Research, Development and Innovation Council

Analysis of the Existing State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad in 2019

CONTENTS

SUMMARY

The research, development and innovation (RDI) environment has been advancing dynamically in the Czech Republic in recent decades. Total research and development (R&D) expenditures in the Czech Republic have been growing long-term, with a record CZK 111.6 billion being spent on research and development conducted domestically in 2019. In relation to the GDP, R&D expenditure has risen to 1.94% and the Czech Republic has once again drawn near to the EU average. Corporate investment made the greatest contribution to the year-on-year increases in overall R&D expenditures in the monitored period. Businesses invested nearly CZK 65 billion of their own resources in R&D activities in 2019, primarily in in-house R&D. According to the statistics of the Czech Statistical Office (CZSO), a record CZK 37.5 billion was spent from domestic public sources in 2019, which is CZK 2.5 billion more than in 2018.

Table S. 1: Research and development expenditures and their year-on-year changes compared against basic macroeconomic indicators

		2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Total R&D expenditures (GERD)	CZK bn	53.0	62.8	72.4	77.9	85.1	88.7	80.1	90.4	102.8	111.6
GERD share of GDP	%	1.33	1.54	1.77	1.88	1.96	1.92	1.67	1.77	1.9	1.94
Share of budgeted RDI expenditures on overall Czech budget	%	2.14	2.2	2.24	2.21	2.2	2.21	2.33	2.49	2.55	2.45
R&D expenditures in the private sector (BERD)	CZK bn	30.0	34.1	38.2	41.5	47.0	48.1	49.0	56.8	63.7	68.8
Indirect aid to private businesses	CZK bn	1.32	1.84	1.98	2.3	2.26	2.52	2.38	2.52	2.58	-
Total income from valid licences provided during the year	CZK bn	1.88	2.18	3.51	6.05	7.33	6.76	7.57	5.56	5.18	4.6
Year-on-year changes			**11/10**	**12/11**	**13/12**	**14/13**	**15/14**	**16/15**	**17/16**	**18/17**	**19/18**
Total R&D expenditures	%		18.49	15.29	7.60	9.24	4.23	-9.70	12.86	13.72	8.56
GDP (current prices)	%		1.74	0.65	1.32	4.90	6.43	3.71	6.54	5.83	6.28
Exports of goods and services	%		9.89	7.43	1.95	13.05	4.74	1.81	6.47	3.15	2.77

Source: CZSO – Study on Research and Development, National Accounts, Main Economic Indicators of the Czech Republic and State Budget Acts in the years 2009 to 2018

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

Table S.1 shows the evolution of basic RDI financial indicators and their year-on-year development including selected macroeconomic indicators. The percentage share of RDI expenditures from the Czech state budget on the overall budget may serve as a supplementary indicator on the volume of R&D expenditures.. This percentage grew by 0.31 pp between 2010 and 2019, i.e., from 2.14% to 2.45%. The increase of this percentage indicates a rising significance of direct public support from the RDI system for implementing the Czech Republic's economic policy.

Competencies in the system for public RDI support are defined by Act No. 130/2002 Coll., on Support for Research, Experimental Development and Innovation from Public Funds and on the Amendment of Certain Related Acts (hereinafter the "Act No. 130/2002 Coll., on Support for Research, Experimental Development and Innovation"). In February 2020, a "minor technical amendment" to this act was published in the Collection of Laws, related primarily to a change in the evaluation of research organisations. The amendment did not however provide room for more thorough and extensive changes. In 2019, work commenced on an extensive amendment to the act, where the main goals include e.g. new instruments for targeted support of innovation, simplifying administration in the field of research, development and innovation, and following up on the Methodology 2017+ by implementing a systematic evaluation of targeted support programmes.

Since 2017, a change in the system for evaluation of research organisations has been underway, consisting in a shift from a system based on quantity to an assessment of the quality and impact of research and development (for more information see the Methodology 2017+). Aside from this change in evaluation related to institutional support, a modification is also underway to the system for assessing targeted support, where changes to the assessment procedure are gradually being implemented so as to bring the evaluation process in line with standards in place in countries with the most experience with such evaluation (e.g. the USA, UK, Germany and Austria)

In total, the expenditure on R&D from public sources represented 0.79% of the GDP in 2019. The Czech Republic thus came close to hitting the national target for the Europe 2020 strategy. The volume of R&D from domestic public sources (i.e., part of the state budget) could be increased by the "claims for unused expenditures from national resources" (i.e., the difference between budgeted and actually drawn expenditures from the state budget). As of 1 January 2020, the unused expenditures totalled CZK 6 billion. These "additional" funds not yet used by 2020 comprise 0.10% of the GDP.

The budgeted expenditure for RDI from the 2020 state budget is CZK 36.3 billion and for the year 2021 expenditures could reach CZK 37.5 billion, which according to the most recent prediction published by the Ministry of Finance (Sept 2020) is 0.65% of the GDP in 2020 and 0.64% in 2021. The long-term proposal for state budget RDI expenditures is taken into account in the 2019 – 2030 Innovation Strategy (2019+ Innovation Strategy). This is based on boosting domestic public resources and above all making use of the potential of private investment. The Czech Republic is a country whose economy is driven, among other things, by industry, with manufacturing accounting for nearly 25% of the GVA. For this and other reasons, it is important that private investment accounts for nearly 60% of R&D expenditures. Private R&D expenditures reached 1.13% of GDP in 2019, having passed the 1% mark back in 2016. In terms of private investment, the primary goal is to create conditions that will allow private investment to reach at least 1.5% of GDP by 2025, which would mean an increase to approx. CZK 98 billion.

The newly approved Czech National Policy on Research, Development and Innovation 2021+ (RDI NP 2021+) represents an overarching national-level strategic document for developing all the components of research, development and education in the Czech Republic. Its vision is to use effective support and targeting of RDI to contribute to the Czech Republic prospering as a country, citizens having access to quality living conditions, and the Czech Republic being a recognised partner in the community of European countries as well as worldwide, which is in line with the goal of the 2019+ Innovation Strategy "to become a dynamic innovative society". One of the points of departure for the government-approved RDI NP 2021+ was the *Analysis of the State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad 2018* and the continuously updated data that are now part of the *Analysis of the State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad 2019*. The RDI NP 2021+ should contribute to development and progress in the following key areas: management and financing of the research, development and innovation system; motivating people to enter a research career and development of human resources; quality and international excellence in research and development; cooperation between the research and application spheres; and the innovation potential of the Czech Republic. It also reacts to 21st century global risks and threats. The RDI NP 2021+ defines 5 strategic objectives stemming from key areas and 28 measures to implement the objectives. Each measure specifies dates of implementation, fulfilment indicators, and who is responsible and co-responsible for it.

At the end of 2019, the first reports of the COVID-19 coronavirus surfaced. It is already apparent as of this writing that events associated with the COVID-19 disease will have a fundamental impact on the RDI funding system. Prioritisation of aid for individual fields and multidisciplinary teams will see changes aiming to avert further threats of this type. This will not mean solely support for medical fields, however, but for an entire range of sectors that can help prevent such threats or mitigate their consequences. A new possible orientation is emerging in certain calls to further the main political priorities of the EU, in particular the European Green Deal (EGD), digital transformation, and pandemic readiness, including addressing the situation caused by COVID-19. Given how comprehensively the pandemic has impacted the functioning of society, the response will also cover a wide spectrum of fields.

The *Analysis of the State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad 2019* arrived at the following key findings, which are commented on in detail and supplemented with graphical output in the Detailed Report section.

FINANCIAL FLOWS IN RESEARCH AND DEVELOPMENT

- The gross expenditure on R&D in the Czech Republic reached CZK 111.6 billion in 2019, i.e., 1.94% of GDP, and its long-term growth was caused primarily by steady growth in expenditures from private sources.
- R&D expenditures from private sources totalled CZK 64.7 billion (i.e., a year-on-year increase of 8%), those from domestic public sources reached a record CZK 37.5 billion (i.e., a year-on-year increase of 7.3%), and those from foreign public sources were CZK 8.1 billion (i.e., a year-on-year increase of 7.9%).
- R&D expenditures from public sources totalled 0.79% of GDP in 2019. The Czech Republic thus approached fulfilment of the national target for the Europe 2020 strategy. The volume of R&D from public sources could be increased by the "claims for unused expenditures from national resources"; these "additional" funds not yet used by 2020 comprise CZK 6 billion (i.e., 0.1% of GDP).
- The financial indicators for 2019 indicate that reaching the milestones laid down in the 2019+ Innovation Strategy is realistic, namely those of the first Pillar: Financing and Evaluation of R&D, which are to boost the funding of science (measured as a percentage of GDP).
- Compared internationally, the Czech Republic lags slightly behind the European average in terms of GERD as a percentage of GDP. Between 2009 and 2018, the R&D intensity (GERD as a percentage of GDP) in the Czech Republic grew by 0.64 pp, which was the second highest growth of all EU Member States.
- Private sources are used almost exclusively to finance R&D in the private sector; support of public R&D from domestic private sources is very low, not quite reaching CZK 2.4 billion for the higher education and government sector in 2019. Business entities received public aid of CZK 6.5 billion.
- Domestic public financial resources went primarily into R&D carried out in the government and higher education sectors, with a total of CZK 32.7 billion in public funding being utilized there.
- In the private sector, the majority (65%) of funds spent on R&D in 2019 were spent by private enterprises under foreign control; in the government sector the majority sponsor was the CAS (72%), and in the higher education sector it was universities (95%).
- Private enterprises in the Czech Republic are supported from the state budget directly (CZK 3.62 billion in 2019) and indirectly in the form of deductibles from the corporate income tax base (CZK 2.58 billion in 2018); long-term indirect support has been utilized 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 state budget for research, development and innovation, which in 2019 reached nearly CZK 36 billion.
- The drafting of proposals for state budget expenditures on RDI and a medium-term outlook is the responsibility of the Research, Development and Innovation Council (RDIC).
- Since 2017 this proposal has been structured into 15 budget headings, whereof 4 headings can now once again provide institutional support for RDI: the Ministry of Foreign Affairs (MFA), Ministry of Labour and Social Affairs (MoLSA), Ministry of the Environment (ME) and the Ministry of Transport (MT); thus the role of the operators of research institutions has been strengthened.
- Institutions carrying out research and development are financed from multiple sources, with the targeted component of support in 2019 forming the predominant share of overall support for nearly all groups of beneficiaries. In the case of private sector entities, this fundamental predominance can be considered desirable, but for public entities it indicates an increased risk of year-on-year instability in funding.
- The greatest volume of institutional support for long-term conceptual development of research organisations in the Czech Republic is provided by the Ministry of Education, Youth and Sport (MEYS) and the Academy of Sciences (CAS). In 2019, higher education institutions drew funds for long-term conceptual development that reached nearly CZK 6.9 billion and CAS institutes drew CZK 4.1 billion.
- Targeted support is provided primarily by the Czech Science Foundation (utilised primarily by universities and institutes of the CAS), the Technology Agency of the Czech Republic (support directed primarily at businesses and universities) and the Ministry of Education, Youth and Sport. The targeted support provided under the heading of the Ministry of Education, Youth and Sport is specific in that it includes subsidy titles for Major RDI Infrastructure Projects and Specific Higher Education Research, for which support is not provided after the conclusion of a public tender.
- Targeted support from other ministries is also successfully utilised by universities, in addition to the entities operated by those ministries.
- In terms of areas, targeted support in the Czech Republic goes primarily into the sectors Industry (CZK 4.47 billion), Social Sciences and Humanities (CZK 1.63 billion), Life Sciences (CZK 1.51 billion) and Medical Science (CZK 1.47 billion).
- Since 2017, newly commenced projects have been entered into the RDI information system using the OECD Fields of Research and Development structure. It was necessary to convert the code list into the OECD structure in order to implement the national level of evaluation of research organisations under the Methodology 2017+.

- Institutional support cannot currently be reliably broken down by field due to the lack of data on distribution within research organisations (in particular higher education institutions).

RDI Support in the Czech Republic from European Funds

- EU structural funds provided through individual operational programmes are one of the key foreign public sources of financial support of activities associated with R&D.
- One of the EU's thematic objectives is investment in applied research, development and innovation; for the Czech Republic, EUR 2.5 billion has been earmarked for this objective from the ESIF (i.e., 10.5% of the total ESIF amount for the country). This funding is provided through the operational programmes OP RDE (managing authority MEYS), OP EIC (managing authority MIT) and OP Prague – Growth Pole of the Czech Republic (managing authority City of Prague).
- Institutions of higher education are the most successful in obtaining foreign public support in terms of the volume of funding, followed by CAS institutes and private businesses.
- Another instrument for supporting RDI from European funds is the EU's Horizon 2020 Framework Programme, the operational period of which is 2014 – 2020. The Horizon 2020 budget totals over EUR 77 billion, with the EUROATOM programme having a budget of EUR 1.6 billion.
- According to analysis by the European Commission and the Technology Centre of the CAS, the Czech Republic still falls among those EU Member States with a very low level of researcher activity under Horizon 2020, but at the same time, the Czech Republic has a good project success rate.
- As of March 2020, the Czech Republic had obtained financial aid of EUR 379 million (CZK 10.0 billion) under the H2020 programme with an overall project success rate of 15.2%, while Austria had obtained support of EUR 1.4 billion (CZK 38.1 billion) with an overall project success rate of 16.7%.
- Participation in ERC projects is generally considered an indicator of the quality of a research organisation or even an important indicator of the quality of national research as a whole:
    - The European Research Council was established by the European Commission in 2007 as part of the EU's 7th Framework Programme for Research, and its mission is to support cutting-edge research in all scientific fields, or "frontier research".
    - The ERC manages funding for projects that aspire to excellence and major influence in a given field, expanding existing scientific knowledge and opening up entirely new research perspectives on a global scale.
    - The ERC is part of the first pillar of the Horizon 2020 programme, "Excellent Science". Financial support for the ERC is based on a "bottom-up" approach.
    - The ERC represents 17% of the total Horizon 2020 budget, i.e., EUR 13.1 billion (2014 – 2020). Since 2007, a total of 9,500 projects have been supported, producing 150,000 articles in scientific journals, 6,100 high-citation papers, and 7

Nobel Prizes; over 70% of projects have led to scientific breakthroughs or advances.

- In the Czech Republic, the MEYS programme ERC CZ, approved to run through 2026, supports excellent scientists. A total of CZK 1.1 billion is allocated under the ERC CZ, of which 8 project proposals were supported in the 5th public tender with approved support of CZK 276,929. Further funding allocated in the state budget for groups of grant projects as part of excellent research associated with the ERC is provided by the Czech Science Foundation (CSF) under Support for ERC Applicants, with an allocation of CZK 61.5 million, as well as EXPRO, with an allocation of CZK 13.5 million.
- 17 countries entered the fight against COVID-19 as part of ERC grants, with their research teams taking part in 164 grant projects funded by the ERC in six areas: Diagnostics and Treatments, Environmental Impacts, Medical Devices, Digital Tools, Social Behaviour and Crisis Impact and Management, and Structural and Molecular Mechanisms and Functions.
- The most active countries in the fight against COVID-19 as part of ERC grants were the UK with 38 grants, Germany with 20 grants and France with 19 grants.
- In the Czech Republic the top researchers and their teams work at institutions including Charles University, Masaryk University, the Biology Centre of the CAS, and the Czech Technical University in Prague.

