4	↓	25	↑	18	↑	24
Zaměstnanost v odvětvích náročných na znalosti	84,7	84,6	92,3	↗	17	↑	4	↑	11	↓	14	↑	16
Zaměstnanost v rychle rostoucích podnicích nejvíce inovativních odvětví	144,6	136,3	146,3	↑	6	↓	9	↓	27	↑	19	↘	23
Dopady na prodej	**93,0**	**105,4**	**95,8**	↘	7	↗	10	↗	13	↘	19	↘	21
Vývoz medium & high tech výrobků	128,2	127,2	138,3	↑	4	↑	12	↗	7	↑	8	↓	23
Vývoz znalostně intenzivních služeb	49,3	41,1	50,9	↗	20	↘	8	↘	19	↗	25	↑	16
Tržby z prodeje produktů nových pro firmu nebo pro trh	100,0	153,4	97,0	↓	9	↗	18	↑	10	↓	19	↓	14

Relative Performance of CR to EU 2018 Relative Performance of CR to EU 2011 SII Rank in EU 28 for 2018 and change between 2013 and 2018

CR Sweden Austria Slovenia Estonia

SUMMARY INNOVATION INDEX
Human resources
New doctoral graduates
Population with tertiary education
Lifelong learning
Attractive research systems
International scientific co-publications
Top 10% most cited publications
Foreign doctoral students
Innovation-friendly environment
Broadband penetration
Opportunity-driven entrepreneurship
Finance and support
R&D expenditure in the public sector
Venture capital investment
Firm investments
R&D expenditure in the business sector
Non-R&D innovation expenditures
Enterprises providing ICT employee training
Innovators
SMEs product/process innovations

SMEs marketing/organizational innovations
SMEs innovating in-house
Linkages
Innovative SMEs collaborating with others
Public-private co-publications
Private co-funding of public R&D
Intellectual assets
PCT patent applications
Trademark applications
Design applications
Employment impacts
Employment in knowledge-intensive activities
Employment in fast-growing enterprises
Sales impacts
Medium and high-tech product exports
Knowledge-intensive service exports
Sales of new-to-market/firm innovations

Source: own draft according to EIS 2019

Note: Performance – dark green: normalised performance above 120% of EU; light green: normalised performance between 90% and 120% of EU; yellow: normalised performance between 50% and 90% of EU; orange: normalised performance below 50% of EU. Red values show drop in performance compared to values in 2010. Position – green positions 1–14, red positions 15–28; Change – positive change greater than 5 pp labelled with a green arrow, a change of less than 5 pp labelled with a yellow arrow; a negative of more than 5 pp labelled with a red arrow.

GLOBAL INNOVATION INDEX (GII)

The GII is one of the most frequently used composite indictors of innovation performance. GII is composed of innovation inputs and innovation outputs. The monitored areas in innovation inputs are institutions, human capital and research, infrastructure, market sophistication and entrepreneurial sophistication. The monitored areas in innovation outputs are knowledge, technology and creativity. The resulting GII value is calculated as the average of the innovation inputs and innovation outputs. The ratio of innovation inputs and innovation outputs is called the Innovation Efficiency Indicator. This indictor shows how much of an innovation output is produced by one innovation input.

The latest GII 2019 is based on data from 2018. A total of 129 countries were evaluated. As in previous years, Switzerland achieved the best ranking, followed by Sweden, the USA, the Netherlands, Great Britain, Finland, Denmark, Singapore, Germany and Israel. The Czech Republic is ranked in 26th position according to GII 2019 (according to GII 2018, it ranked 27th and according to GII 2017, 24th). The Czech Republic's absolute value under GII 2019 is 49.4 (Switzerland is first at 67.2; Yemen last at 14.5). Other selected countries achieved the following rankings: Sweden ranked 2nd (score: 63.7), Austria 21st (50.9), Estonia 24th (50.0) and Slovenia 31st (45.3).

Within the Innovation INSPt Sub-Index indicator, Singapore ranked first, followed by Switzerland, the USA and Sweden. The Czech Republic ranked 29th (Sweden 4th, Austria 19th, Estonia 27th and Slovenia 33rd).

According to the Innovation Output Sub-Index indicator, Switzerland is in first place, followed by the Netherlands, Sweden and Great Britain. The Czech Republic ranked 21st (Sweden 3rd, Estonia 19th, Austria 25th, Slovenia 30th).

Table 8.2 shows the ranking of selected countries only within the EU 28 according to GII 2019 in the various pillars and sub-pillars and the change between GII 2019 and 2013. The green arrow depicts a positive change of more than 10%; conversely, the red arrow depicts a negative change of more than 10%. In the case of some indicators, it was not possible to calculate the change between years because the composition of GII 2013 and GII 2019 differs slightly.

Of the monitored indicators, 13 are designated as strengths and 11 as weaknesses in the case of the Czech Republic. The strengths are primarily in the area of innovation inputs and the weaknesses are in the area of innovation outputs (most in the area of innovation infrastructure and market sophistication). The Czech Republic was ranked first in the EU 28 in several areas of the GII 2018 evaluation (High-tech imports, Utility model applications by origin, High-tech exports, Creative goods exports). In fact, in two indicators (High-tech exports, Creative goods exports), the Czech Republic is ranked as the best out of all 129 evaluated countries.

In the Applied tariff rate indicator, all EU Member States (save Croatia) achieved the same values, i.e., the same ranking. The order in this indicator thus says very little.

Conversely, the Czech Republic is ranked last among the EU 28 in the following areas: ICT, Government's online service, Online e-participation.

Table 8.2: Ranking of the Czech Republic and Selected Countries according to GII 2019 within the EU 28