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 (OG) 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 monitoring period 2015 – 2019, total support of CZK 43.82 billion was earmarked under the National RIS3 Strategy for supporting applied and targeted research from Czech public funds (26%), while EU support totalled CZK 74.99 billion (44%), and the private sector contributed CZK 51.12 billion (30%).
- During the period in question, the MIT has been using a harmonised set of primary data to monitor a total of 4,103 projects in the OP EIC programme, 13,552 projects under OP RDE, 65 projects under OP RDE, 333 projects under IROP and 46 projects under OP E. There is a total of 2,571 projects approved and being implemented in national and ministerial support programmes and monitored under the National RIS3 Strategy.
- The most supported objective (key area) of the National RIS3 Strategy in the operational programmes is Innovation Performance of Companies with an amount of CZK 48.45 billion. This is however so far less than half (48%) of the total support planned for this area for the 2014 – 2020 period.
- The area most supported from EU and Czech public funds is the applied sector Digital Economy and Digital Content (CZK 15.21 bn and CZK 2.06 bn respectively), which is the most supported applied sector in general. The sector Mechanical Engineering – Mechatronics is the most supported from private sources (CZK 9.23 bn), and the second most supported sector of the National RIS3 Strategy overall, after Digital Economy.
- The South Bohemian Region receives the highest share of funding from operational programmes (CZK 16.49 bn), as well as from European funds (CZK 8.15 bn) and Czech and foreign private investment (CZK 7.96 bn). Czech public sources are most extensively utilised to support the National RIS3 Strategy in the City of Prague (CKZ 2.20 bn), which is the result of the EU rules for co-financing of highly developed regions.

HUMAN RESOURCES IN RESEARCH AND DEVELOPMENT

- At the end of 2019, there were over a hundred thousand employees (117,075 to be exact) in the Czech Republic whose work duties consisted entirely or partially of R&D. Thus there were 21.6 R&D workers per 1,000 employees in the Czech Republic.
- The majority of R&D employees are research workers (approximately 55%), followed by technical workers (approximately 31%) and other workers (approximately 14%).
- The greatest number of employees in R&D is reported by the private sector (the share of the private sector in overall R&D employment is consistently growing, now at 51.5%). In contrast, the largest number of research workers work in the higher education sector (26,766), closely followed by the private sector (25,868).
- Comparing the number of employees in R&D internationally within the EU-28, the Czech Republic ranks the same as last year, in 11th place (between Austria and Denmark). Comparing the number of research employees within the EU-28, the Czech Republic ranked 13th (between Portugal and Finland).
- Growth in the number of research workers in the private sector occurred primarily in large enterprises under foreign control (11,518 people in 2019). The second most significant group are small and medium enterprises (7,590 people in 2019).
- There remains a gender imbalance of research workers in all sectors. The proportion of women among research workers in the Czech Republic is only around 27%. The greatest disparity between research workers (men vs. women) is in the private sector (only around 13% women). In contrast, the greatest representation of women in research positions is found in the government sector (40%).
- The situation is not positive from a gender perspective even at the individual stages of an idealized academic career path. While there are more women among students and graduates of master's studies, men clearly predominate among students and graduates of doctoral studies. The difference between representation of men and women in actual research 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 Article 2, point 91 of Commission Regulation (EU) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market pursuant to Articles 107 and 108 of the Treaty.
- Infrastructures may be "single-sited" or "distributed" (an organised network of resources) in accordance with Article 2(a) of Council Regulation (EC) No 723/2009 of 25 June 2009.
- They comprise sites designated for the effective interconnection of all segments of the innovation chain and interaction between entities involved in education, public research and the business sphere, with the final effect of producing goods and services with a high added value.
- They generally do not have legal personality, are usually founded, developed and operated by research organisations, and can be considered an elementary component of the research, development and innovation base of the Czech Republic.
- In the Czech Republic they are financed from multiple sources using both public and private resources, domestic and foreign – much like entities conducting research, development and innovation – and their support from public sources may be divided into three groups: (i) operational programmes co-financed from the state budget, (ii) targeted support programmes or groups of grant projects focused on infrastructure construction and further development, and (iii) financial instruments focused on supporting the operation of RDI infrastructure and ensuring its sustainability.
- In the years 2005 – 2019, funds from the state budget were spent on support of research infrastructure through national grant and targeted support programmes totalling CZK 37.7 billion.
- In 2019 the MEYS issued an update to the "Roadmap of Major Research Infrastructures in the Czech Republic 2016 – 2022",[1] which presents the involvement of the scientific community in individual calls and opportunities in the field of research infrastructure. The Roadmap includes a total of 48 major research infrastructures operated in various scientific fields.
- A document has been produced at the level of EU Member States and the European Commission that provides a broad range of measures and represents a response to the current pandemic and presents the initiatives developed to date in the fight against SARS-CoV-2 / COVID-19, called the "ERAvsCorona" Action Plan.

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[1] https://www.vyzkumne-infrastruktury.cz/wp-content/uploads/2019/11/Aktualizace-Cestovn%C3%AD-mapy-2019_cz.pdf [cit. 1.9.2020] (available in Czech only)

RESEARCH AND DEVELOPMENT RESULTS

- Current annual production exceeds 52,000 results, with the share of non-publication results having grown by 1 pp in 2015 – 2019 compared to 2010 – 2014.
- The share of journal articles (type J results) in the overall number of publication results has increased, from 54.9% in 2010 – 2014 to 59.1% in 2015 – 2019.
- In 2019, over 25,000 journal articles were produced, with universities being once again the largest producer in 2019 (participation in 19,500 articles), followed at some distance by state contributory organisations, organisational units of the state and public research institutions (participation in 5,300 articles) and institutes of the CAS (participation in 5,200 articles).
- The share of publications indexed on the Web of Science or Scopus was 71% in 2019. For CAS institutes it was over 90% of all articles they helped produce; for universities, 72%.
- In 2019 over 4,800 applied results were produced, with the most significant share of non-publication applied results in 2019 comprising research reports (type V; 28%), followed by prototypes and functional models (type G; 26%). The largest producer of results is once again universities (participation in 2,300 results), primarily thanks to the production of type V results – research reports. The second largest producer is business entities (participation in 1,300 results), which are most focused on producing results of type G – prototype and functional models. In terms of non-publication results, there are still very few patents.
- The switch to the FORD code system will allow production of results to be monitored according to this breakdown in the future. In 2019 the greatest number of results was produced in the field of Natural Sciences, followed by Engineering and Technology, and Social Sciences.
- The highest number of academic articles indexed on the Web of Science has long been produced in the fields of Physical Sciences and Astronomy, Chemical Sciences, Basic Medical Research and Clinical Medicine.
- In assessing the quality of publications, it is useful to also monitor the structure of publications in terms of journal citation response and the associated publication strategy, which can vary by field. There was an increase in the number of WoS journals in which Czech authors published in nearly all groups of FORD fields aside from Medical and Health Sciences. On the other hand, the Medical and Health Sciences group has the largest percentage of journals included in the first quartile. The number of Czech journals with a non-zero IF went almost unchanged; any increases were in the single digits, and the majority of these journals remain in the bottom two quartiles (Q3 and Q4).
- It is evident from a comparison of the development of the normalised citation index for individual field groups that the Czech Republic is one of the countries lagging behind the

EU-15 average; only in Medical and Health Sciences does the Czech Republic exceed this average.

- The frequency of publications with international participation in the field groups of Natural Sciences, Engineering and Technology, Medical and Health Sciences, and Agricultural Sciences in the Czech Republic was above the EU-15 average in 2019. In the remaining two field groups, the percentage of publications produced in international collaboration is below the EU-15 average, but over the last five years this percentage has increased, which can be considered a positive sign.
- Czech authors collaborate most often with authors from Germany, followed by the USA and UK. In the case of collaboration between Czech authors and colleagues from the UK, Italy, Spain 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 collaboration with colleagues from Slovakia. The composition of countries with which colleagues from Austria collaborate is similar to the composition for the Czech Republic, but the NCI of these publications is generally higher.

Innovation Performance of the Czech Economy and International Comparison

- In 2019, the knowledge intensity in the Czech Republic amounted to 1.94%. In an international comparison of knowledge intensity for 2018, the Czech Republic placed 10th in the EU-28, but is still behind the EU-28 average.
- 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". 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, Germany and Austria. As part of the SII indicator, the Czech Republic achieved its best position (3rd) in the EU-27 (the UK is not included) in the indicator Export of Medium & High-Tech Products. The Czech Republic's worst result was in the indicator Venture Capital Investment (27th). The country's strengths lie in the dimensions of Employment Impacts, Innovators, Sales Impacts, while weaknesses are seen in the dimensions of Intellectual Assets, Finance and Support, and Innovation-Friendly Environment.
- According to the Global Innovation Index (GII), in 2019 the Czech Republic ranked 24th (in 2018, 26th) of a total of 131 economies evaluated. In an evaluation of the EU-28, the Czech Republic achieved first place in several indicators (GERD Financed by Abroad, High-Tech Imports, Utility Model by Origin, High-Tech Net Exports, Creative Goods and Services, Creative Goods Exports). In two indicators (GERD Financed by Abroad, Creative Goods Exports) the Czech Republic even attained the best result of all the countries assessed under GII 2020.
- By the Innovation Output Indicator (IOI), the Czech Republic is above the EU average.
- The proportion of innovative businesses in the Czech Republic is at 46.8%, of which 43.6% are innovative domestic businesses and 58.1% are businesses under foreign control. The share of innovative businesses is higher in industry than in services, but is growing in the latter. The greatest percentage of businesses with successfully implemented innovations had applied procedural and product innovations.
- In terms of the innovative businesses in the Czech Republic, 94.4% had successfully implemented innovations; the remaining businesses had not completed innovation plans or had cancelled them. Large enterprises are considerably more successful in completing and implementing innovations than small enterprises. From the categories of domestic businesses and foreign affiliates, the latter are more successful.
- In terms of the proportion of innovative enterprises in the EU-28, the Czech Republic is below average. The EU countries with the highest level of innovative businesses are Belgium, Portugal and Finland.

INTERNATIONAL COOPERATION IN RESEARCH, DEVELOPMENT AND INNOVATION

- The MEYS is the authority responsible for international cooperation in science, research and innovation. Among the other actors involved in the field of international cooperation on RDI are the Czech Science Foundation (CSF), Technology Agency of the Czech Republic (TA CR), Academy of Sciences of the Czech Republic (CAS), Ministry of Defence (MD) and the Ministry of Transport (MT).
- The largest volume of funding for targeted aid for international cooperation in RDI goes into projects of major research infrastructures and the programme INTER-EXCELLENCE. Aside from the MEYS, targeted aid in this area is also provided by the CSF and TA CR. A central instrument of institutional support is coverage of the Czech Republic's membership fees and expense shares in international research and development organisations and ERIC consortia. Examples of other instruments of international cooperation in this area include the mobility programmes of the MEYS and CAS.
- International R&D organisations are a specific type of research infrastructure in which the Czech Republic participates as a member state. These organisations differ from other international research infrastructures in terms of their legal framework. The Czech Republic is currently active in 9 major international R&D organisations, with membership providing benefits in terms of the development of Czech scientific and industrial capabilities.
- In terms of research and development activities, the Czech Republic pays the highest membership fees to the European Space Agency (ESA), the European Organisation for Nuclear Research (CERN), and the Joint Institute for Nuclear Research (JINR).
    - 23 Czech scientific institutes and universities are currently involved in cooperation with the ESA. The Czech Republic also participates in developing scientific instruments and experiments for ESA scientific missions through the PRODEX programme. CERN also presents a significant benefit to the Czech scientific community, with the Czech Republic numbering among the most active member states by number of researchers involved in CERN projects. In terms of the Czech Republic's activity under JINR, in 2019 Czech authors published more than 400 scholarly articles in the field of particle and nuclear physics, placing the Czech Republic among the countries with the highest publication activity in the organisation.
- In terms of international scientific cooperation and boosting the prestige of Czech science on a global level, it is important not only to support Czech scientists in participating in international scientific teams and projects, but also to support Czech representation in the governing bodies of international research organisations. Czech scientists are currently active in the leadership bodies of JINR, as well as in the European Joint Undertaking for ITER and the Development of Fusion Energy.

Detailed Report

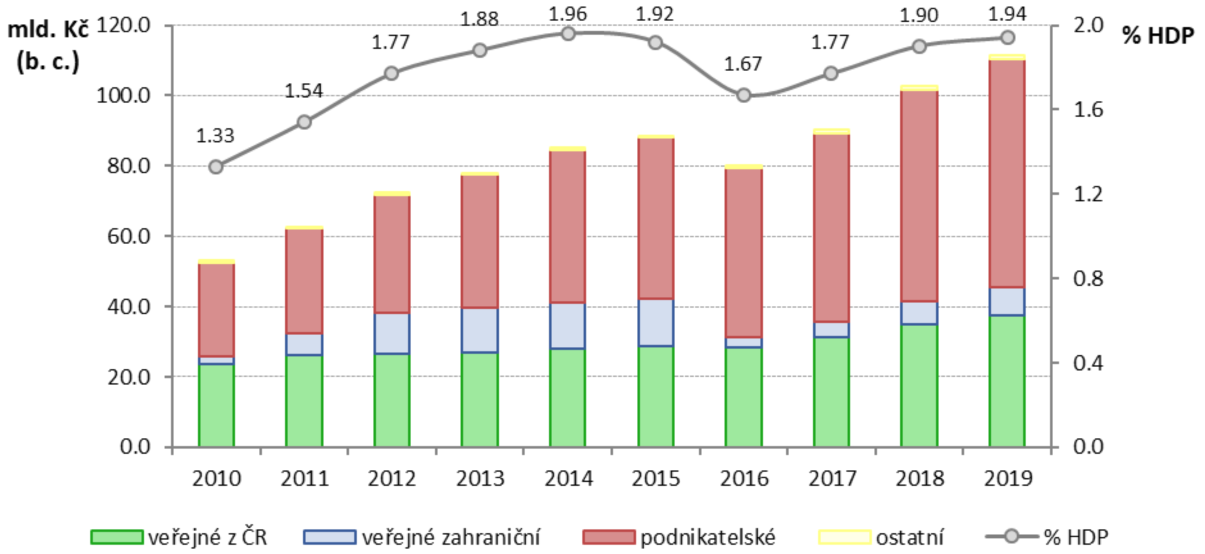
1 Financial Flows in Research and Development

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 2010–2019, the regular year-on-year growth was interrupted only in the year 2016, when there was a shortage of public resources from abroad due to the transition to the new programming period. **In 2019, the absolute amount of overall expenditures first exceeded a record CZK 110 billion.** The R&D Intensity indicator (i.e. R&D expenditure as % 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 observe the rate of growth of the gross R&D expenditure being higher than GDP growth. In 2019 R&D expenditures expressed as a % of the GDP approached the level of 2014, when this indicator reached its peak within the monitored period.** 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 65 billion in 2019***,* i.e. almost 2.5 times more than in 2010. 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 still relatively stable compared to business sources, **in 2017 surpassing CZK 30 billion for the first time and in 2019 even reaching CZK 37.6 billion in absolute numbers.** Contributing to this record growth of public resources was above all the Research Development and Innovation Council (RDIC), which prepares the draft RDI expenditure from the state budget, as in recent years it has been endeavouring to increase the state budget expenditure on RDI while also streamlining the focus of these public resources. RDI expenditures from the state budget 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. A 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 from the ESIF (for more detail see Chapter 3 – Research, Development and Innovation Support in the Czech Republic from European Funds). In 2017 and 2018 we can observe a gradual increase in foreign public resources (in particular due to OP RDE and OP EIC), while in 2019 foreign public resources represented CZK 8 billion.

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 126.2 billion (i.e. 15% of the total R&D expenditures for 2010–2019). The majority has consisted of current expenditures: wages (48%) and other current expenditures (37%). **In 2018, capital expenditures totalled CZK 10.5 billion, wage expenditures CZK 60.9 billion and other current expenditures CZK 40.2 billion**. The amount of capital expenditures in recent years has depended primarily on the amount of public resources drawn from abroad, with the highest capital expenditures being made in the years 2012–2015 due to the building of the European Centres of Excellence and Regional R&D Centres (an average of CZK 17.6 billion a year). In the case of wage expenditures, the business sector saw the greatest increase, with wage expenditures having grown 175% in 2019 compared to 2010, which naturally correlates to the growing number of R&D employees in the sector in question (growth in number of FTEs of 69% between 2010 and 2019) 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 28% in 2009–2019, in the higher education sector by 40%; this was also accompanied by a growth in wage expenditures. In the government sector this grew by 90% and in the higher education sector a full 157%. If we compare the wage expenditures among individual sectors calculated per 1 FTE, in 2019 the highest annual wage expenditures were in the business sector (CZK 0.86 million), followed with a gap by the government sector (CZK 0.66 million) and right behind them the higher education sector (CZK 0.64 million). 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 research and development (GERD) in the Czech Republic in 2010 – 2019 by source of financing (in current prices)

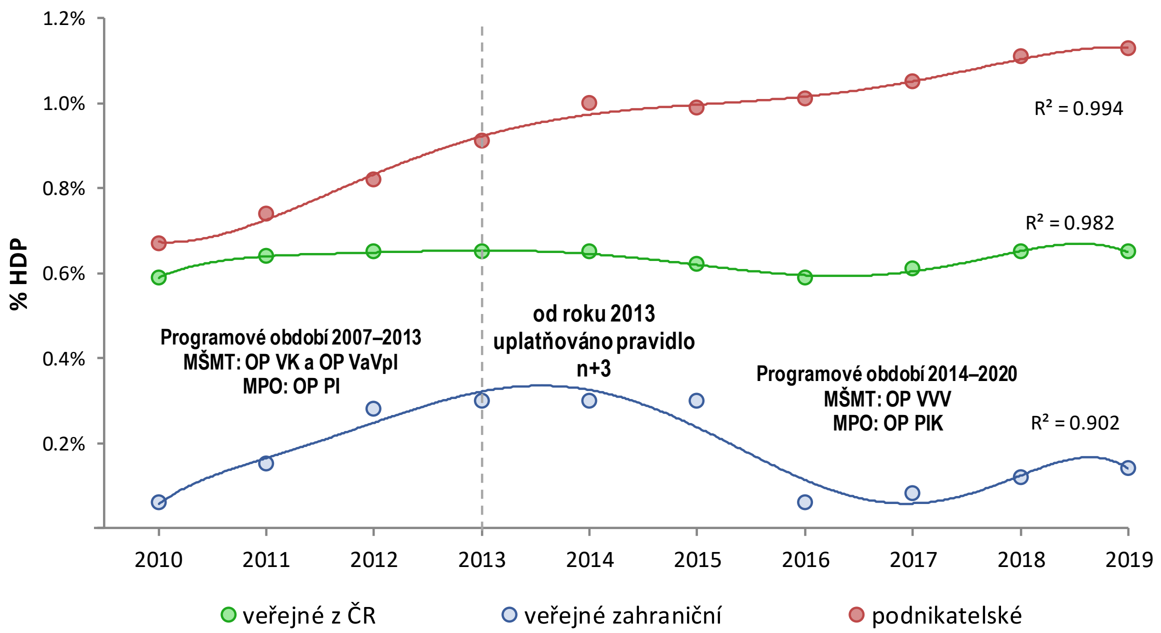


billion CZK **% of GDP**
(c. p.)

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

Source: CZSO, Annual Report on Research and Development

Figure 1.2: Sources of financing for gross expenditure on research and development (GERD) in current prices expressed as % of gross domestic product (GDP) in 2010 – 2019



% of GDP

2007 – 2013 planning period *2014 – 2020 planning period*
MEYS: ECOP and OP RDI *MEYS: OP RDE*
MIT: OPEI *MIT: OP EIC*

n+3 rule applied
since 2013

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

Source: CZSO | Coefficient of determination R^2 expresses the closeness of fit of the actual data points to the smoothed curve.

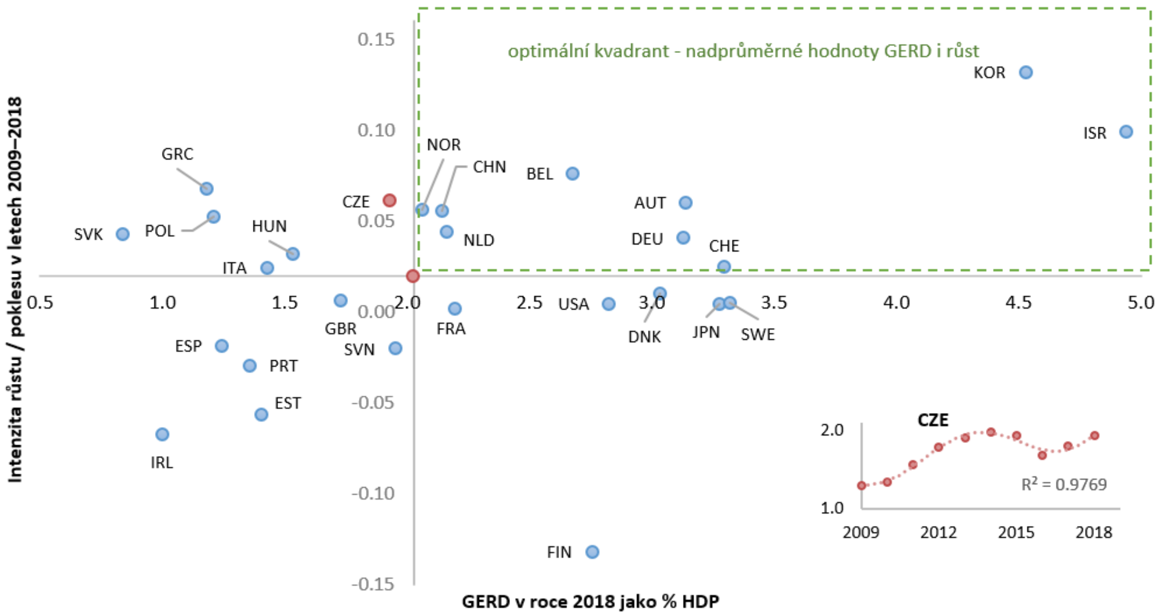
The development of individual GERD components adjusted for GDP by source of financing in time is shown by Figure 1.2. Research and development expenditures financed from business resources as a percentage of GDP reached 1.13% in 2018, having passed 1% of the GDP back in 2016. **The growth of R&D expenditures as a % 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 show a balanced trend in 2010–2019, with the value ranging from 0.59% to 0.65%. In the year 2019 it reached 0.65%, i.e. the same amount as in 2012–2014, with the difference that at that time the economy was just pulling out of crisis. In 2019 the GDP grew by 5.6% and Czech public R&D expenditures rose by 7.2%. In terms of business resources the main objective is to create the conditions so that business expenditures comprise 1.5% of the GDP after 2024, which according to the most recent forecasts would mean an increase up to over CZK 90 billion. 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 expenditures on R&D. Another possibility for stimulating private spending on R&D is harmonising the methodology for tax deductions. In 2018 a working group was established for R&D tax deductions, the members of which include representatives of the RDIC, Ministry of Finance (MF), General Financial Directorate, 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 not increasing the likelihood of deductions being abused, all while respecting the instrument's ultimate goal of "supporting competitiveness".

As is also evident from Figure 1.2, in the years 2012–2015, public funding from abroad was a highly significant source of funds for R&D, in particular from EU structural funds. **In 2019, foreign public resources comprised a mere 0.14% of the GDP**. **Expenditures from public resources as a whole** (the state budget, local budgets, foreign public resources) **constituted 0.79% of the GDP in 2019**, which means that the **Czech Republic was close to fulfilling the national target of the Europe 2020 strategy of annually investing public funds of 1% of the GDP in R&D**. The milestone for meeting it in further years, which is laid down in the 2019+ Innovation Strategy, is laid out 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 the years 2009–2018, but in some cases only up to 2017 (i.e. for 2007–2016), or even only up to 2016. Data are thus compared with a delay compared to the available statistics for the Czech Republic published by CZSO in Chapter 1.2. It is evident from Figure 1.3 that **in comparison with other countries the Czech Republic lags 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 the years 2009 and 2018, the R&D Intensity in the Czech Republic grew the most of all new EU Member States. 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 high intensity of R&D expenditures in 2018 were the USA (2.8% of the GDP), South Korea (4.53% of the GDP) and Japan (3.28% of the GDP). In terms of the development of R&D Intensity, a growing trend can be observed in 2009–2018 for most countries that strongly support R&D (with the exception of Finland). Of the countries outside the EU, there is stable R&D investment growth in Asian countries, in particular South Korea and China. In China the R&D Intensity surpassed the EU-28 average for the first time in 2013 and the difference is ever increasing, with China gradually approaching countries like the Netherlands or France in intensity of R&D expenditures.

Figure 1.3: Gross expenditure on research and development (GERD) in 2009 – 2018 in international comparison



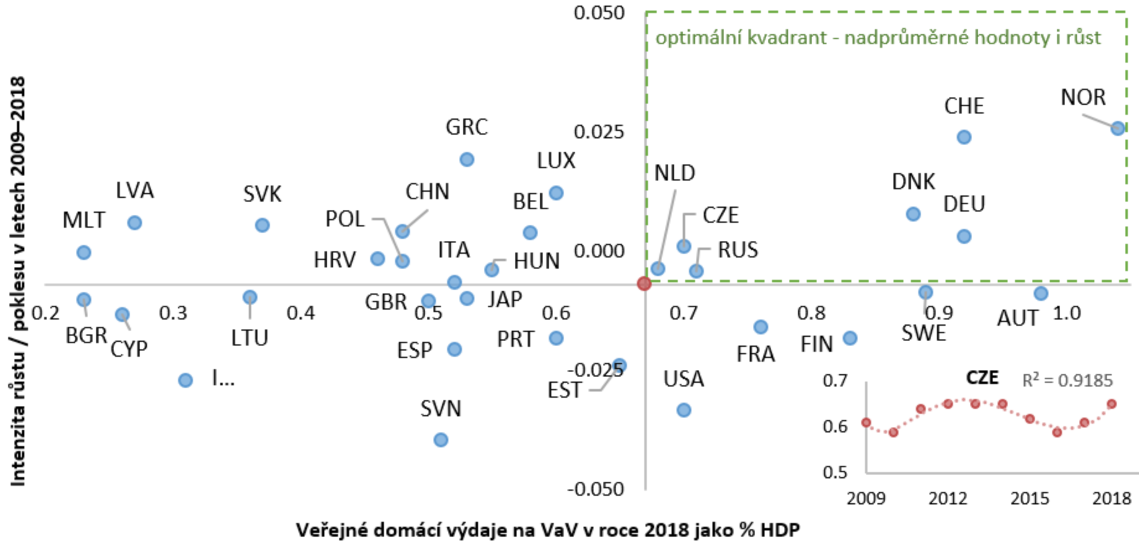
Intensity of growth / decline in 2009 – 2018 optimal quadrant – above-average values of GERD and growth

GERD in 2018 as % of GDP

Source: OECD | Intensity of increase / decrease in 2009 – 2018 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 demonstrates the values for the individual years in the Czech Republic; R^2 indicates the closeness of fit achieved by the curve.*

If we perform an international comparison based on domestic public R&D expenditures (expressed relatively as a % of GDP, Figure 1.4), the Czech Republic has exceeded the European average. For the first time the Czech Republic has got into the optimal quadrant, where it also has an above-average growth intensity value.

Figure 1.4: Domestic public expenditure on research and development in 2009 – 2018 in international comparison



Intensity of growth / decline in 2009 – 2018 optimal quadrant – above-average values and growth

Domestic public R&D expenditure in 2018 as % of GDP

Source: OECD – Main Science and Technology Indicators | The intensity of increase / decrease in 2009 – 2018 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 demonstrates the values for the individual years in the Czech Republic; R^2 indicates the closeness of fit achieved by the curve.

1.2 Financial Flows Between Sectors

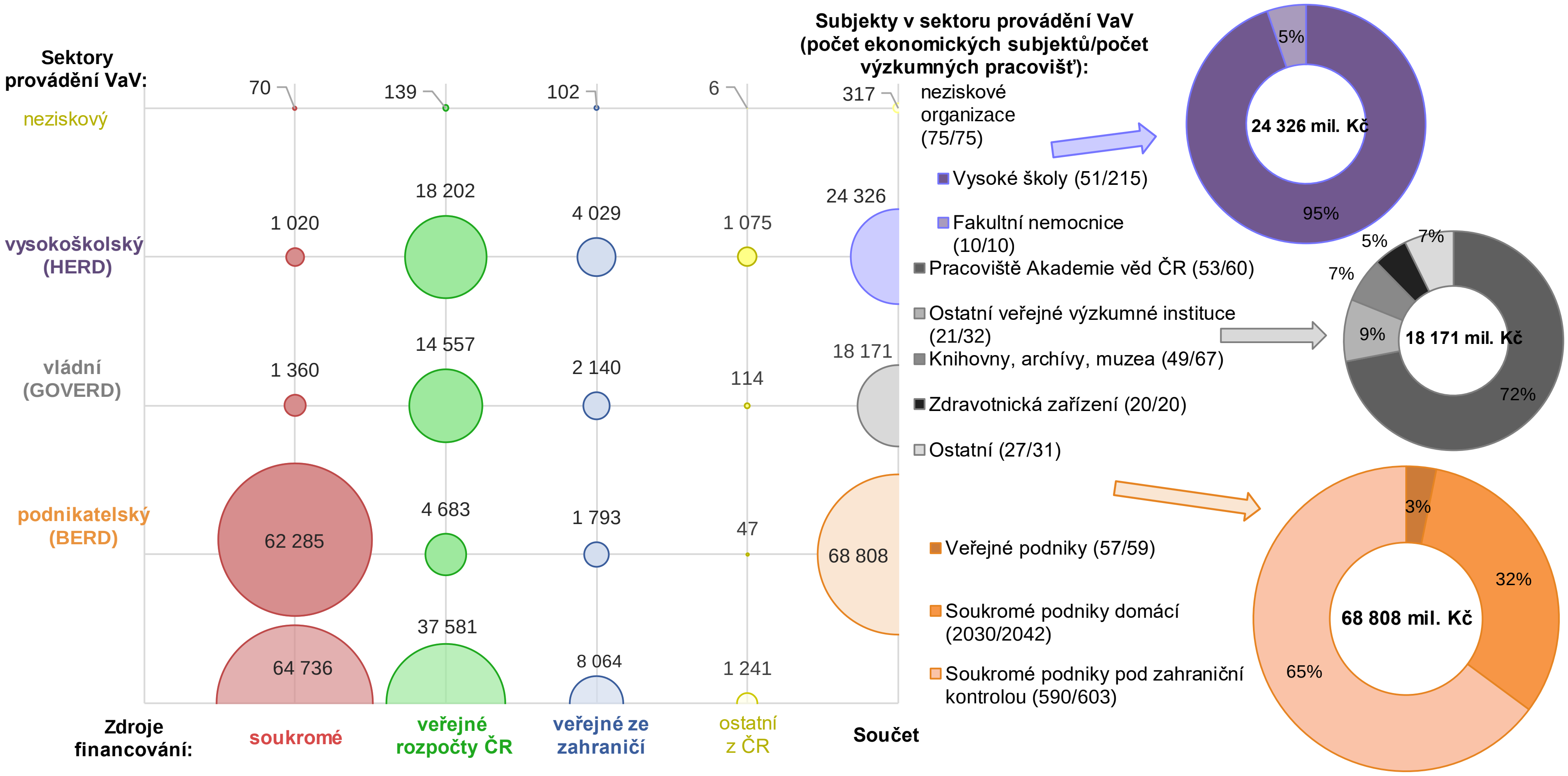
The relations between individual sectors and sources of funding are recorded in Figure 1.5, which shows the values for 2019. It is evident from Figure 1.5 that certain disproportions were recorded in the distribution of individual financial sources among sectors that carry out R&D. **Business sources 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 2.5 billion for the university and government sector (CZK 1.0 billion and CZK 1.4 billion respectively). In contrast, support from domestic public sources was directed primarily into the higher education and government sectors (CZK 18.2 billion and CZK 14.6 billion). The amount of support from domestic and foreign public sources for R&D carried out in the business sector totalled CZK 6.5 billion (CZK 4.7 billion from the Czech public budget and CZK 1.8 billion 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 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 sector in conducting R&D is not sufficient, despite the fact that such collaboration is supported from the state budget. The motivation effect is evidently not being sufficiently lived up to, because the initial phase of collaboration financed from the state budget has not yet sufficiently raised the confidence of the business sector in the public one, which would be expressed with 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 for 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 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 can also occur through participation in projects financed from public sources.