		Pořadí v EU28 dle GII 2019 a změna GII 2013 a 2019									
		ČR		Švédsko		Rakousko		Slovinsko		Estonsko	
	Indicator	Δ	pozice	Δ	pozice	Δ	pozice	Δ	pozice	Δ	pozice
	Global Innovation Index	↗	13	↗	1	↘	10	↘	18	↘	12
	Innovation Efficiency Ratio	↘	22	↘	26	↓	5	↓	10	↘	20
	Innovation Input Sub-index	↗	15	↗	1	↗	8	↗	19	↗	13
	Innovation Output Sub-index	↗	12	↗	2	↘	15	↓	19	↘	10
	Index										
1.	Institutions	↗	16	↗	4	↘	7	↗	10	↗	13
1.1.	Political environment	↘	16	↘	3	↘	7	↗	13	↘	12
1.1.1.	Political stability and absence of violence/terrorism	↘	13	↘	3	↘	7	↘	13	↗	7
1.1.2.	Government effectiveness	↗	16	↘	3	↘	7	↑	13	↗	14
1.2.	Regulatory environment	↗	20	↘	5	↘	3	↘	16	↗	8
1.2.1.	Regulatory quality	↘	13	↘	3	↘	10	↓	25	↗	7
1.2.2.	Rule of law	↗	15	↘	2	↘	5	↘	16	↗	12
1.2.3.	Cost of redundancy dismissal	↗	26	↗	17	↗	1	↗	10	↗	11
1.3.	Business environment	↑	15	↗	8	↗	16	↑	5	↑	18
1.3.1.	Ease of starting a business	↗	24	↗	3	↗	25	↘	10	↗	2
1.3.2.	Ease of resolving insolvency	↑	8	↗	10	↓	13	↑	6	↑	19
2.	Human capital and research	↘	16	↘	4	↗	5	↘	14	↓	17
2.1.	Education	↗	11	↘	4	↘	7	↓	10	↓	19
2.1.1.	Expenditure on education	↑	6	↑	2	↘	9	↘	14	↗	13
2.1.2.	Government funding per secondary student	-	11	-	12	-	5	-	10	-	24
2.1.3.	School life expectancy	↘	12	↗	5	↓	16	↓	10	↓	19
2.1.4.	Assessment in reading, mathematics, and science	↗	16	↗	12	↑	14	↑	3	↑	1
2.1.5.	Pupil-teacher ratio, secondary	↘	18	↓	23	↗	10	↘	12	↗	6
2.2.	Tertiary education	↘	10	↓	11	↑	1	↘	16	↑	6
2.2.1.	Tertiary enrolment	↓	18	↓	19	↗	5	↓	8	↘	11
2.2.2.	Graduates in science and engineering	↘	16	↗	8	↑	2	↑	13	↑	7
2.2.3.	Tertiary level inbound mobility	↓	6	↓	17	↓	4	↓	26	↘	16
2.3.	Research and development (R&D)	↓	19	↑	1	↗	9	↑	13	↓	20
2.3.1.	Researchers	↑	14	↑	2	↑	4	↑	9	↗	15
2.3.2.	Gross expenditure on R&D (GERD)	↘	10	↘	1	↗	2	↓	9	↓	15
2.3.3.	Global R&D companies, average expenditure top 3	-	20	-	5	-	13	-	15	-	20
2.3.4.	QS university ranking average score top 3 universities	↓	14	↓	5	↘	12	↑	22	↑	17
3.	Infrastructure	↑	17	↗	1	↑	11	↑	21	↑	10
3.1.	Information and communication technologies (ICTs)	↑	28	↑	6	↑	15	↑	20	↑	10
3.1.1.	ICT access	↑	26	↘	8	↗	6	↑	13	↑	10
3.1.2.	ICT use	↑	17	↑	2	↑	16	↑	23	↑	7
3.1.3.	Government's online service	↑	28	↑	6	↑	14	↑	18	↗	13
3.1.4.	Online e-participation	↑	28	↑	8	↑	18	↑	20	↑	12
3.2.	General infrastructure	↑	5	↑	1	↑	3	↗	17	↑	8
3.2.1.	Electricity output	↓	5	↓	1	↓	8	↓	7	↓	3
3.2.2.	Logistics performance	↑	12	↑	2	↑	4	↗	18	↑	19
3.2.3.	Gross capital formation	↑	2	↑	4	↑	5	↑	20	↑	3
3.3.	Ecological sustainability	↓	12	↘	8	↑	19	↘	25	↘	14
3.3.1.	GDP per unit of energy use	↓	25	↘	19	↓	12	↓	23	↘	27
3.3.2.	Environmental performance	↗	21	↑	4	↑	7	↗	22	↑	27
3.3.3.	ISO 14001 environmental certificates	↓	3	↓	6	↘	22	↓	13	↗	1
4.	Market sophistication	↗	15	↓	4	↓	13	↓	27	↗	14
4.1.	Credit	↘	17	↓	4	↓	16	↓	26	↓	9
4.1.1.	Ease of getting credit	↗	6	↓	18	↓	18	↘	23	↘	6
4.1.2.	Domestic credit to private sector	↘	22	↘	4	↓	12	↓	24	↓	16
4.1.3.	Microfinance institutions' gross loan portfolio	-	-	-	-	-	-	-	-	-	-
4.2.	Investment	↑	17	↓	4	↑	18	↑	21	↑	8
4.2.1.	Ease of protecting minority investors	-	20	-	5	-	5	-	3	-	25
4.2.2.	Market capitalization	-	-	-	-	↑	12	↓	18	-	-
4.2.3.	Venture capital deals	↓	26	↓	10	↓	17	↓	20	-	9
4.3.	Trade, competition, & market scale	-	11	-	10	-	9	-	22	-	25
4.3.1.	Applied tariff rate, weighted mean	↘	1	↘	1	↘	1	↘	1	↘	1
4.3.2.	Intensity of local competition	↘	8	↘	12	↘	6	↗	16	↗	5
4.3.3.	Domestic market scale	-	12	-	9	-	11	-	23	-	26

		Pořadí v EU28 dle GII 2019 a změna GII 2013 a 2019									
		ČR		Švédsko		Rakousko		Slovinsko		Estonsko	
	Indicator	Δ	pozice	Δ	pozice	Δ	pozice	Δ	pozice	Δ	pozice
5.	Business sophistication	↘	14	↑	1	↑	11	↗	15	↘	16
5.1.	Knowledge workers	↓	15	↑	1	↗	9	↑	11	↓	13
5.1.1.	Employment in knowledge-intensive services	↑	18	↑	2	↑	16	↑	11	↑	8
5.1.2.	Firms offering formal training	↓	2	-	1	-	-	↘	7	↓	9
5.1.3.	GERD performed by business enterprise	↘	11	↘	1	↗	2	↓	8	↓	19
5.1.4.	GERD financed by business enterprise	↘	25	↗	5	↑	10	↑	1	↘	17
5.1.5.	Females employed with advanced degrees	-	27	-	6	-	19	-	12	-	3
5.2.	Innovation linkages	↗	16	↑	1	↑	8	↓	21	↘	18
5.2.1.	University/industry research collaboration	↓	14	↘	5	↗	9	↘	17	↓	18
5.2.2.	State of cluster development	↘	16	↗	5	↗	7	↗	17	↘	24
5.2.3.	GERD financed by abroad	↑	3	↓	25	↑	9	↑	18	↑	13
5.2.4.	Joint venture/strategic alliance deals	↑	22	↑	2	↑	13	↓	25	↘	10
5.2.5.	Patent families filed in at least two offices	↓	17	↑	1	↓	8	↓	15	↓	16
5.3.	Knowledge absorption	↗	11	↑	4	↑	13	↗	16	↗	19
5.3.1.	Intellectual property payments	-	19	-	6	-	20	-	23	-	26
5.3.2.	High-tech imports	↗	1	↓	15	↓	13	↘	26	↓	9
5.3.3.	ICT services imports	-	20	-	3	-	8	-	17	-	11
5.3.4.	Foreign direct investment, net inflows	↑	11	↑	14	↑	28	↑	13	↑	20
5.3.5.	Research talent in business enterprise	-	13	-	1	-	3	-	4	-	21
6.	Knowledge and technology outputs	↑	9	↑	1	↘	16	↓	22	↗	17
6.1.	Knowledge creation	↗	12	↗	1	↗	10	↑	14	↓	16
6.1.1.	Patent applications by origin	-	15	-	5	-	8	-	6	-	19
6.1.2.	PCT international applications by origin	-	21	-	1	-	7	-	13	-	16
6.1.3.	Utility model applications by origin	-	1	-	-	-	8	-	15	-	7
6.1.4.	Scientific and technical publications	↑	9	↗	4	↑	12	↑	2	↗	6
6.1.5.	Citable documents H index	↘	16	↓	6	↓	10	↘	18	↗	21
6.2.	Knowledge impact	↑	6	↘	14	↗	19	↓	25	↗	7
6.2.1.	Growth rate of GDP per person engaged	↑	8	↑	21	↑	14	↑	9	↑	6
6.2.2.	New business density	↓	16	↓	8	↓	28	↓	22	↑	1
6.2.3.	Total computer software spending	↑	16	↑	8	↘	12	-	26	-	24
6.2.4.	ISO 9001 quality certificates	↓	3	↓	24	↓	23	↘	8	↘	7
6.2.5.	High-tech and medium high-tech output	↑	3	↘	7	↘	8	↓	19	↓	22
6.3.	Knowledge diffusion	↑	11	↑	3	↓	21	↓	25	↑	17
6.3.1.	Intellectual property receipts	-	16	-	1	-	14	-	18	-	25
6.3.2.	High-tech exports	↑	1	↗	13	↑	11	↑	18	↑	9
6.3.3.	ICT services exports	↓	17	↑	4	↑	12	↓	25	↑	7
6.3.4.	Foreign direct investment, net outflows	↓	14	↘	7	↓	27	↓	20	-	23
7.	Creative outputs	↓	12	↘	5	↓	15	↘	14	↘	6
7.1.	Intangible assets	↑	17	↑	10	↑	16	↑	12	↗	6
7.1.1.	Trademark application class count by origin	-	11	-	14	-	17	-	2	-	8
7.1.2.	Industrial designs by origin	-	10	-	16	-	7	-	12	-	11
7.1.3.	ICTs and business model creation	↑	21	↗	3	↗	15	↑	17	↘	11
7.1.4.	ICTs and organizational model creation	↑	13	↑	1	↑	15	↑	20	↑	4
7.2.	Creative goods and services	↓	3	↓	9	↓	16	↓	14	↓	7
7.2.1.	Cultural and creative services exports	-	24	-	14	-	12	-	17	-	6
7.2.2.	National feature films produced	↓	15	↓	10	↓	14	↓	5	↗	2
7.2.3.	Entertainment and media market	-	14	-	2	-	3	-	-	-	-
7.2.4.	Printing, publications & other media output	↓	23	↗	14	↘	11	↗	7	↗	5
7.2.5.	Creative goods exports	↗	1	↓	11	↓	20	↓	19	↓	16
7.3.	Online creativity	↓	16	↓	3	↓	12	↓	15	↓	8
7.3.1.	Generic top-level domains (gTLDs)	↑	19	↓	9	↓	11	↓	17	↓	24
7.3.2.	Country-code top-level domains (ccTLDs)	↓	9	↘	5	↓	7	↓	18	↓	11
7.3.3.	Wikipedia yearly edits	-	11	-	2	-	13	-	7	-	1
7.3.4.	Mobile app creation	-	12	-	5	-	15	-	10	-	4