According to CZSO statistics, research organisations in the government sector focus primarily on basic research (CZK 13.8 billion in 2019, i.e. 76%), compared to which institutions in the government sector in European countries such as Norway, the Netherlands, Finland, Portugal or Ireland 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 (2018), expenditures for applied research and experimental development in the Czech government sector reached 0.06% of the GDP and were 3.8 times lower than expenditures for basic research, compared to which in the aforementioned European countries expenditures on applied research in the government sector were at least twice as high as expenditures on basic research. In the case of the higher education sector, funds focused on applied research reached 0.13% of the GDP in the Czech Republic in 2018 (in the period when drawing from OP RDI was culminating, this rate was 0.16% of the GDP on average and then fell again to 0.1%) and were nearly 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, only being available for example for the Netherlands and the UK, where the percentage of expenditures on applied research was twice that of the Czech Republic, in the case of Denmark in fact fourfold. 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 other countries for which data was available, this ratio 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 CAS institutes could lead to greater collaboration between the business and academic spheres, which is the aim of the current National Research, Development and Innovation Policy of the Czech Republic for 2016–2020 (Measure 16), as well as the newly approved NP RDI 2021+ (Measures 17, 18, 19, 20, 28) and the 2019+ Innovation Strategy (Pillar V – Innovation and Research Centres).

Figure 1.5: Financial flows in R&D across sectors in 2019



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 economic entities/number of research workplaces):
universities (51/215) → CZK 24.326 bn

university hospitals (10/10)

CAS institutes (53/60) → CZK 18.171 bn
other public research institutions (21/32)
libraries, archives, museums (49/67)
healthcare facilities (20/20)
other (27/31)

public enterprises (57/59) -> CZK 68.808 bn
domestic private enterprises (2,030/2,042)
private enterprises under foreign control (590/603)

Source: CZSO | The figure shows other sources of funding for R&D that contribute to own revenue of universities and private non-profit institutions and do not come from the state budget, the business sector, or from abroad. The average amount of these resources in 2014 – 2018 was roughly CZK 816 million; in 2019 it exceeded CZK 1.2 billion. About 80% of these resources are allocated to the higher education sector, comprising primarily tuition fees, journal subscriptions, and publication revenue. The number of entities in the R&D sectors in parentheses is the average number of workplaces. The number of CAS institutes is listed based on the CZSO methodology, as due to region-based tracking, CZSO keeps separate data for multiple branches of certain institutes (Institute of Botany, Institute of History, Institute of Plasma Physics). Since 2019, CZSO has changed the categorization of entities in the government sector, with the type "ministerial research organisations" being replaced with "other public research institutions".

Figure 1.5 provides a detailed view of the drawing of expenditures based on type of research facility in the individual sectors (pie charts on the right). The **business sector** used the greatest volume of funding for R&D it conducted. **R&D expenditures in the business sector totalled CZK 68.8 billion**, with 2677 economic entities active in this sector; in contrast to the higher education sector this number nearly corresponds to the number of research workplaces. 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 (65%), the second most being spent by domestic private enterprises (32%), and only a negligible share coming from public enterprises (3%). **The higher education sector invested a total of CZK 24.3 billion 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 18.1 billion,** with the largest group in terms of volume of R&D funding comprising CAS institutes (72%). **In terms of funding volume there are thus 4 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 is private enterprises under foreign control (CZK 183.6 billion), the second group is universities (CZK 96.9 billion), followed by private domestic companies (CZK 92.0 billion) and in 4th place with a relatively large gap are institutes of the CAS (CZK 62.1 billion). Private 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).

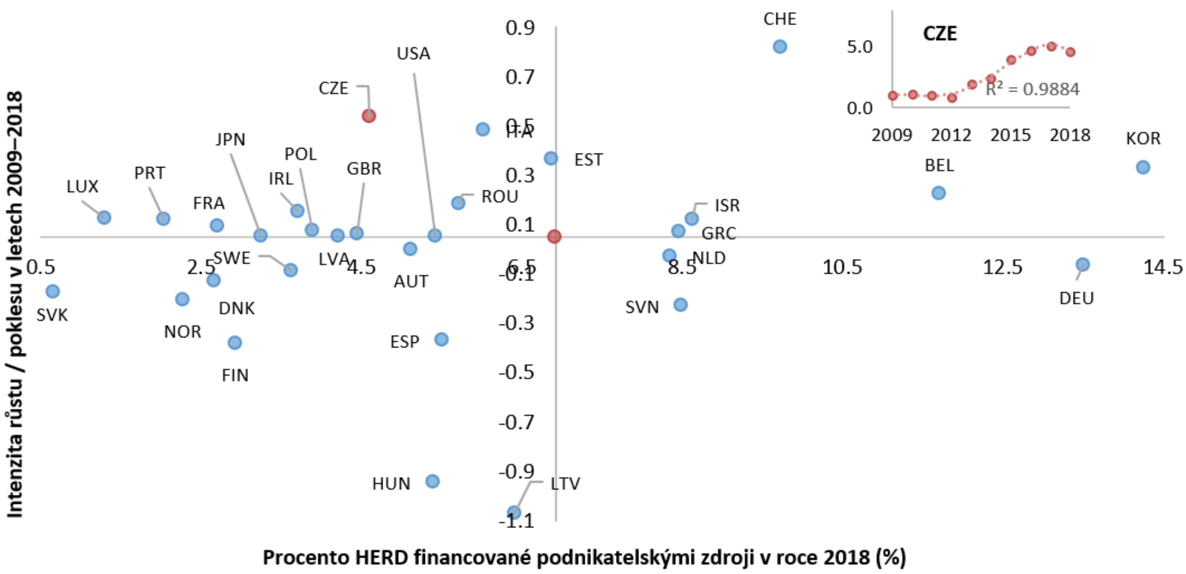
INTERNATIONAL COMPARISON

The imbalance between funds heading from businesses to public entities and funding provided to businesses from the Czech state budget is also evident from an international comparison (see Figures 1.6–1.8). While in 2019 support for the business sector from Czech public funds reached 6.8% of the volume of funds spent on R&D by the business sector (7.3% on average for the years 2014–2018), business sources constituted 4.2% of the expenditures of the higher education sector on R&D (4.6% in 2018) and 7.5% of the government sector's R&D expenditures[2] (3.9% in 2018). In contrast, in Germany for example direct support of businesses from domestic public sources constituted a mere 3.1% of business sector expenditures on R&D in 2018, but business sources contributed nearly 13.5% to the R&D expenditures of the higher education sector and nearly 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 2017; in previous years, certain similarities to the Czech Republic could be seen in the distribution

[2] In the case of the government sector, only domestic business resources are meant, which eliminates the impact of the licensing fees of the Institute of Organic Chemistry and Biochemistry of the CAS.

between funds going from businesses to public entities, with private sources providing slightly more than the in Czech Republic in the higher education sector (HERD: 5.2%) and more than twice as much in the government sector (GOVERD: 8.7%). Austrian businesses used to be relatively more successful in acquiring public support, with domestic public resources contributing 12% to expenditures in the business sector in 2015; currently this is 3.7%. Austrian enterprises also make use to a relatively large extent of indirect support as well (Figure 1.11), which could be one of the successful ways to accelerate private expenditures in the Czech RDI system and help increase the competitiveness of the Czech state.

Figure 1.6: Share of private investment on higher education research and development expenditure (HERD) in 2009–2018 in international comparison (in %)

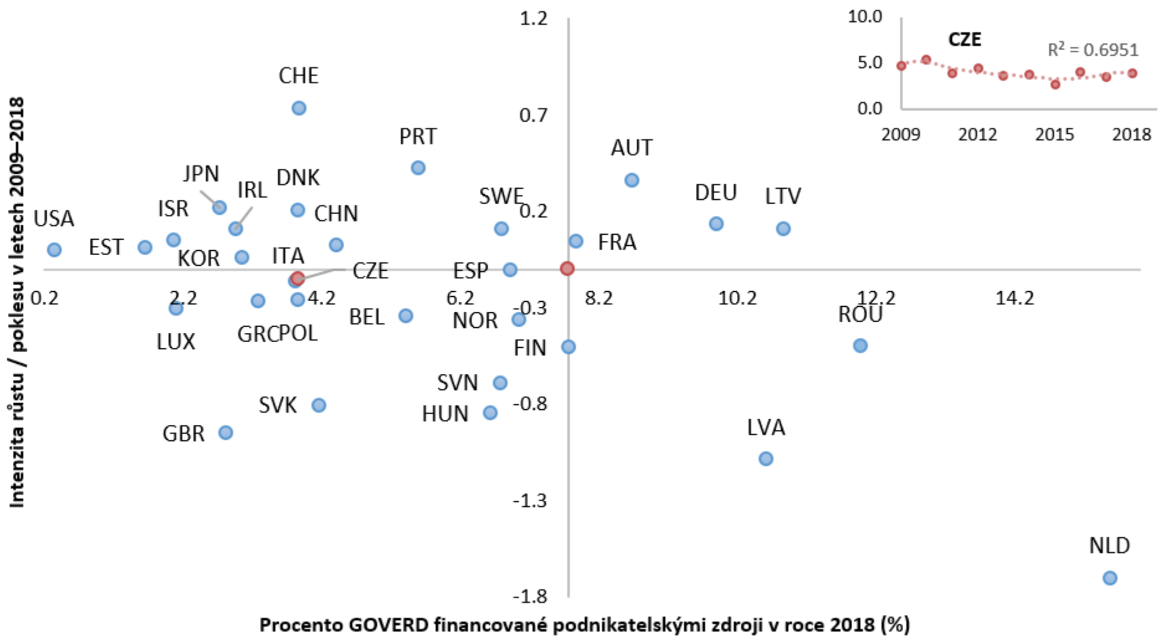


Intensity of increase / decrease in 2009–2018

Percentage of HERD funded from private sources in 2018 (%)

Source: OECD

Figure 1.7: Share of private investment on government sector research and development expenditure (GOVERD) in 2009–2018 in international comparison (in %)



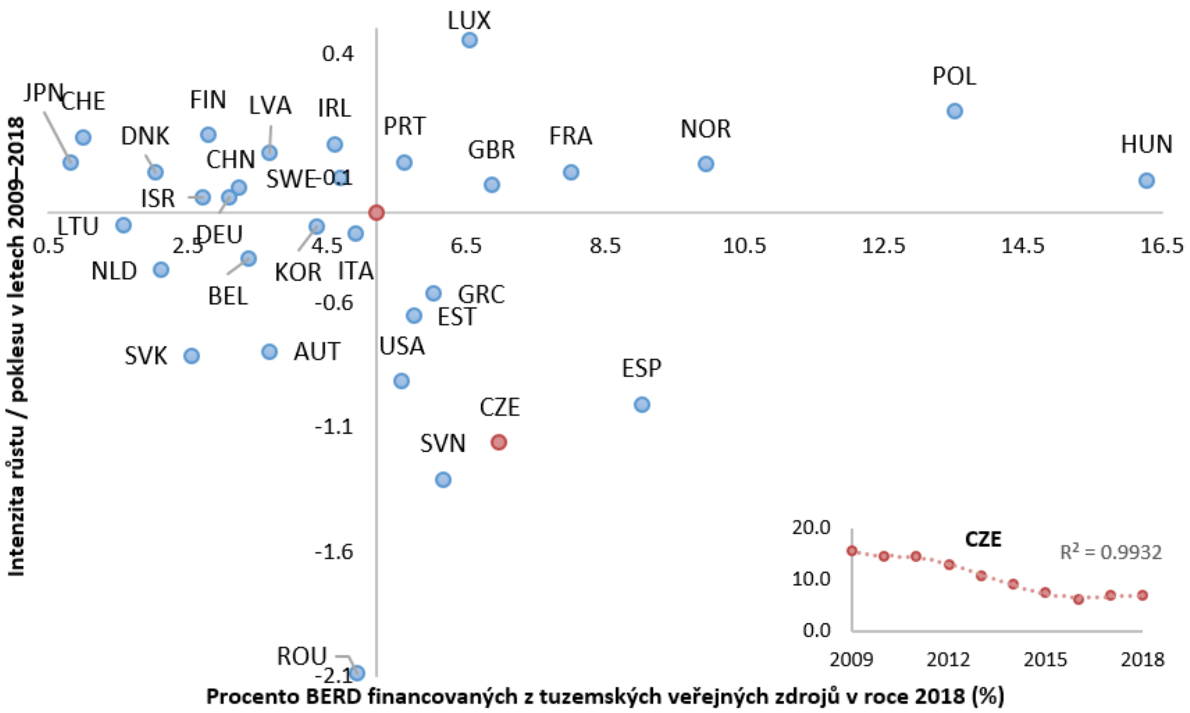
Intensity of increase / decrease in 2009–2018
Percentage of GOVERD funded from private sources in 2018 (%)

Source: OECD | The intensity of increase / decrease in 2009–2018 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 fit achieved by the curve. Private sources include the following funds: revenue from sale of research and development 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, cash donations).

A more detailed analysis of the share of domestic business resources in funding research and development 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. A similar situation to that of the share in higher education R&D expenditures is 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 research and development expenditures (Figure 1.8) reached nearly 16% in 2009, in 2018 only 7%. In 2011 it was still at 14.7%, which was followed by gradual convergence towards the European average (in 2015 this was 6.35% for the EU-28, 5.6% in 2016 and 5.22 in 2017).

Figure 1.8: Share of domestic public sources on gross business expenditure on research and development (BERD) in 2009–2018



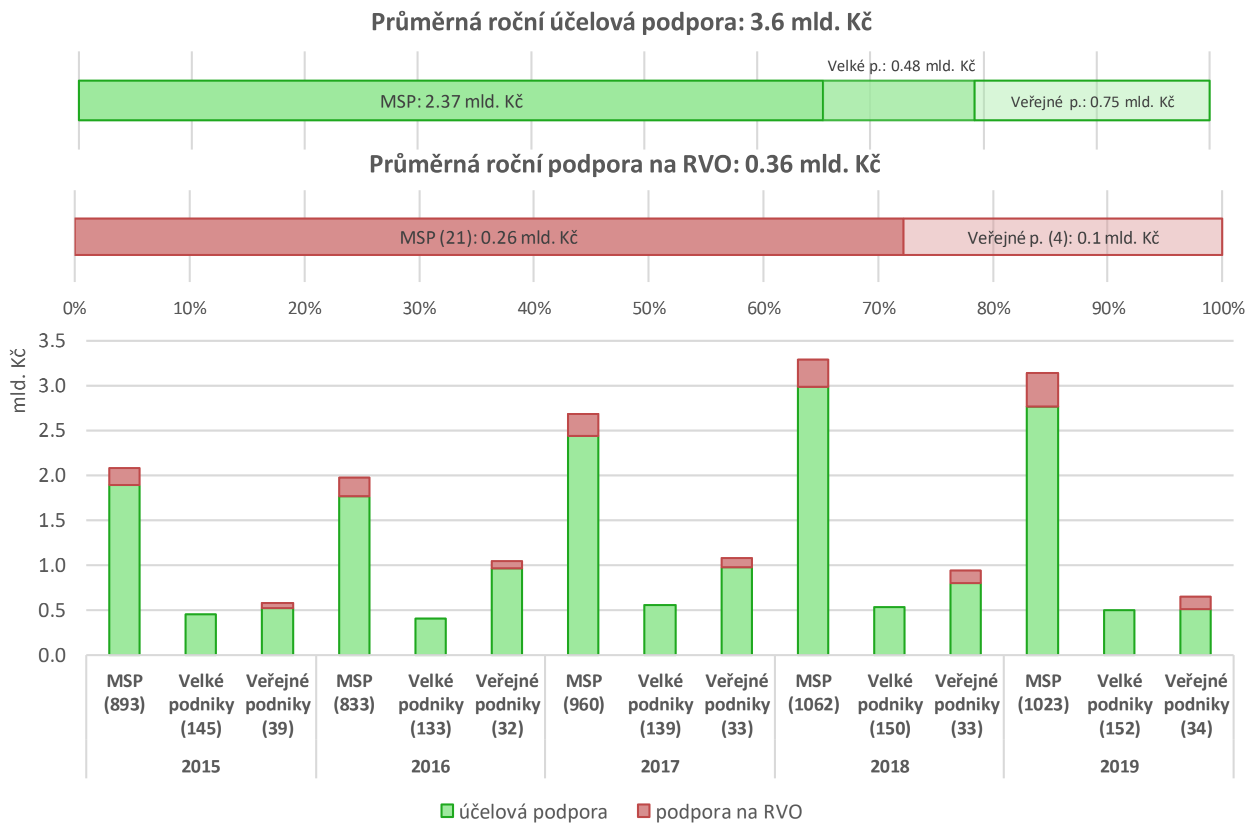
Intensity of increase / decrease in 2009–2018
Percentage of BERD funded from domestic public sources in 2018 (%)

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 shows the values for the individual years in the Czech Republic; the coefficient of determination R^2 indicates the closeness of fit achieved by the curve.
Domestic public expenditure includes co-financing of EU operational and framework programmes.

1.3 Direct and Indirect Support for Research and Development in the Private Sector

Figure 1.9 below presents the distribution of direct public support in the private sector. Data were used from the RDI IS on the actually drawn support from the state budget, with private businesses comprising the group of SMEs and large enterprises. According to the data submitted to the RDI IS, **in 2019 the total direct support for private enterprises drawn was CZK 3.62 billion, with public enterprises drawing aid of CZK 641 million**. Of this, CZK 374 million was spent to support long-term conceptual development for 21 private enterprises. A total of 4 public enterprises drew aid for long-term conceptual development, amounting to CZK 136 million. The remaining aid was spent on other forms of direct R&D support (i.e. primarily on targeted support projects.

Figure 1.9: Direct support for research and development in the private sector from the state budget in 2015–2019



Average annual targeted support: CZK 3.6 bn
SMEs: CZK 2.37 bn Large ent.: CZK 0.48 bn Public ent.: CZK 0.75 bn

Average annual support for development of research organisations: CZK 0.36 bn
SMEs (21): CZK 0.26 bn Public ent. (4): CZK 0.1 bn

CZK bn | SMEs Large enterprises Public enterprises [repeated 4 more times]

targeted support support for research organisation development

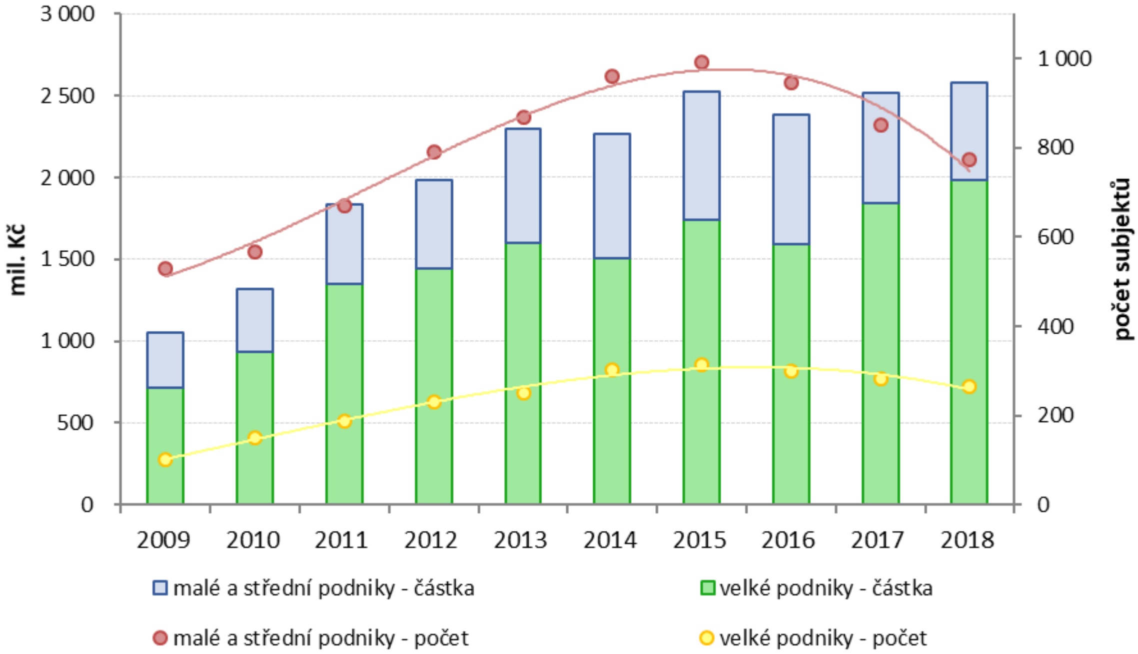
Source: RDI IS after adjusting entity categories based on CZSO methodology for statistical studies.
Note: Number of entities provided in parentheses.

For the years 2015–2019, public enterprises received an average of CZK 850 million (21%), large enterprises CZK 480 million (12%), and SMEs CZK 2.630 billion (66%). **Between the years 2015 and 2019 the overall support for the business sector increased by CZK 1.2 billion, while support for private enterprises rose by over CZK 1.1 billion.** Support rose primarily for SMEs (by over CZK 1 billion), in the case of large enterprises public support grew only minimally (by approx. CZK 50 million). 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.

Aside from direct R&D support from the state budget, private enterprises are also supported indirectly in the form of items that are deductible from the income tax base of legal persons.[3] **In 2018, the amount of indirect support for research and development at businesses in the Czech Republic reached CZK 2.52 billion** (Figure 1.10). Compared to 2009 this support had risen nearly 150% (i.e. from CZK 1.05 billion), 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 2018, the volume of deducted R&D expenditures stayed at almost the same level as the previous year, 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 and 2018). **In 2018, 264 large enterprises made use of indirect public support, claiming R&D tax support of CZK 1.99 billion**, 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 7.5 million, while for SMEs it was more than eight times less (i.e. CZK 0.77 million).

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

Figure 1.10: Indirect support for research and development in the private sector in the Czech Republic in 2009–2018



CZK million — 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[4] 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 research and development project as a necessary condition for claiming deductions on research and development support under Section 34 (4) and (5) of the Income Tax Act" issued by the General Financial Directorate (GFD) in September 2017.[5] 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. In 2018 a working group was established for R&D tax deductions, the members of which include representatives of

[4] 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 30 October 2019] (available in Czech only).

[5] 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 30 October 2019]; this is an interpretation on the formal requirements of projects. (available in Czech only)

the RDIC, MF, General Financial Directorate, Confederation of Industry of the Czech Republic, Association of Research Organisations, and the Association of SMEs. The shared goal for tax 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 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 the years 2014–2018 (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. Up to 2015 the number of private enterprises grew continuously, 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 cause in part by the transition to the new programming period and approaching end of the TIP programme under the MIT. The majority of the volume of public support is obtained by domestic businesses, with the share of businesses under foreign control growing up until 2017 and in 2017 reached nearly 39%. In 2018 this share fell to 36%. The expectation was fulfilled 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 accent support for the group of SMEs, under which mostly domestic businesses fall.

Table 1.1: Development of public support of R&D in private enterprises in the Czech Republic in 2014–2018

		2014	2015	2016	2017	2018
Number of enterprises that used public support		2,090	2,062	1,918	1,966	1,968
of which:	domestic	1,594	1,564	1,448	1,515	1,542
	under,foreign,control	496	498	470	451	426
Gross public R&D support (CZK mil.)		7,625	7,212	5,259	6,494	7,626
of which:	direct,domestic,support	3,778	3,156	2,459	3,040	3,545
	direct,foreign	1,583	1,532	415	938	1,498
	indirect	2,263	2,525	2,384	2,516	2,583
Structure of gross public R&D support by type of support in %						
of which:	direct domestic support	49.6	43.8	46.8	46.8	46.5
	direct foreign	20.8	21.2	7.9	14.4	19.6
	indirect	29.7	35.0	45.3	38.7	33.9
Gross public R&D support by enterprise ownership (CZK mil.)						
of which:	for domestic enterprises	5,277	4,556	3,330	3,977	4,883
	for enterprises under foreign control	2,345	2,656	1,929	2,517	2,743
Structure of support by ownership in %						
of which:	for domestic enterprises	69.2	63.2	63.3	61.2	64.0
	for enterprises under foreign control	30.8	36.8	36.7	38.8	36.0
Gross public R&D support by sector (CZK mil.)						
of which:	manufacturing industry	3,396	3,533	2,540	3,201	3,691
	information and comm. activities	1,273	1,361	935	1,104	1,336
	professional, scientific and technical activities	2,149	1,710	1,307	1,617	1,863
	other sectors	808	609	476	572	737
Structure by sector %						
of which:	manufacturing industry	44.5	49.0	48.3	49.3	48.4
	information and comm. activities	16.7	18.9	17.8	17.0	17.5
	professional, scientific and technical activities	28.2	23.7	24.9	24.9	24.4
	other sectors	10.6	8.4	9.0	8.8	9.7

Source: CZSO

The more detailed structure of R&D support at private enterprises in the Czech Republic in 2018 is provided by Table 1.2. In 2018, each enterprise received indirect public R&D support of CZK 2.5 million on average. For private domestic enterprises the average support amount was CZK 1.31 million, for private foreign enterprises this amount was four times higher. 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 2018.

Table 1.2: Structure of support for R&D in private enterprises in 2018

Beneficiary, sector, field	Number of enterprises			Support amount (CZK mil.)			Share of support (%)		
	total	ownership		total	ownership		for	for	direct /
		foreign	domestic		foreign	domestic	foreign	domestic	indirect
Indirect support									
Manufacturing industry:	593	182	411	1,803	1,192	611	66.1	33.9	
of which: 26 Electronic industry	61			95					
27 Electrical industry	71			230					
28 Engineering industry	138			210					
29 Automotive industry	35			661					
Information and communication activities	175	37	138	383	184	199	48.0	52.0	
Professional, scientific and tech. activities	126	44	82	226	162	64	71.6	28.4	
Other	143	39	104	172	80	92	46.5	53.5	
Indirect support	1,037	302	735	2,583	1,617	966	62.6	37.4	33.9
Direct domestic support	862	136	726	3,545	602	2,944	17.0	83.0	46.5
Direct foreign support	377	54	323	1,498	524	974	35.0	65.0	19.6
Gross public R&D support to enterprises in the Czech Rep.				**7,626**	**2,743**	**4,883**	**36.0**	**64.0**	**100.0**

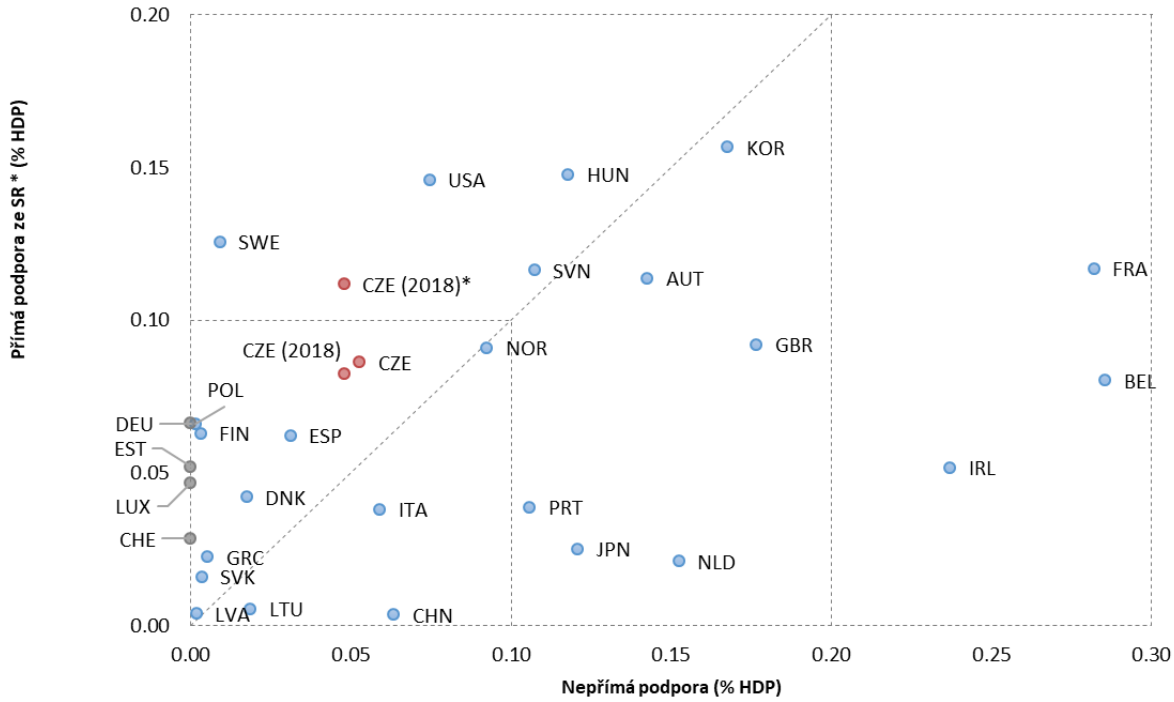
Source: CZSO

INTERNATIONAL COMPARISON

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 2017, thus the comparison was conducted on average values for the 5-year period of 2013–2017.

It is evident from Figure 1.11 that countries such as France, as well as Belgium and Ireland, make use primarily of indirect support. In contrast the intensity of direct support is relatively high in South Korea, Austria or Hungary, and at the same time indirect support is also utilised to a relatively large extent. In terms of the intensity of direct support, the Czech Republic holds a position comparable to the UK, where however the average intensity of indirect support is higher. China or 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 in the business sector is understandably almost zero. In Germany, Finland, Switzerland, Estonia or 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 0.14% of the GDP, which is approximately 2.3 times more than in the case of Denmark and nearly 1.5 times more than in Italy, but on the other hand 2.9 times less than in France and 2.6 times less than in Belgium and two times less than in Ireland.