Source: own draft according to GII Report 2019

Ranking – green, ranking 1–14; red, ranking 15–28.

Change – green arrow indicates a positive change greater than 10%; yellow arrow indicates change of less than 10%; red arrow indicates a negative change greater than 10%.

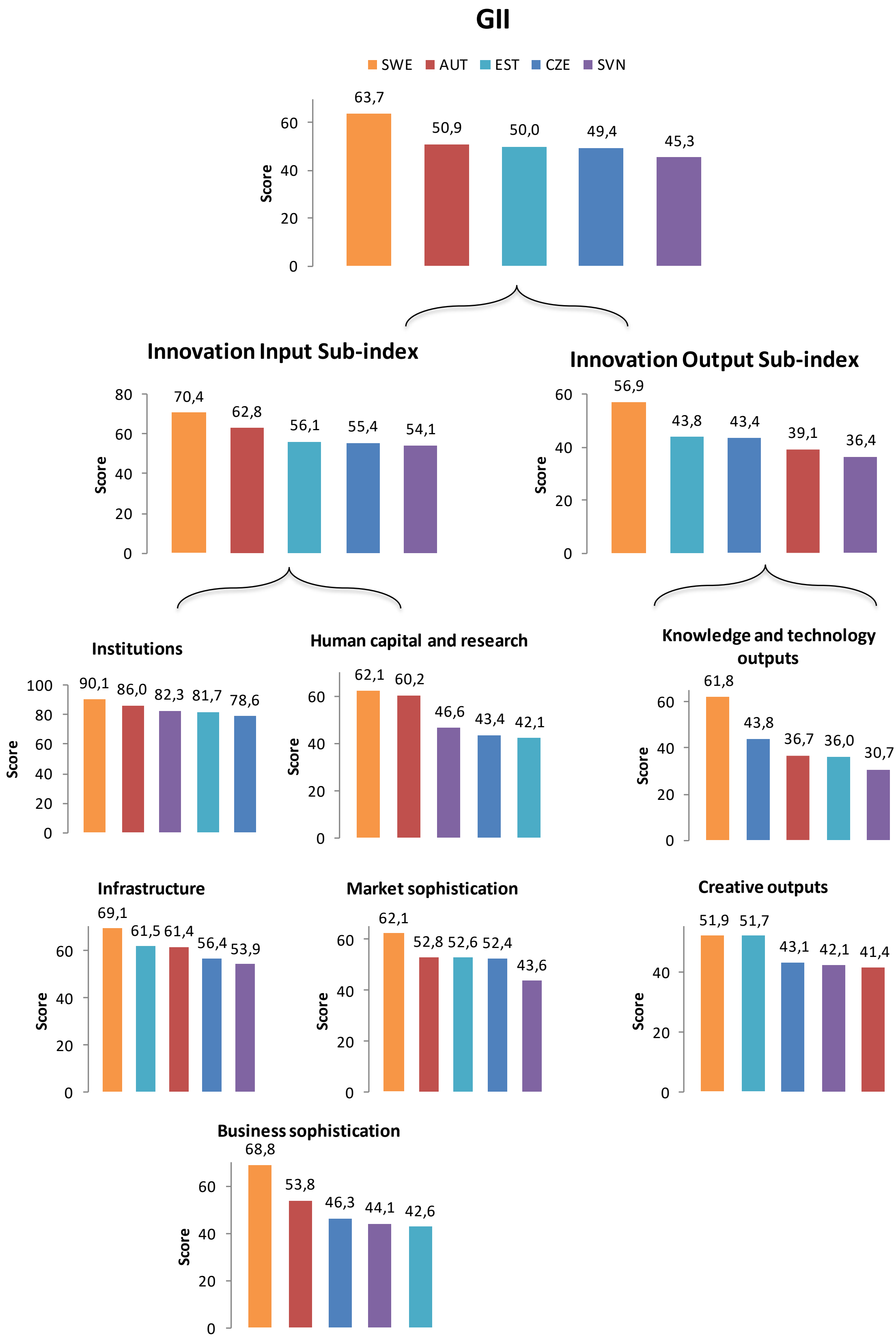
Figure 8.8 depicts the breakdown of GII 2019 according to pillar and achieved values for the Czech Republic and selected countries.

In GII 2019, the Czech Republic achieved a value of 49.4; of the selected countries, only Slovenia ranked lower. The value of the Czech Republic is close to the scores of Estonia (50.0) and Austria (50.9).

In the case of the Innovation INSPt sub-index, the Czech Republic received a score of 55.4. All other countries, save Slovenia, placed ahead of the Czech Republic. As part of the Innovation Output Sub-Index, the Czech Republic received a score of 43.4. Of the selected countries, Sweden and Estonia ranked higher and Austria and Slovenia ranked lower than the Czech Republic.