Figure 1.11: Direct and indirect support for RDI in the business sector as a % of GDP in international comparison (average for 2013–2017)



Direct support from the state budget (% of GDP)

Indirect support (% of GDP)

Source: OECD – Main Science and Technology Indicators R&D Tax Incentive Indicators
*Note: CZE (2018) values for 2018; CZE (2018) * values for 2018 and public support values also include foreign public sources*

2 Funding of Research and Development from the State Budget

Domestic public resources earmarked for supporting RDI consist primarily of the state budget 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. After being incorporated into the state budget 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

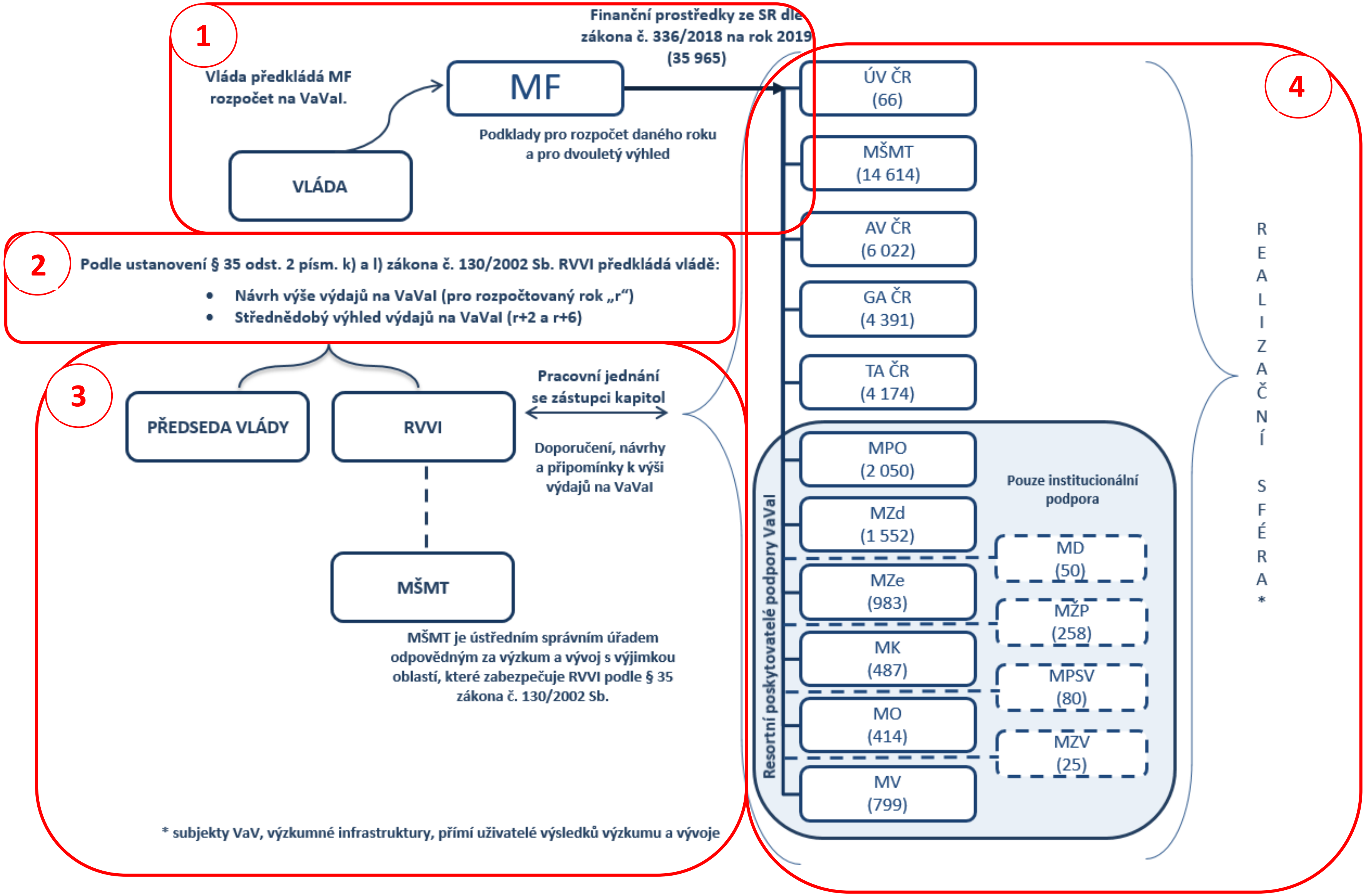
Preparation of the draft state budget for RDI is a continuous and comprehensive process described illustratively in Diagram 2.1 below. According to Section 35 (2) k) and l) of the Act No. 130/2002 Coll. on Support for Research, Experimental Development and Innovation, the RDIC provides for drawing up the draft amount of gross RDI expenditures for individual budget headings and their mid-term outlook. The proposal for state budget expenditures stems from the document *National Policy on Research Development and Innovation for 2016–2020* (NP RDI 2016–2020)[6]. Boosting RDI funding after 2020 is a goal of the 2019+ Innovation Strategy, which the government approved with its Resolution No. 104 of 4 February 2019. One of the goals of the 2019+ Innovation Strategy is to "boost financing of research and development (measured as a % 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 2019+ Innovation Strategy in addition to the NP RDI.

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 Ministry of Transport, Ministry of the Environment, Ministry of Foreign Affairs and Ministry of Labour and Social Affairs. These chapters are however only providers of institutional support. The gross budgeted expenditure on RDI was approved by law in 2019 was CZK 35.965 billion, with the Office of the Government'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 66 million. The chapters for the Academy of Sciences, Czech Science Foundation, and Technology Agency include in their expenditures costs for activities, while several other budget chapters register funds for organising public competitions and evaluation of projects and expenditures for in-kind or financial rewarding of

[6] Government Order No. 759 of 20 July 2020 approved the National Policy on Research, Dvelopment and Innovation of the Czech Republic 2021+.

exceptional results, with these "operating" costs totalling CZK 2.175 billion in 2019 (i.e. 6.1%). All chapters aside from the Office of the Government primarily include funding intended for distribution to individual entities carrying out RDI. In 2019 these funds were budgeted at CZK 33.724 billion.

Diagram 2.1: Creation of the draft State Budget Expenditure on RDI for 2019 (in CZK millions): chapter responsibilities, role of central authority and financial flows (without European financial resources and their co-financing from the state budget)



1.

Government presents RDI budget to MF	MF	Financial resources from 2019 budget (35,965)
CABINET		Source materials for the year's budget and two-year outlook

2.

Pursuant to the provisions 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)

3.

PRIME MINISTER	RDIC	Working meetings with chapter representatives
		Recommendations, proposals and comments on the amount of RDI expenditure

MEYS

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

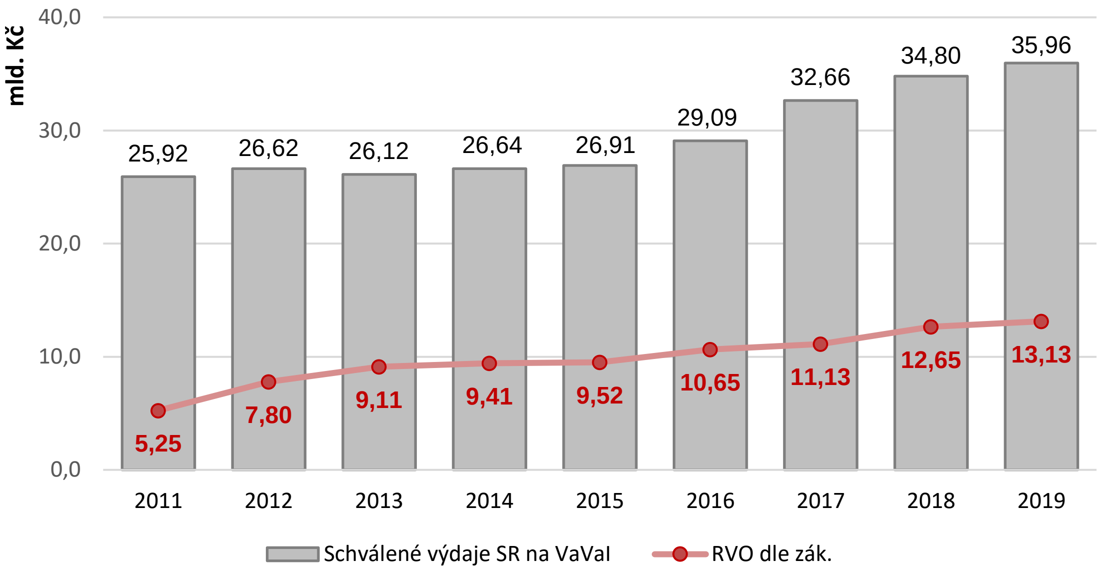
* R&D entities, research infrastructure, direct users of research and development results

4.

Department providers of RDI support	Solely institutional support
OG CR (66)	MT (50)
MEYS (14,614)	ME (258)
CAS (6,022)	MoLSA (80)
CSF (4,391)	MFA (25)
TA CR (4,174)	
MIT (2,050)	REALISATION SPHERE*
MH (1,552)	
MA (983)	
MC (487)	
MD (414)	
MI (799)	

With Act No. 336/2018 Coll., on the State Budget of the Czech Republic for 2019, a year-on-year increase in the RDI budget was once again achieved, despite the fact that the RDI Council took into account the unused claims for individual providers in creating the draft RDI budget. The total budgeted expenditure for 2019 grew by CZK 1.17 billion, i.e. 3.4%, to CZK 35.96. The development of the gross expenditures based on the state budget acts is provided in Figure 2.1.

Figure 2.1: Development of the total budgeted state budget expenditures on RDI (in CZK bn)



CZK bn

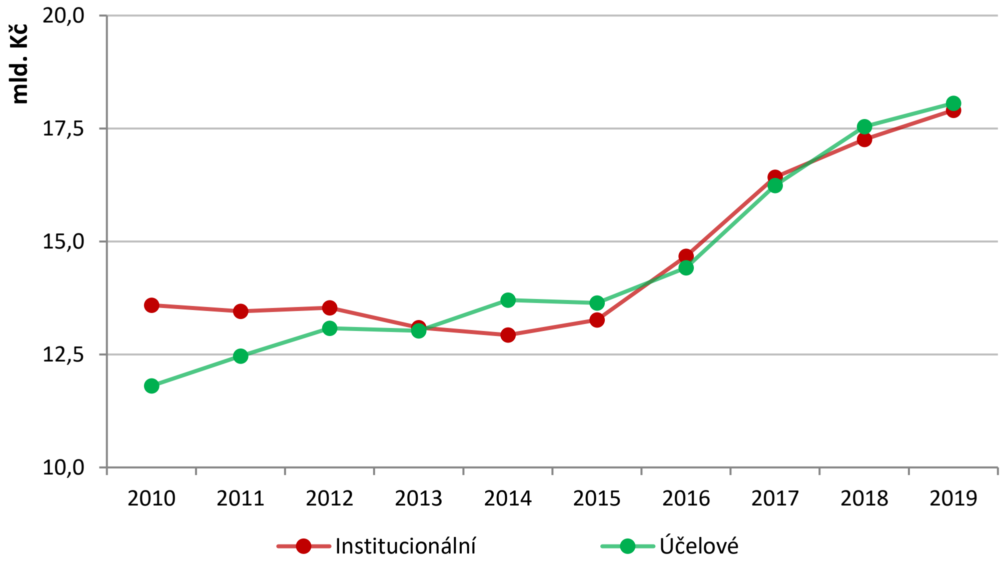
Approved state budget RDI expenditures

Research organisation development under the law

Source: state budget acts from the respective years

For institutional expenditures, there was an increase of CZK 0.62 billion (i.e. 3.8%) and for targeted expenditures 0.52 billion (i.e. 3.0%). The development of budgeted institutional and targeted expenditures from the state budget is depicted in Figure 2.2.

Figure 2.2: Development of budgeted institutional and targeted expenditures from the state RDI budget (in CZK bn)



CZK bn
institutional *targeted*

Source: state budget acts from the respective years

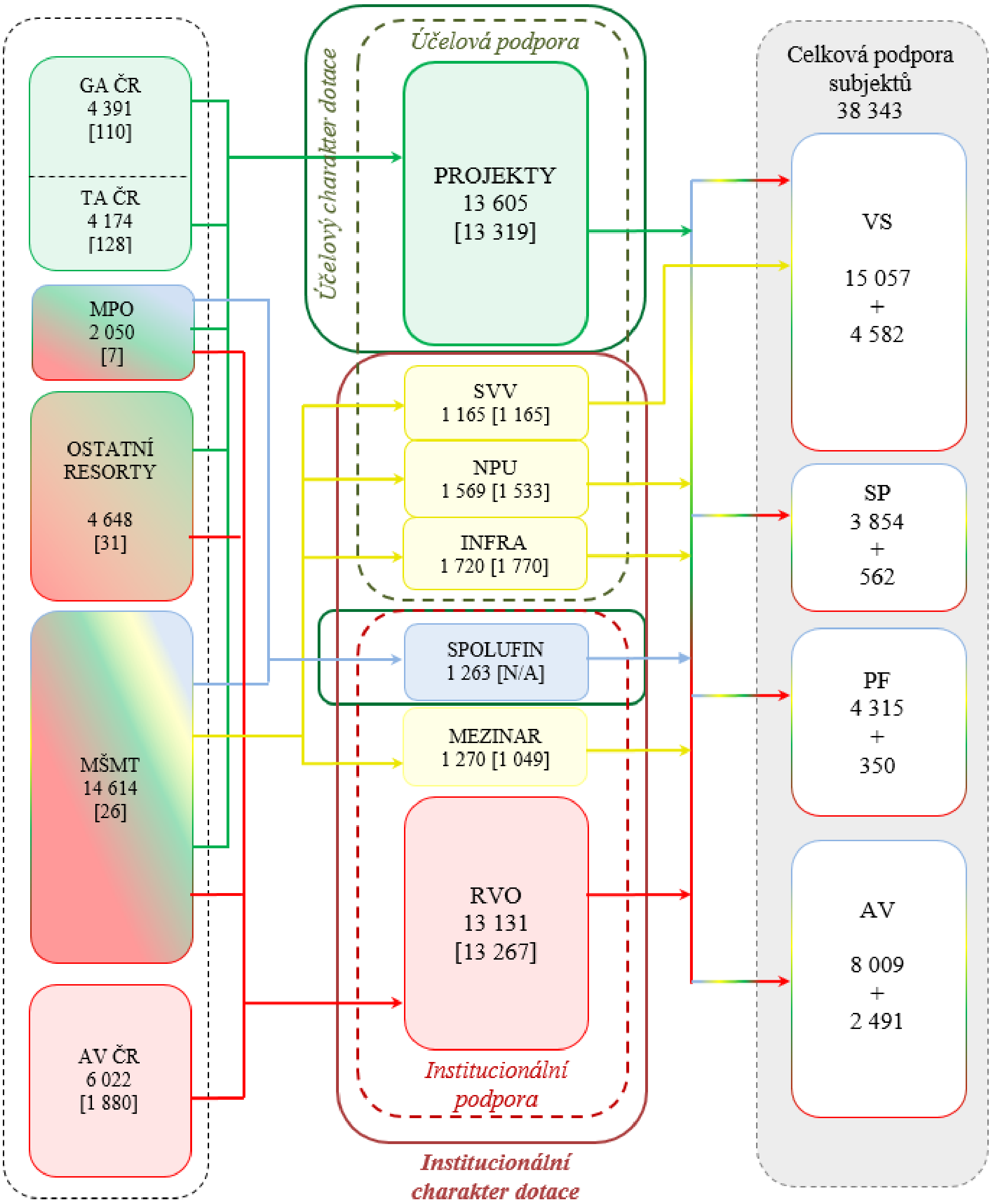
The MEYS, as the central administrative authority responsible for R&D under the competent law as the provider of by far the highest proportion of RDI support from public funds (approx. 41% of the support from the state budget) and as the managing authority of the OP RDE – the programme with the highest 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. Starting in 2019, this sustainability support is gradually being shifted to the items of support for Research Organisation Development (ROD) of the respective authorities. In the case of ROD support for research organisations whose superior authority was not a provider of RDI support, after 2017 the situation was sorted out, with the competency for allocating ROD shifting in most cases back to their founders, and thus in reality in 2019 the MEYS only funded one extra-ministerial research organisation, the founder of which is the State Administration of Land Surveying and Cadastre. The Ministry of the Interior 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 and State Office for Nuclear Safety.

2.2 Categories of R&D Support in the Czech Republic and Structure of Providers and Beneficiaries

In 2019, state budget 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 Act No. 130/2002 Coll., 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 state budget (COFIN) 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 Act No. 130/2002 Coll., on Support for Research, Experimental Development and Innovation. This is support for major infrastructure (INFRA), international cooperation of the Czech Republic in research and development executed under international contracts (INTERNAT) and support for specific university research (SUR). The National Sustainability Programmes I and II (NSP) have particular significance, being targeted support programmes within the meaning of Act No. 130/2002 Coll., on Support for Research, Experimental Development and Innovation, but being meant 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 significantly differs from other programmes.

Diagram 2.2: Method of funding research and development from the state budget and volume of funds spent in 2019 (CZK million)

Provider	Support category	Entity performing RDI
Budgeted expenditure 35,899 of that operating costs, project evaluation, etc. [2,175]	Budgeted expenditure 33,724 Total support drawn [32,104]	Support drawn 31,235 + OP & COFIN 7,985



CSF 4,333	*Targeted support* *Targeted nature of subsidy*	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]	CAS 7,408 + 1,967
CAS 5,685	COFIN 1,181 [N/A]	
	INTERNAT 1,286 [1,151]	
	ROD 12,645 [12,668]	
	Institutional support	
	Institutional nature of subsidy	

CAS *– public research institutes established by the CAS 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 CAS and public 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;* ***COFIN*** *– co-financing of OPs;* ***INTERNAT*** *– international cooperation;* ***ROD*** *– long-term conceptual development of research organisations*

Diagram 2.2 shows that individual groups of beneficiaries can make use of all categories of support from the state budget 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, it is highly complicated to prevent duplications and multiplications in financing. 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.