Figure 8.8 shows that out of the selected countries, the Czech Republic had the best ranking in the areas of Knowledge and technological procedures (only Sweden ranked higher). Conversely, the Czech Republic ranked last in the area of Institutions.

Table 8.8: GII 2019 breakdown for the Czech Republic and Selected Countries



Source: own draft according to GII Report 2019

RECOMMENDATIONS

Based on the breakdowns and analyses executed, the RDI Council proposes implementing or continuing with the implementation of the below recommendations. The execution of these recommendations should contribute to the stabilisation of components of the RDI system and to the elimination of the system's weaknesses, thereby contributing in the future to the effective functioning of the RDI system as a whole. The 2018 Analysis of the Existing State of Research, Development and Innovation, as in the analyses from previous years, was one of the main starting points for the creation of the 2021+ National Research, Development and Innovation Policy, and selected recommendations should be implemented into the final wording of this document. Monitoring of the qualitive target fulfilment indicators of the 2016-2020 National Research, Development and Innovation Policy is set out in Annex 1.

It is clear that in some of the areas, it is necessary to carry out more detailed analyses, which unfortunately are often limited by missing or insufficient data. For this reason, some of the recommendations are directed towards developing an evidence base (so-called technical recommendations).

STRATEGIC RECOMMENDATIONS:

- In connection with the new method of evaluating research organisations, which emphasises quality outputs and their usability in innovation, stabilise research organisations financially by giving the long-term institutional components of the SB for RDI preference over special-purpose support.
- When supporting research, development and innovation from the SB, place greater emphasis on R&D in important/ground-breaking areas of each scientific field where it would be appropriate to protect the results thereof internationally.
- Analyse the benefits of the various instruments of financial support and use the outputs of the analysis to optimise them, which can be achieved in part by thorough implementation of the new evaluation method of research organisations and of special-purpose support for research, development and innovation, which will eliminate the negative impacts on the R&D system caused by previous evaluation methods.
- Carry out interventions that will motivate Czech research organisations (scientific teams) to participate more in European and other international RDI programmes, especially as part of the EU framework programmes (Horizon Europe).
- Support the building of relationships with foreign partners and create long-term links to leading research facilities.
- In analyses, focus in more detail on the relationships between business entities and public research entities (universities, institutes of the AS CR, government research facilities), with

special regard for social and economic growth (including employment in technologically advanced fields with corresponding growth in real wages).

- Focus on removing shortcomings in human resources in R&D, thereby eliminating gender inequality, supporting sustainability of scientific careers by improving the conditions for combining family and professional life (work-life balance), creating conditions for retaining women in the research environment, and motivating graduates to continue being active in science and research.
- When planning funding of operations and further development of research infrastructures, emphasise institutional support of long-term conceptual development of research organisations.
- Utilise the potential of R&D centres built using resources from SF EU (especially OP RDI) as the basis for long-term cooperation in applied research.
- Implement measures supporting improvements in the quality of publication outputs and internationalisation, especially in basic research.
- Implement measures motivating research organisations to carry out applied research, which should manifest itself in an increase in the proportion of applied results to publication results.
- Focus more on the issue of intellectual property and set the conditions for research organisations or research facilities, so that they are sufficiently motivated to implement an effective licencing policy and, thereby, contribute in the future to greater revenues from selling patent licences, an area in which the Czech Republic lags behind markedly.
- Continue with efforts to remove the main barriers to innovation progress in the Czech Republic in the form of low investment of venture capital, low use of intellectual property protection in the form of international patents, shortcomings in human resources (focus on training, career system), and then promote the use of other forms of financing instruments, including guarantees, subsidised loans etc., for the development of innovation activities.

STRATEGIC RECOMMENDATIONS (TECHNICAL):

- Arrange for institutional support of research, development and innovation in RDI IS to be recorded by scientific fields that were supported and, in the case of universities, arrange for records to be kept at faculty or department level.
- Keep a record of support of research, development and innovation in RDI IS from all foreign public sources; in the case of the operational programmes, keep a record of support divided up into the EU part and SB part (co-financing from SB).
- Keep an accounting record of support for research, development and innovation provided at national level divided up according to direct costs (payroll, materials and services) and indirect costs for each category of support, especially institutional support.
- Continue with implementing a unified code list of scientific fields in RDI IS and of groups of fields used in the Czech Republic in line with the OECD FORD structure (part of the Frascati Manual).
- Link data from surveys and public administration registers (e.g., CZSO surveys, Czech Social Security Administration and GFD registers and RDI IS, see also Annex 2) to allow for more detailed analyses of the R&D base, despite linking options having been legislatively very restricted to date.
- Implement regular monitoring of the application of research infrastructures in applied research for the needs of important sectors of the Czech national economy; the implementation of a record of the results created using research infrastructure is related to this.
- Arrange for a record to be kept of information about the use of R&D results at national level.

LIST OF ABBREVIATIONS

AIS	Article Influence Score
AS	Public research institutions established by the Academy of Sciences of the Czech Republic under the Act No. 341/2005 Coll.
AS CR	Academy of Sciences of the Czech Republic
BBMRI ERIC	Bio-banking and Bio-molecular Resources Research Infrastructure
BERD	Business Enterprise Expenditure on R&D
CEA	Central Register of Research Activities
CEP	Central Register of Research, Experimental Development and Innovation Projects
CERIC-ERIC	Central European Research Infrastructure Consortium
CIS	Community Innovation Survey
CNB	Czech National Bank
CR	Czech Republic
CZ-CPA	Classification of production
ČÚZK	State Administration of Land Surveying and Cadastre
CZ-NACE	Classification of economic activities
CZSO	Czech Statistical Office
EC	European Commission
EC	European Community
EDP	Entrepreneurial discovery process
EIS	European Innovation Scoreboard
EPO	European Patent Office
ERDF	European Regional Development Fund
ERC	European Research Council
ERIC	European Research Infrastructure Consortium
ERIH PLUS	European Reference Index for the Humanities and the Social Sciences
ESF	European Social Fund
ESFRI	European Strategy Forum on Research Infrastructures
ESIF	European Structural and Investment Funds
EU	European Union
EU 28	All EU Member States since July 2013 (including Croatia)
Eurostat	Statistical office of the EU
FN	Teaching hospital
FOS	Fields of Science and Technology classification
FTE	Full Time Equivalent
FP7	7th Framework Programme of the European Union for Research and Technological Development
GA CR	Grant Agency of the Czech Republic (Czech Science Foundation)
GDP	Gross Domestic Product
GERD	Gross Expenditure on R&D
GFD	General Financial Directorate
GII	Global Innovation Index
GOVERD	Government Expenditure on R&D
GVA	Gross Value Added
H2020	Horizon 2020 – Research and Innovation Framework Programme
HC	Headcount
ICRI 2018	International Conference on Research Infrastructures
ICT	Information and Communication Technologies
INFRA	Projects of Large Infrastructures
IOI	The Innovation Output Indicator
IPO CR	Industrial Property Office of the Czech Republic
ITS	Intelligent transportation systems
IUS	Innovation Union Scoreboard
KIA	or KIABI – Employment rate in knowledge-intensive fields measured as total employment rate percentage
Lic 5-01	CZSO survey/Annual Licence Report