Act No. 130/2002 Coll., Support for Research, Development and Innovation 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 NSP under institutional support, as these categories have a similar effect as ROD, i.e. supporting the stability and development of the research base. [7] In contrast, the category COFIN and in part also INTERNAT have more of a targeted character, because they are co-financed projects selected on the basis of competition. Generally projects have specific objectives, usually field-specific and pre-defined in strategic documents at the national or ministerial level[8] (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 2019. It shows the distribution of expenditures into individual budget chapters in the amount approved by Act No. 336/2018 Coll., on the State Budget of the Czech Republic for 2019 (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, broken down by CAS, HE, SB and LN. The state budget funds actually drawn by RDI entities in 2019[9] differ in total from the funds drawn for individual categories of support, with this difference totalling around CZK 869 billion. This difference arises after deducting the category INTERNAT in the right column, as over CZK 850 million was paid out directly to international organisations, plus another over CZK 28 million from the PROJECTS category was paid out to foreign entities (ZAHR). It is problematic to divide funds drawn in the case of operational programmes (OP RDE and OP EIC) into the EU part and the state budget part (COFIN), as in the data on record in the RDI IS the drawn aid is reported together, thus in the right column it is added to the drawn support for the category OP and COFIN. 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.

Specific volumes of institutional and targeted support within the meaning of the Act No. 130/2002 Coll., on Support for Research, Development and Innovation drawn in 2019 by individual groups of beneficiaries are presented in Figure 2.3. If we leave out the category OP + COFIN, the targeted component of support forms a predominant share of the overall support for nearly all

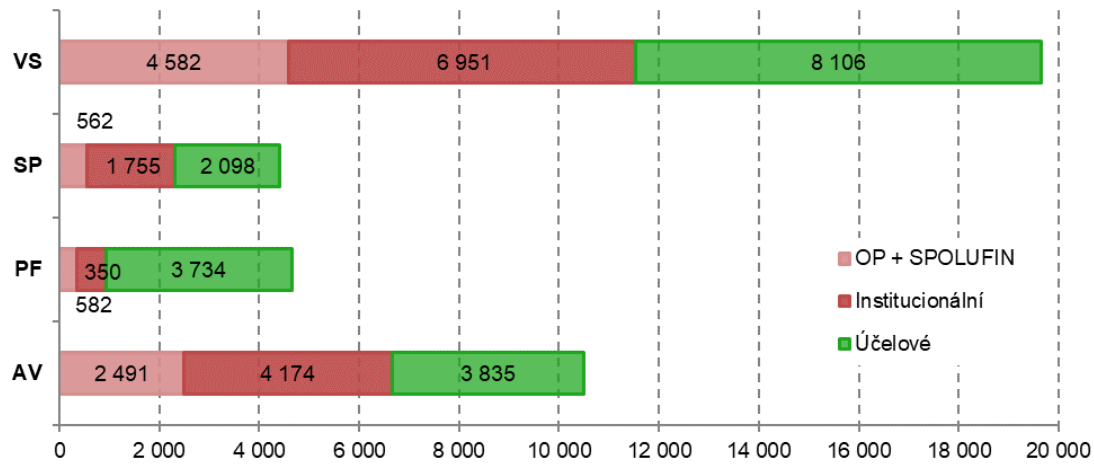
[7] The research base means human resources in RDI and research infrastructure within the meaning of Communication from the Commission 214/C 198/01 – Framework for State Aid for Research, Development and Innovation that are concentrated in organisations conducting research, development, innovation and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

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

[9] Based on data from RDI IS exported 1 September 2020.

groups of beneficiaries, aside from CAS institutes. In the case of businesses this fundamental predominance (87%) can be considered desirable, but for public entities it indicates an increased risk of year-on-year instability in financing. For universities the share of targeted funding was 35% in 2019 and the share of targeted funding in the category OP + COFIN was 23%. For state budgetary organisations these shares were 48% and 13%. In the case of CAS institutes, the share of drawn institutional support (without OP + COFIN) was 52% in 2019. 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 2.3: Volume of state budget funds and parts of other funds drawn by groups of beneficiaries in 2019 (CZK million)



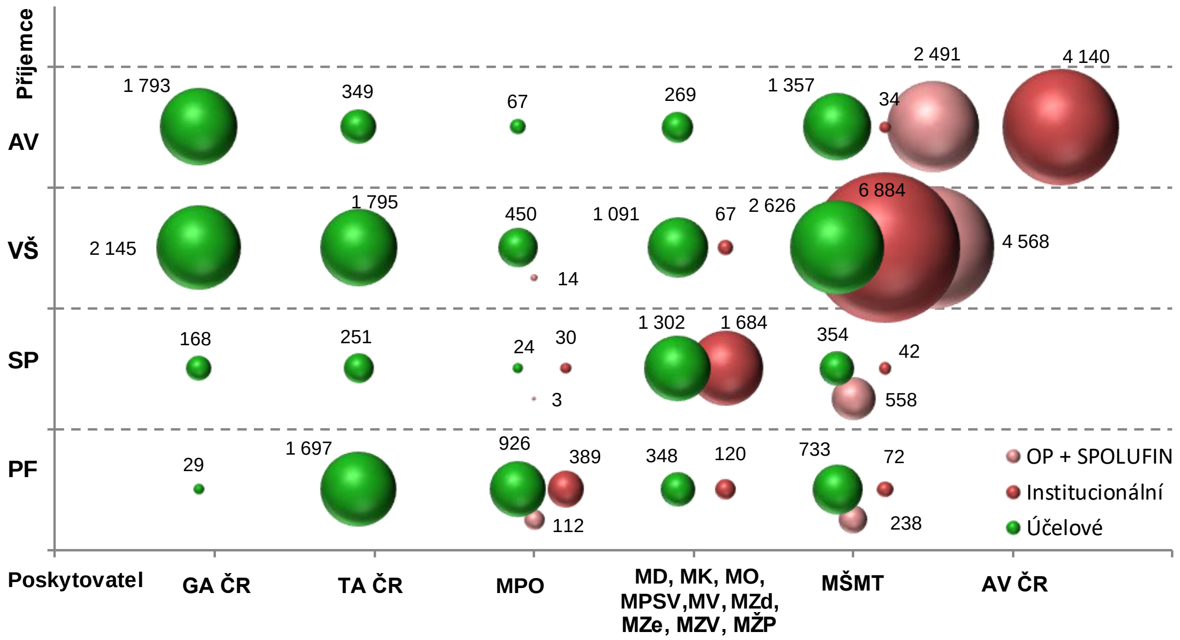
HE
SB
LN
AS

OP + SPOLUFUN
Institutional
Targeted

Source: RDI IS, export 1 September 2020 | 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 CAS 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 CAS and public 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 state budget and part of OPs in 2019 can be seen in Figure 2.4.

Figure 2.4: Distribution of funds from state budget and parts of other funds drawn by groups of beneficiaries in 2019 by individual provider (CZK million)



Beneficiary
AS
HE
SB
LN

OP + COFIN
Institutional
Targeted

Provider *CSF* *TA CR* *MIT* *MT, MC, MD, MoLSA, MI, MH, MA, MFA, ME* *MEYS* *CAS*

Source: RDI IS, export 1 September 2020 | 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 + COFIN. The highest amount from this category was drawn by universities (CZK 4.6 billion), followed by institutes of the CAS (CZK 2.5 billion). Targeted funds are obtained by all groups of beneficiaries from all providers with the exception of funds from the CAS, as it provides institutional support to its own institutes exclusively,[10] with this totalling CZK 4.1 billion in 2019. CSF funds are primarily utilised by universities (CZK 2 billion) and CAS institutes (CZK 1.8 billion). Support from the TA CR should go primarily to businesses (CZK 1.7 billion), but to a significant extent it also went to universities (CZK 1.8 billion). The MIT supports primarily businesses, both with targeted support (CZK 0.9 billion) and institutionally via ROD (CZK 0.3 billion). Nevertheless a significant amount of MIT targeted support once again goes into universities (CZK 0.4 billion). The MEYS, which is the largest provider in terms of volume of funds

[10] Aside from ROD, the budget chapter for the CAS also includes operating costs – in 2019 this was CZK 1.880 billion.

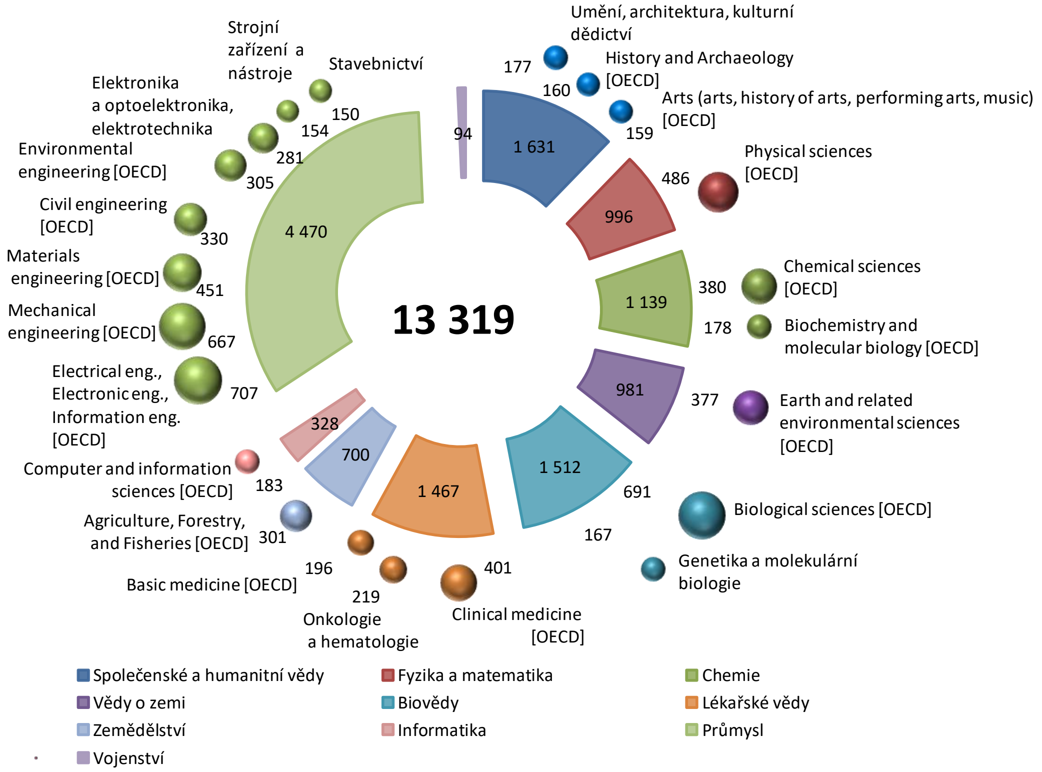
distributed, distributes institutional support primarily to universities (CZK 6.9 billion, not including COFIN). MEYS targeted funds are utilised most by universities (CZK 2.7 billion), at just under half that CAS institutes (CZK 1.4 billion), and also by businesses (CZK 0.7 billion). Other ministries, i.e. the MT, MC, MD, MoLSA, MI, MA, MH, MFA and ME, are focused primarily on those entities they have established (the group SB). They support them both institutionally (CZK 1.7 billion) and with targeted aid (CZK 1.3 billion), with the MT, MoLSA, MFA and ME providing only support for ROD and targeted support from the remaining other ministries also being utilised with success by universities (CZK 1.1 billion) and businesses (CZK 0.7 billion). The low financial share of CAS 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; currently data for newly launched projects is 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 Methodology for the Evaluation of Research Organisations and Programmes of Targeted Support for Research, Development and Innovation (2017+ Methodology), which was approved by Government Resolution No. 107 of 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 2.5 shows the targeted support drawn in 2019 broken down by field groups. Only funds for programme and grant projects are included (a total of 27 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 2.5: Targeted support for projects from the state budget to groups of fields and individual fields in 2019 (CZK million)



Art, architecture, cultural heritage
…
Genetics and molecular biology
…
Oncology and haematology
…
Electronics, optoelectronics, electrical eng.
Machinery and tools
Construction

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

Source: RDI IS, export 1 September 2020 | Only fields whose support exceeded CZK 150 mil. in 2019 are included.

The targeted support for projects (CZK 13.3 billion) 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 and gradual shift to the new code list still being fine-tuned and the focus of certain programmes on support for horizontal activities. It is also evident from the example of the high level of support drawn in the field Art, Architecture and Cultural Heritage that certain fields are preferred within the field groups 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 4.5 billion) followed by Social Sciences and Humanities (CZK 1.6 billion), Life Sciences (CZK 1.5 billion) and Medical Sciences (CZK 1.5 billion). Financial support reaching over CZK 1 billion was also reported by the group Chemistry.

The distribution of funds for programme and grant projects to field groups by provider is depicted in Figure 2.7. The group of fields Industry 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 CSF chapter. Aside from the MC, Social Sciences and Humanities are also supported significantly by the CSF and TA CR. Focusing the most on Life Sciences, Chemistry and Physic and Mathematics is grant support under the CSF. 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 state budget expenditures on RDI can be streamlined.

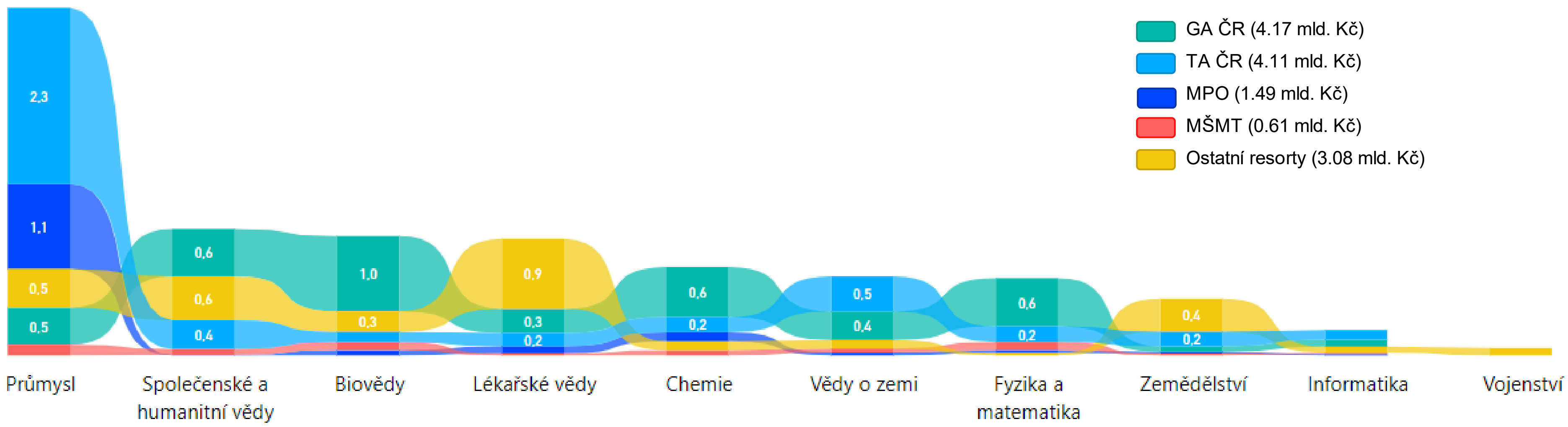
For an international comparison of the distribution of R&D expenditures by field, data was obtained from the OECD database from 2017. These data unfortunately do not contain information on the source of R&D expenditures, thus it cannot be directly determined what part is solely public aid, and thus targeted support for projects from the state budget as per Figure 2.6. 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 observe 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 in this field ranged between 15–45%. 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 field Natural Sciences. The share of R&D expenditures in the public sector focused on the field of Medical and Health Sciences reached 11% in the Czech Republic, which is considerably lower in comparison to Denmark or the Netherlands. 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 7.6), in both cases the fields Natural Sciences and Engineering and Technology 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 number of results in WoS published in Q1 and Q2 journals (see Figure 7.10); in comparison the field Humanities sticks out, which is due to the specifics of the field and the publication habits in our country in general.