LP	Legal and natural persons outside universities
LRI Council	Council for Large Research Infrastructures
MA	Ministry of Agriculture
MC	Ministry of Culture
MD	Ministry of Defence
ME	Ministry of the Environment
Methodology	Methodology for evaluating the results of research organisations and evaluation of the results of expired programmes (valid for the 2013–2016 period)
Methodology 2017+	Methodology for evaluating research organisations and special-purpose support for research, development and innovation approved by Government Regulation No. 107 of 8 February 2017
MEZINAR	International cooperation of the Czech Republic in Research and Development executed under international contracts
MEYS	Ministry of Education, Youth and Sports
MF	Ministry of Finance
MH	Ministry of Health
MI	Ministry of the Interior
MIT	Ministry of Industry and Trade
MJ	Ministry of Justice
MLSA	Ministry of Labour and Social Affairs
MRD	Ministry of Regional Development
MS2014+	Monitoring system of EU Structural Funds and Investment Funds (ESIF) for the programming period 2014–2020
MSC2007	Monitoring system of Structural Funds
MSTI	Main Science and Technology Indicators, OECD
MT	Ministry of Transport
NCC	National Competence Centre
NCA	National Coordination Authority
NCI	Normalised Citation Index
NE	National economy
NIP	National Innovation Platform
NSP	National Sustainability Programmes I and II
OECD	Organization for Economic Cooperation and Development
OG CR	Office of the Government of the Czech Republic
OP	Operational Programme
OP EC	Operational Programme Education for Competitiveness
OPEI	Operational Programme Enterprise and Innovations
OP EIC	Operational Programme Enterprise and Innovations for Competitiveness
OP PGP	Operational Programme Prague – Growth Pole of the Czech Republic
OP RDE	Operational Programme Research, Development and Education
OP RDI	Operational Programme Research and Development for Innovation
PA	Priority axis of an operational programme
PCT	Patent Cooperation Treaty
PPP	Purchasing Power Parity
PPS	Purchasing Power Standard
PRI	Public research institution
PU	Public or state university
R&D	Research and Development
RDI Council	Council for Research, Development and Innovation
RDI IS	Research, Experimental Development and Innovation Information System
WG	Working group
RII	Regional Innovation Index
RIS	Regional Innovation Scoreboard
RIS3	National Research and Innovation Strategy for Smart Specialisation of the Czech Republic
RIV	Information Register of R&D results
RP	Framework Programmes of the EU for Research and Technological Development

RVKHR	Government Council for Competitiveness and Economic Growth
ROD	Research Organisation Development
SB	State budgetary organizations (SBO), state organizational units (SOU) and public research institutions (PRI) except for the departments of AS CR
SERV	Export of knowledge-intensive services as % of total services export
SF EU	Structural Funds of the European Union
SME	Small and Medium enterprise
SO	Specific objective of an operational programme
SSH	Social Sciences and the Humanities
SII	Summary Innovation Index
SPO	State-subsidized organizations
SPOLUFIN	Co-financing of Operational Programmes from the State Budget
SB	State budget
SUSEN	Sustainable Energy project
SONS	State Office for Nuclear Safety
SUR	Specific University Research
TA CR	Technology Agency of the Czech Republic
TC AS	Technology Centre of the Academy of Sciences of the Czech Republic
R&D	Research and Development
RDI	Research, Experimental Development and Innovation
RO	Research organisation
UNI	University (state, public, private, business organisation)
VES	Register of Public Tenders in Research, Experimental Development and Innovation
VŠE	University of Economics, Prague
VTR 5-01	CZSO survey – Annual Report on Research and Development
WoS	Web of Science
ZO 1-04	Quarterly Report on service import and export

Document prepared by:

Research, Development and Innovation Council: *Jan Marek*

Department of Analysis and Coordination of Research, Development and Innovation:
Přemysl Filip

Authors of each chapter:

Financial Flows in Research and Development
Lucie Kureková

Funding RDI from the State Budget
Lucie Kureková

RDI Support in the Czech Republic from European Funds
Pavel Jaroš, Jana Frantíkova, Otakar Dobiáš, Lucie Kureková

Implementation of the National Strategy for Intelligent Specialisations
MIT: Jan Bilík

Human Resources in Research and Development
Jana Kubecová

Research Infrastructures and Research and Development Centres
Jana Frantíková, Lucie Kureková

Results of Research and Development
Lucie Kureková, Otakar Dobiáš

Innovation Performance of the Czech Economy and International Comparison
Jana Kubecová

Annexes:

P. 1 Monitoring Qualitative Indictors of Fulfilment of the Objectives of National Research, Development and Innovation Policy for 2016-2020
Prepared in cooperation with the Technological Centre of AS CR

P. 2 Data Sources in Research, Development and Innovation
Jana Kubecová

Expert Reviewers:

Prof. Ing. Štěpán Jurajda, Ph.D.

Assoc. Prof. Ing. Karel Havlíček, Ph.D., MBA

Ing. Martin Mana, Mgr. Marek Štampach	Chapters: Financial Flows in Research and Development and Human Resources in Research and Development.
PhDr. Lukáš Levák	Chapter: Research Infrastructure and Research and Development Centres

ANNEXES

P.1 Monitoring Qualitative Indicators of Fulfilment of the Objectives of National Research, Development and Innovation Policy for 2016-2020

The National Research, Development and Innovation Policy of the Czech Republic for 2016-2020 (NP RDI), as the overarching strategic document in the area of RDI, is drafted to include indicator systems. Using the set indicators, it is possible to assess progress in fulfilling objectives in connection with the implementation of the mentioned strategy. A part of the implementation of NP RDI should also be the regular monitoring of indicators and their analysis. **Interim evaluation of NP RDI** should be carried out in line with the principal milestones of its specific objective 1.3: Reinforcing Strategic Intelligence for RDI Policy **in 2018, which is in the purview of the RPRI Department of the OG CR**.

As part of the **commencement of regular monitoring,** the current **values of quantitative indicators** were set (for 2016 in most cases, if possible). The indicator systems proposed in NP RDI contain quantitative and qualitative indicators relevant at the time of their creation. Table P 1 provides **more specific details in the case of some indictors** to give them more relevance, as well as the values available for 2018 (if the values for that specific year were not available, the data for the year when data was last available are used). As some data used for determining qualitative indicators are updated regularly by their providers and retroactively adjusted (e.g., number of publications or patent application), their values from previous years were also retroactively adjusted in some cases. Even though the data set out in the table below are not entirely comparable with data from the previous Analysis, they allow for a better assessment of the development of the monitored indicators (the trends are now consistent). Other information about how indicators were determined is set out in the notes below the table.

Table P.1: Values of quantitative indicators for assessing progress in fulfilment of the objectives of the Nation Research, Development and Innovation Policy of the Czech Republic for 2016–2020

	Name	Starting value when creating NP RDI (year)	Starting value for monitoring the fulfilment of objectives (year)	Indicator value for 2018
1	Number of Doctoral students aged 25–34 per million inhabitants of the same age category [1]	1 114 * (2013)	1 134 (2016)	1 181 (2017)
2	Proportion of women to total number of researchers (%)	25% (2013)	23.1% (2016)	23.2% (2018)

	Name	Starting value when creating NP RDI (year)	Starting value for monitoring the fulfilment of objectives (year)	Indicator value for 2018
3	Proportion of scientific publications with co-authorship between domestic and foreign researchers (%) [2]	36.7% * (2012)	40.8% (2016)	45.0% (2017) 50.6% (2018)
4	Proportion of foreign researchers to total number of researchers in the government and UNI sector (%) [3]	6% (2011)	9.5% (2015)	10.6% (2017)
5	Number of participants in the Horizon 2020 project per thousand researchers (FTE)	-	18.4 (2016)	27.9 [4] (2019)
6	Acquired financial contribution in the Horizon 2020 programme per € GDP bn.	-	-	1.52 [5] (2019)
7	Total number of publications registered in the WoS database per million inhabitants [2]	1 872 * (2014)	2 191 (2016)	2 156 (2017) 1 972 (2018)
8	Number of PCT applications per million inhabitants [6]	16.7 * (2012)	17.8 (2014)	16.9 (2016)
9	Revenues from the sale of patent licences (incl. national) in CZK mil.	2 726 (2014)	3 356 (2016)	1 930 (2017)
10	Share of highly cited publications (proportion of publications in top 10% of the most cited publications in total)[2]	9.8% * (2012)	9.7% (2015)	9.8% (2017) 8.8% (2018)
11	Total number of ERC grants per thousand researchers in the government in UNI sector [7]	0.17 (2013)	0.33 (2016)	1.44 [7] (2019)
12	Proportion of publications co-authored by the public and private sector in total number of publications (%)[2]	1.5% (2013)	1.7% (2016)	1.8% (2017) 1.9% (2018)
13	Proportion of resources from the business sector in government and UNI sector RDI expenditure (%)	6.8% * (2013)	9.2% (2016)	6.0% (2018)
14	Proportion of jobs in high- and medium high-tech processing (%)	11.2% (2014)	11.5% (2016)	11.3% (2018)
15	Proportion of jobs in knowledge-intensive services (%)	32.6% (2013)	32.9% (2016)	33.3% (2018)
16	Proportion of public sector resources in GERD (%)	48.6% * (2013)	60.2% (2016)	58.3% (2018)
17	Early-stage venture capital (% GDP)	0.001% (2013)	0.002% (2016)	-
18	Proportion of domestic added value in total exports (%) [8]	61.3% * (2011)	60.3% (2014)	62.3% (2016)

**The initial values of the indicator were adjusted using updated data.*

Notes to indicators:

1 Indicator calculation was adjusted. Updated data published by Eurostat were used to determine it; all values of the indicator in the table were retroactively adjusted accordingly.

2 Data determined from WoS InCites for publication of 'article', 'review', 'letter', 'articles in proceedings'. As the data was adjusted in the mentioned database, the values of the indicators in previous years were also adjusted accordingly. As data from 2018 are incomplete, data for 2017 are used.

3 The name of the indicator was revised to correspond to the definition set out in NP RDI.

4 The value was determined as the number of participants in the previous course of H2020 (i.e. as at October 2019) from data in the E-Corda database. Existing and expired projects were included in the calculation (i.e. projects in preparation and suspended projects were excluded) and only those with direct aid beneficiaries. The value of the indicator grows over time as the number of H2020 projects grows. The value should thus be compared with the sum for all EU Member States (the value of the indictor for EU 28 in October 2019 was 48.6).

5 The value was determined as an EC contribution obtained by teams from the CR in the previous course of H2020 (i.e. as at October 2019) from data in the E-Corda database. Existing and expired projects were included in the calculation (i.e. projects in preparation and suspended projects were excluded) and only those with direct aid beneficiaries. The value of the indicator grows over time as the number of H2020 projects also grows. The value should thus be compared with the sum for all EU Member States (the value of the indictor for EU 28 in October 2019 was 2.58).

6 As the OECD was updated, the values of the indicator in previous years was updated retroactively accordingly.

7 The value was set as the number of ERC grants obtained in the previous course of H2020 (i.e. as at October 2019) from data in the E-Corda database. Existing and expired projects were included in the calculation (i.e. projects in preparation and suspended projects were excluded) and only those with direct aid beneficiaries. The value of the indicator grows over time as the number of H2020 projects also grows. The value should thus be compared with the sum for all EU Member States (the value of the indictor for EU 28 in October 2019 was 5.07).

8 The data were updated for the entire reference period, as in 2018 a different version of source data was used to set this indicator in the OECD TiVA database.

P.2 Data Sources in Research, Development and Innovation

The bases of each analysis, other than suitably selected analytical methods, are exact, relevant and complete data. The sources of such data have to be reliable and the data collection method as stable as possible. There are many other factors that are tied to data sources and that subsequently affect the explanatory power of the conducted analyses. In addition to reliability and stability, mention can also be made of currency, relevance, data file size, size of time series, representative sample and much more. It is necessary to work with a database that is substantially extensive in terms of sample size and timeframe. For a proper empirical analysis, it is not sufficient to simply evaluate the current situation: an analysis of the hitherto evolution (i.e. determination of the trends) has to be made and, based thereon, a prediction has to be made, i.e., future development modelled.

Despite the large amount of databases providing sources for RDI analyses and their continuous upgrade in quality and expansion, there is always room for improvement. In addition to publicly available databases, there are also paid databases and information systems that are accessible to users only upon payment of a fee. As databases cover various areas of data (e.g., statistical data, information about activities, projects and subject, etc.), it is often necessary to use several databases or choose a paid database to achieve excellent, effective and thorough analyses. Statistical data are provided by various institutions (CZSO, Eurostat, OECD, RPRI etc.), and although there is pressure to unify reports and data collection methods, data can differ across various sources (e.g., due to differently defined terms, terminology, different timeframes, other forms of data collection etc.). For comparing and modelling trends in analyses, it is necessary to see the above as a possible limitation and try to avoid the shortcomings that may stem from the above.

Table P.2 provides a list of the most commonly used sources for analysing RDI. Sources can be divided up into national and foreign. Basic RDI data are managed by the RPRI and the CZSO. The RPRI is the administrator of the RDI information system, and OG CR is the operator. This information system serves to collect, process, provide and utilise data about RDI supported by public funds. The objectives and contents of the RDI system as well as the rights, obligations and procedures for handing over, classifying, processing and providing RDI data are set out in Act No. 130/2002 Coll., on Support for Research, Experimental Development and Innovation. Other documents addressing the area of the RDI information systems include Government Regulation No. 397/2009 Coll., on the information system for research, experimental development and innovation, other legal regulations and the Rules of Operation of the Information System for Research, Experimental Development and Innovation. The RDI information system comprises the following modules:

- Register of Public Tenders in Research, Development and Innovation (VES)
- Central Register of Research, Experimental Development and Innovation Projects (CEA)
- Central Register of Projects (CEP),
- Register of Information about Results (RIV)
- Central Register of Research Plans (CEZ) – conserved module

and the personal data listed in Government Regulation No. 397/2009 Coll. is also recorded. The second processor of RID data is the aforementioned CZSO. This office monitors basic RDI data through direct statistical surveys and processes the data of other institutions. The surveys observe EU and OECD principles stemming from the Frascati Manual and implementing Commission Regulation (EU) No. 995/2012. The CZSO has long been trying to create a comprehensive picture of the evolution of R&D in the CR through statistical instruments, information and analytical activities, always with regard to the development of other macroeconomic and structural indicators. To fulfil this objective, the CZSO has been using the VTR 5-01 questionnaire annually since 1995.

On the international level, the main institutions providing information about RDI are Eurostat and the OECD. Together with the CR's accession to the EU, the obligation arose to register each project, check its progress and monitor the utilisation of funds from structural and other funds. These efforts are in particularly in the purview of the MRD. At this time, the MS2014+ information system (MSC2007 in the previous monitoring period) is used to store data on projects and to check the implementation of the various programmes.

As part of the data source topic, the RISIS (now RISIS2) project should also be mentioned. RISIS is the abbreviation for European Research Infrastructure for Science, Technology and Innovation Policy Studies falling under H2020. The RISIS2 project builds on the now-expired RISIS project, which ran in 2014–2018. The result of RISIS is 12 databases that are interconnected through a register of organisations or businesses. These databases contain data sources across RDI (from the area of patents, publications, quickly developing enterprises, development of careers and mobility of researchers and European projects). The main objective of the follow-up RISIS2 project is updating, expanding and extending the aforementioned databases. TC AS is also involved in the RISIS2 project, and its goal is to expand the database of European projects to include national research projects. In particular, TC AS is mainly involved in a project that collects data on national projects of new member states (EU 13). The promoters of European projects (which are the target users) are then given access to the aforementioned data sources, which included methodological support in connection with transformation and analytical activities.

Table P.2: RDI Data Resources

		Data		Note
NATIONAL	RPRI (OG CR)	RDI IS	CEA	Information about the provision of RDI support, RDI programmes and RID entities (since 2010)
			VES	Information about public tenders in RDI (since 2000)
			CEP	Information about RDI projects (since 1994)
			CEZ	Information about research plans (until 2009, now a conserved module)
			RIV	Information about RDI results applied since 1993
	CZSO	Research and development indicator		Regular annual survey (VTR 5-01)
		Indirect public support of research and development in the CR		Metadata from the GFD database – MF
		Statistical survey of innovations		Last published survey (TI2016) pertains to the 2014–2016 period
		Direct public support for research and development in the CR		Based on expenditures approved in the Act on the State budget, budget for the respective fiscal period (preliminary data) and expenditures of the state revenue and expenditure account for R&D (final data)
		Patent statistics		Metadata from IPO CR and EPO
		Licence		Regular annual statistical survey (LIC 5-01)
		Foreign trade with high-tech goods		Database of foreign trade and metadata from Eurostat
		Technological payment balance – foreign trade with technological services		Quarterly account of import and export of services (ZO 1-04) and metadata from the CNB
	MMR	MSC2007		Material and financial monitoring of programmes and projects paid for from the EU funds in 2007-2013
		MS2014+		Material and financial monitoring of programmes and projects paid for from the EU funds in 2014-2020
	MF	CEDR		Central register of subsidies from the budget (information about special purpose subsidies provided from the state budget, EU funding and other funding sources)
	TA CR	INKA		Mapping of the innovation capacity of the CR: software for online presentation of data from the INKA – Innovation Capacity 2014+ project
		STARFOS		Search engine for RDI projects and results supported by public funding
	MIT/CI	Awarded investment incentives		Overview of investment incentives awarded to the manufacturing industry, R&D and selected support fields of services
	Other documents and statistics of licensors or departments and other organisations *			
FOREIGN	EUROSTAT			Government budget appropriations or outlays for R&D statistics
	EUROSTAT OECD			Community innovation survey
				High-tech industry and knowledge-intensive service statistics
				Patent statistics
				Statistics on Human Resources in Science & Technology
				Research and Development Statistics
	CORDIS			Information about Framework Programme projects
	E-CORDA			External Common Research Data Warehouse
	ERC Funded Projects			Database of European Research Council projects
	Partner Search			Search engine of entities with a similar type of research at EU level
	PATSTAT			Information about patent applications and awarded patents within the whole of the EU
	STAR METRICS			Information about public funding, structure and results of R&D activities in the USA
	EU Open Data Portal			Data published by EU authorities and institutions, e.g., data on participation in EU framework programmes

	Data		Note
	RISIS Datasets		Contains databases such as CHEETAH, CIB/CinnoB, CWTS Publication Database, EUPRO, IFRIS-PATSTAT, JOREP 2.0, MORE, NANO, PROFILE, RISIS-ETER, SIPER, VICO
	Thomson Reuters	Web of Science	Allows processing of RP participation statistics (grant agreement databases and project proposal and application databases)
	Thomson Reuters	Journal Citation Reports	Citation registers
	Elsevier	Scopus	
	European science foundation	ERIH PLUS	
	Google Scholar	EBSCO	Full-text database
	Other documents, statistics and studies **		

Source: own draft

* *For example, Registry of public research institutions; Databases of accredited study programmes; Processing Industry Panorama published by the MIT; programme documents, monitoring reports and other materials pertaining to operational programmes.*

** *For example, European Innovation Scoreboard, Research and innovation statistics at regional level*

With regard to current needs, it would be worth supplementing statistics with a record of institutional funding by RDI field and keeping a record of RDI support provided at national level, with each financial instrument accounted for according to direct and indirect costs. It would be appropriate to monitor and have statistics available on the use of results. In the field of human resources, it would be beneficial to link data with data from the job market and expand it to include gender statistics. A converter has been created to unify code lists of scientific fields used in the CR with the structure defined by OECD − Fields of Science, both at RDI IS level (CEP&CEZ&RIV field groups and the field groups according to Annex 7 of the Results Evaluation Methodology).

Table P.3 Result type – Code List for the Results of Research and Development Chapter

Table P.3: Result type

A	Audiovisual production
B	Specialist book
C	Chapter in a specialist book
D	Article in proceedings
E	Exhibition organisation
F	Utility model or industrial design
G	Prototype or functional sample
H	Result reflected into legislation and strategic materials
J	Peer-reviewed scientific article
M	Conference organisation
N	Methodology certified by authorised body, medical and conservation procedure or specialised map
O	Miscellaneous – Other results that cannot be classified into any of the above types of result
P	Patent
R	Software
S	Aggregate category for further applied results used until 2007
T	Aggregate category for other applied results used until 2006
V	Research report
W	Organisation of workshops
Z	Pilot operation, verified technology, variety or breed

P.4 Alphabetical list of European Centres of Excellence and Regional Research and Development Centres

Table P.4: Alphabetical list of European Centres of Excellence and Regional Research and Development Centres

Abbreviation	Name	Beneficiary	RDI designation
AdMaS	AdMaS – Pokročilé stavební materiály, konstrukce a technologie (Advanced Materials, Structures and Technology)	Brno University of Technology	Regional R&D centres
ALISI	Aplikační a vývojové laboratoře pokročilých mikrotechnologií a nanotechnologií (Application Laboratories of Microtechnologies and Nanotechnologies)	Institute of Scientific Instruments AS CR.	Regional R&D centres
BIOMEDREG	Biomedicína pro regionální rozvoj a lidské zdroje (BIOMEDREG) (Biomedicine for regional development and human resources)	Palacký University Olomouc	Regional R&D centres
UniMeC Plzeň	Biomedicínské centrum Lékařské fakulty v Plzni (Biomedical Centre of the Faculty of Medicine in Plzeň)	Charles University	Regional R&D centres
BIOCEV	Biotechnologické a biomedicínské centrum Akademie věd a Univerzity Karlovy (Biotechnological and Biomedical Centre for the Academy of Sciences and Charles University)	Institute of Molecular Genetics AS CR	European Centres of Excellence
CEITEC	CEITEC – středoevropský technologický institut (Central European Institute of Technology)	Masaryk University Brno	European Centres of Excellence
CMV	Centra materiálového výzkumu na FCH VUT v Brně (Materials Research Centre)	Brno University of Technology	Regional R&D centres
CEBIA – Tech	Centrum bezpečnostních, informačních a pokročilých technologií (Centre for Security, Information and Advanced Technologies)	Tomáš Baťa University	Regional R&D centres
IT4Innovations	Centrum excelence IT4Innovations (IT4Innovations Centre of Excellence)	Technical University of Ostrava	European Centres of Excellence
Centrum excelence Telč	Centrum excelence Telč (Telč Centre of Excellence)	Institute of Theoretical and Applied Mechanics AS CR	European Centres of Excellence
NTC	Centrum nových technologií a materiálů (New Technologies Research Centre)	University of West Bohemia	Regional R&D centres
CPS	Centrum polymerních systémů (Centre of Polymer Systems)	Tomáš Baťa University	Regional R&D centres
AdmireVet	Centrum pro aplikovanou mikrobiologii a imunologii ve veterinární medicíně (Centre for Advanced Microbiology and Immunology in Veterinary Medicine)	Veterinary Research Institute	Regional R&D centres
CxI	Centrum pro nanomateriály, pokročilé technologie a inovace (Institute for Nanomaterials, Advanced Technologies and Innovation)	Technical University of Liberec	Regional R&D centres
C. R. Haná	Centrum regionu Haná pro biotechnologický a zemědělský výzkum (Centre for the Region of Haná for Biotechnological and Agricultural Research)	Palacký University Olomouc	Regional R&D centres
CRSV	Centrum rozvoje strojírenského výzkumu Liberec (Research Centre of Engineering Manufacturing Technology)	VÚTS, a.s.	Regional R&D centres
Algatech Třeboň	Centrum řasových biotechnologií Třeboň (Algatech) (The Centre of Algal Biotechnology)	Institute of Microbiology AS CR	Regional R&D centres
SIX	Centrum senzorických, informačních a komunikačních systémů (SIX) (Research Centre for Sensor, Information and Communication Systems)	Brno University of Technology	Regional R&D centres
CVVOZE	Centrum výzkumu a využití obnovitelných zdrojů energie (Centre for Research and Utilisation of Renewable	Brno University of Technology	Regional R&D

Abbreviation	Name	Beneficiary	RDI designation
	Energy)		centres
CETOCOEN	CETOCOEN	Masaryk University Brno	Regional R&D centres
CzechGlobe	CzechGlobe – Centrum pro studium dopadů globální změny klimatu (Centre for the Study of Climate Change Impacts)	Institute of Systems Biology and Ecology AS CR	European Centres of Excellence
CDV PLUS	Dopravní R&D centrum (Transport Research Centre)	Transport Research Centre	Regional R&D centres
ELI	ELI: EXTREME LIGHT INFRASTRUCTURE	Institute of Physics AS CR	European Centres of Excellence
ENET	ENET – Energetické jednotky pro využití netradičních zdrojů energie (Energy Units for Using Non-Traditional Energy Sources)	Technical University of Ostrava	Regional R&D centres
ExAM	ExAM Experimental Animal Models	Institute of Animal Physiology and Genetics AV CR	Regional R&D centres
FNUSA-ICRC	Fakultní nemocnice u sv. Anny v Brně – Mezinárodní centrum klinického výzkumu (Saint Anne's Teaching Hospital Brno – International Centre for Clinical Research)	Saint Anne's Teaching Hospital Brno	European Centres of Excellence
HILASE	HILASE: Nové lasery pro průmysl a výzkum (New Lasers for Industry and Research)	Institute of Physics AV CR	Regional R&D centres
INEF	Inovace pro efektivitu a životní prostředí (Innovation for Efficiency and the Environment)	Technical University of Ostrava	Regional R&D centres
ICT	Institut čistých technologií těžby a užití energetických surovin (Institute of Clean Technologies for Mining and Utilisation of Raw Materials for Energy Use)	Technical University of Ostrava	Regional R&D centres
IET	Institut environmentálních technologií (Institute of Environmental Technologies)	Technical University of Ostrava	Regional R&D centres
CE1NAKVA	Jihočeské výzkumné centrum akvakultury a biodiverzity hydrocenóz (South Bohemian Research Centre of Aquaculture and Biodiversity of Hydrocenoses)	University of South Bohemia České Budějovice	Regional R&D centres
11MIC	Membránové inovační centrum (Membrane Innovation Centre)	MemBrain s.r.o.	Regional R&D centres
NUDZ	Národní ústav duševního zdraví (NUDZ) (National Institute of Mental Health)	National Institute of Mental Health	Regional R&D centres
NETME Centre	NETME Centre	Brno University of Technology	Regional R&D centres
NTIS	NTIS – Nové technologie pro informační společnost (New Technologies for the Information Society)	University of West Bohemia	European Centres of Excellence
OVI	Ovocnářský výzkumný institute (Fruit Research and Breeding Institute)	Výzkumný a šlechtitelský ústav ovocnářský Holovousy, s.r.o.	Regional R&D centres
CVUM	Pořízení technologie pro Centrum vozidel udržitelné mobility (Procurement of Technology for the Centre of Vehicles for Sustainable Mobility)	Czech Technical University Prague	Regional R&D centres
RECAMO	Regionální centrum aplikované molekulární onkologie (RECAMO) (Regional Centre of Applied Nuclear Oncology)	Masaryk Memorial Cancer Institute	Regional R&D centres
RPCTM	Regionální centrum pokročilých technologií a materiálů (Regional Centre of Advanced Technologies and Materials)	Palacký University Olomouc	Regional R&D centres
TOPTEC	Regionální centrum speciální optiky a optoelektronických systémů (TOPTEC) (Research Centre for Special Optics and Optoelectronic Systems)	Institute of Plasma Physics AS CR	Regional R&D centres
RICE	Regionální inovační centrum elektrotechniky (RICE) (Regional Innovation Centre for Electrical Engineering)	University of West Bohemia	Regional R&D

Abbreviation	Name	Beneficiary	RDI designation
			centres
RMTVC	Regionální materiálově technologické výzkumné centrum (Regional Materials Science and Technology Centre)	Technical University of Ostrava	Regional R&D centres
RTI	Regionální technologický institut – RTI (Regional Technological Institute)	University of West Bohemia	Regional R&D centres
CEPLANT	Regionální VAV centrum pro nízkonákladové plazmové a nanotechnologické povrchové úpravy (R&D Centre for Plasma and Nanotechnology Surface Modifications)	Masaryk University Brno	Regional R&D centres
SUSEN	UDRŽITELNÁ ENERGETIKA (SUSEN) (Sustainable Energy)	Centrum výzkumu Řež s.r.o.	Regional R&D centres
UniCRE	Unipetrol výzkumně vzdělávací centrum (Unipetrol Centre for Research and Education)	Unipetrol výzkumně vzdělávací centrum, a.s.	Regional R&D centres
UCEEB	Univerzitní centrum energeticky efektivních budov (UCEEB) (University Centre for Energy Efficient Buildings)	Czech Technical Institute Prague	Regional R&D centres
ZMMC	Západočeské materiálově metalurgické centrum (ZMMC) (Regional centre of research into metallic materials, the processes for their production and their use in industry)	COMTES FHT a.s.	Regional R&D centres