Figure 2.6: Indicative international comparison of R&D expenditures by sector and scientific field (2017)

SECTOR: GOVERD and HERD
SECTOR: BERD

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

Figure 2.7: Targeted support for projects from the state budget for groups of fields in 2019 by provider (in CZK billions)



CSF (CZK 4.17 bn) TA CR (CZK 4.11 bn) MIT (CZK 1.49 bn) MEYS (CZK 0.61 bn) Other ministries (CZK 3.08 bn)

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

Source: RDI IS, export 1 September 2020

Table 2.1: RDI programmes and groups of grant projects funded from the state budget in 2019 (in CZK mil.)

Provider	Programme ID a name		YEAR		Budget support for 2019 under Act No. 336/2018	Data submitted to RDI IS			
						Support allocated in 2019		Support drawn in 2019	
			Start	End		State budget aid	Total costs	State budget aid	Total costs
CSF	GA	Standard projects	1993	-	3,007.2	3,324.9	3,547.8	3,247.4	3,484.4
	GC	International projects	2007	-	89.1	97.6	105.6	95.7	104.0
	GF	International grant projects evaluated on principle of LEAD Agency	2015	2022	73.0	36.1	38.2	34.3	36.5
	GJ	Junior grants	2015	2022	600.0	447.6	450.3	426.6	429.5
	GH	Support for international cooperation in obtaining ERC grants	1998	-	10.0	0.0	0.0	0.0	0.0
	GX	Grant projects for excellence in basic research EXPRO	2019	2030	501.8	346.3	359.3	331.2	344.9
MC	DG	Programme for supporting applied research and experimental development of national and cultural identity for 2016–2022 (NAKI II)	2016	2022	387.6	501.8	503.4	497.2	498.9
MD	OW	Development of the armed forces of the Czech Republic	2015	2022	308.4	352.7	352.7	351.2	351.2
MIT	FV	TRIO	2016	2022	1,607.1	1,525.1	2,183.6	1,468.0	2,174.9
MEYS	LL	ERC CZ	2012	2026	26.7	27.8	27.8	27.8	27.8
	LT	INTER-EXCELLENCE	2016	2024	760.0	576.8	694.8	573.6	694.7
MI	VI	Czech security research 2015–2022	2015	2022	461.7	484.3	524.7	470.5	517.8
	VH	Security research programme for the needs of the state 2016–2021	2016	2021	100.0	158.0	158.0	144.9	149.0
	VJ	Strategic support for development of Czech security research 2019–2025 IMPAKT	2019	2025	91.0	0.0	0.0	0.0	0.0
MH	NV	Programme for supporting applied medical research and development for 2015–2022	2015	2022	1,050.0	1,091.3	1,108.9	1,067.5	1,085.6
MA	QK	Ministry of Agriculture applied research programme for 2017–2025, ZEMĚ	2017	2025	486.2	488.3	501.8	487.7	501.2
TA CR	TE	Competence Centres	2012	2019	722.0	746.1	1,096.3	761.8	1,117.2
	TN	National Competence Centres	2018	2026	230.0	668.8	859.9	553.9	720.1

Provider	Programme ID	a name	YEAR Start	YEAR End	Budget support for 2019 under Act No. 336/2018	Data submitted to RDI IS: Support allocated in 2019 – State budget aid	Support allocated in 2019 – Total costs	Support drawn in 2019 – State budget aid	Support drawn in 2019 – Total costs
	TF	Applied research and experimental development support programme DELTA	2014	2021	200.0	103.5	145.7	103.5	147.5
	TG	Applied research, experimental development and innovation programme GAMA	2014	2019	84.0	106.7	111.0	107.2	111.5
	TP	Applied research, experimental development and innovation programme GAMA 2	2020	2022	57.0	0.0	0.0	0.0	0.0
	TH	Applied research and experimental development programme EPSILON	2015	2025	1,540.1	1,540.2	2,570.6	1,501.0	2,518.5
	TI	Programme of public contracts in research, experimental development and innovation for public administration BETA2	2017	2024	357.5	101.1	101.1	101.1	101.1
	TJ	Programme for supporting applied research ZETA	2017	2025	120.0	326.4	398.9	316.2	385.0
	TK	Programme for supporting applied research, experimental development and innovation THETA	2018	2025	360.0	325.6	449.0	309.7	428.0
	TL	Programme for supporting applied social science and humanities research, experimental development and innovation ETA	2017	2023	357.0	351.6	426.6	341.2	415.5
	TO	Programme for supporting applied research, experimental development and innovation KAPPA	2019	2024	18.0	0.0	0.0	0.0	0.0
Total					**13,605.4**	**13,728.5**	**16,716.0**	**13,319.4**	**16,344.9**

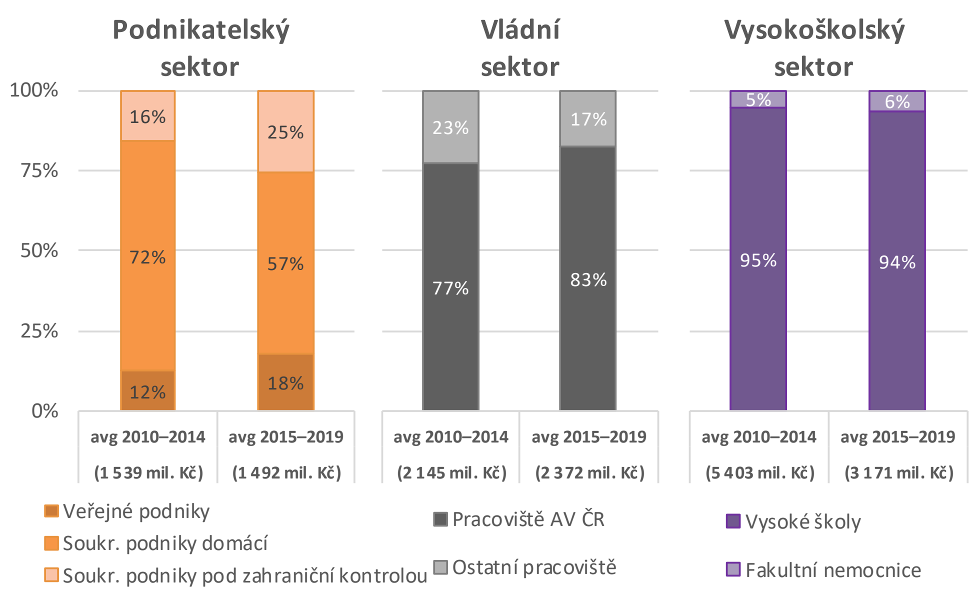
Source: RDI IS, export 1 September 2020; proposals for programmes and groups of grant projects approved by the government
The table does not include Major Infrastructure Projects for RVI (programme code LM), the National Sustainability Programme I (programme code LO) and National Sustainability Programme 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

EU structural funds, through individual operational programmes, are one of the key foreign public resources behind financial support for activities related to R&D. From the perspective of Czech research and development, the most significant are above all the Operational Programme Enterprise and Innovation for Competitiveness and Operational Programme Research, Development and Education, as well as in part Operational Programme Prague – Growth Pole of the Czech Republic (for more detail see Diagram 3.1). Further public foreign resources include other aid from the EU budget (this primarily regards framework programmes – currently Horizon 2020) and resources from international, government and public organisations outside the EU (e.g. CERN, ILL, ESA, NATO, OECD, UN, WHO, Norway/EEA etc.).

The development of foreign public resources in the period between 2010–2019 was described in detail in Chapter 1. Figure 3.1 captures what organisations in the Czech Republic drew foreign public resources to finance their research activities. The most successful sector in drawing foreign public resources was the higher education sector, in particular universities, followed by CAS institutes and private enterprises. According to the IS data, public RDI support totalling CZK 7.99 billion was drawn from OP EIC and OP RDE in 2019. This amount includes both the amount from the EU and the amount from the state budget (OP + COFIN), see Chapter 2 for more. According to the available data, institutions of higher education obtained 57% of the CZK 9.4 billion from OP EIC and OP RDE (OP + COFIN) in 2019, and CAS institutes 32%.

Figure: 3.1: R&D expenditures from foreign sources by type of beneficiary 2010–2019



Business sector *Government sector* *Higher education sector*

Public enterprises
Domestic private enterprises
Private enterprises under foreign control

CAS institutes
Other workplaces

Universities
University hospitals

Source: CZSO, own compilation

3.1 Framework of Research, Development and Innovation Support from the ESIF in the Czech Republic

EU funds comprise a whole range of financial aid instruments. Their focus is primarily to support the economic growth of EU countries in connection with reducing social and economic inequality between individual EU Member States and regions (the cohesion policy). In the current 2014–2020 programming period, the European Structural and Investment Funds (ESIF) are made up of five funds – the Cohesion Fund (CF; EUR 6.25 for the Czech Republic), European Regional Development Fund (ERDF; EUR 11.94 billion for the Czech Republic), European Maritime and Fisheries Fund (EMFF; EUR 0.03 billion for the Czech Republic), European Social Fund (ESF; EUR 3.43 billion for the Czech Republic) and the European Agricultural Fund for Rural Development (EAFRD; EUR 2.36 billion for the Czech Republic). These funds (with a total of EUR 23.9 billion earmarked for the Czech Republic in the 2014–2020 programming period) represent a source of programme funding intended for the Czech Republic.

In general the goal of the regional policy can be defined as supporting job creation, business competitiveness, economic growth, sustainable development and improving quality of life. In order to fulfil these goals and address the development needs of EU Member States or regions, EUR 351.8 billion was allocated for the cohesion policy for the 2014–2020 programming period (i.e. nearly one third of the total EU budget). After taking into account national contributions and potential other private investments, the expected impact of the cohesion policy for the given programming period is estimated at approximately EUR 450 billion. The distribution of funding among individual EU Member States is based on complex negotiations and analysis of the needs of individual states and regions with the goal of reducing differences among them. The conclusions of theses analyses for the Czech Republic are summarised in the Partnership Agreement document. Among other things, this sets out the Czech Republic's national development priorities, which subsequently had to be linked to the priorities of the whole EU, which are called thematic objectives. The EU has laid out 11 thematic objectives, with "operational programmes" serving to achieve them. One of the thematic objectives is investment in research, development and innovation, with EUR 2.5 billion from the ESIF earmarked for the Czech Republic for this objective (i.e. 10.5% of the overall ESIF amount for the Czech Republic).

As part of the introductory analysis of the Partnership Agreement, the following 6 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; insufficient utilisation of research and development results in agriculture.[11] ERDF funds totalling over EUR 2.4 billion 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.

OP RDE aims 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. OP RDE also helps fulfil one of the three priorities of Europe 2020: A Strategy for Smart, Sustainable and Inclusive Growth (Europe 2020 Strategy), "Smart Growth". The aim is to boost the focus of research on societal challenges laid down by the National Priorities for Oriented Research, Experimental Development and innovation (Priorities 2030) and RIS 3 and market needs. The managing authority is the MEYS. **OP EIC** is focused above all on increasing the innovation performance of businesses, utilising the results of industrial research and experimental development and developing enterprise and the competitiveness of SMEs. The managing authority is the MIT. The aim of **OP PGP** is to ensure effective realisation of investments in Prague that will lead to increase 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.

EU Member States are obliged to report regularly to the European Commission over the course of the programming period on the contribution of ESIF funds to carrying out the objectives laid down in the Partnership Agreement. The indicative document for assessment in this Analysis of the Monitored Period is the "Annual Report on Implementation of the Partnership Agreement for 2019" drawn up by the MRD – National Coordination Authority. In terms of research, technological development and innovation, it states primarily the following. In the field of **quality of research and results thereof in practice**, the OP RDE strives for international quality and openness of research (SO 1.1). To date, 174 projects have been supported with a volume of nearly CZK 19.9 billion, with 7 996 scholarly publications should be produced with international co-authorship and 57 research infrastructures and excellence centres should be built, expanded or modernised. In

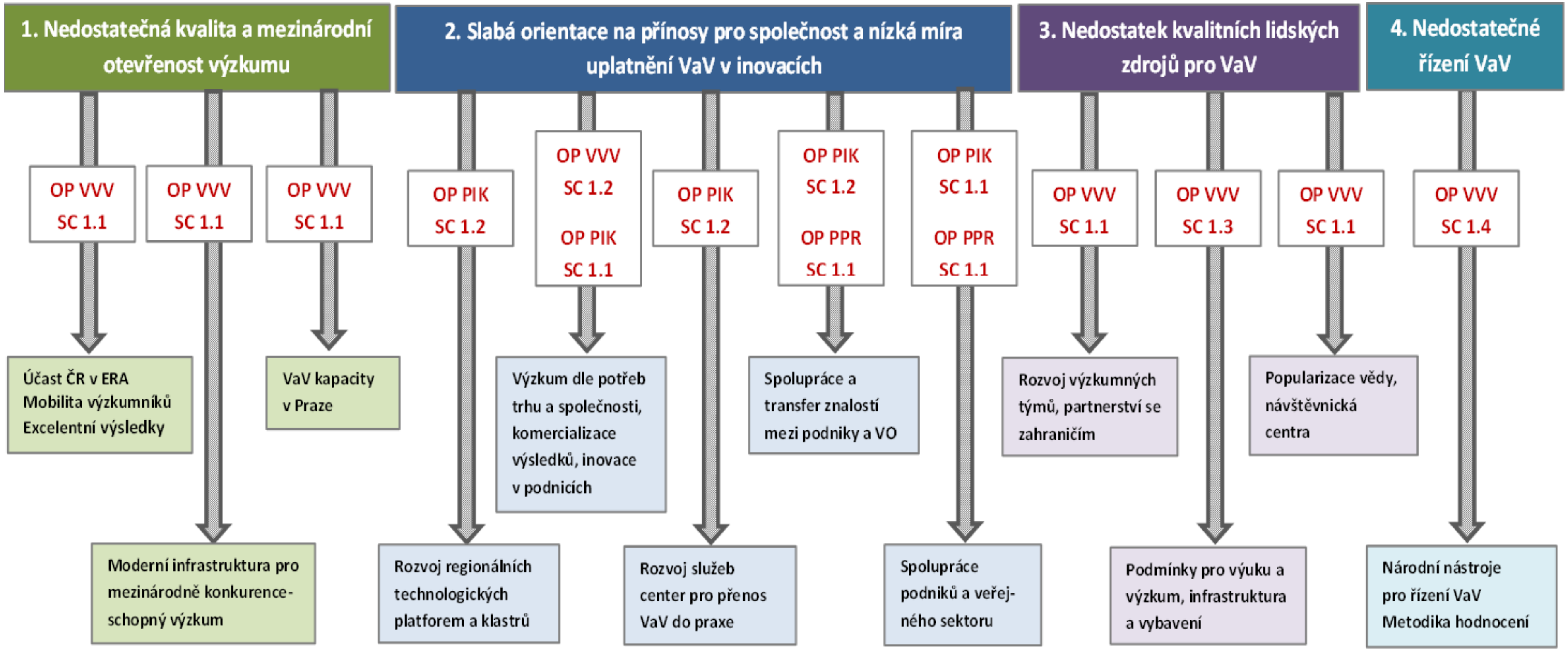
[11] Partnership Agreement in 2014 – 2020 planning period.

[12] Thematic Objective 1 in the Czech Republic is also supported from the European Agricultural Fund for Rural Development (approx. EUR 86 million). Also processed in the Analysis are data relating to allocations under ERDF.

[13] Partnership Agreement in 2014 – 2020 planning period.

order to improve the quality of infrastructure for research education purposes (SO 1.3), 60 projects were supported for CZK 1.7 billion. 114 infrastructures for research-focused study programmes were built, expanded or modernised. With the goal of improving strategic management of research (SO 1.4), the National Technical Library's project of building a National Centre for Electronic Information Sources was supported. Despite the CZK 0.7 billion increase in the financial allocation in 2019, OP RDE already had 100% of the total allocation for thematic objective 1 committed at the end of 2019. In order to boost **cooperation between research organisations and the application sector**, 82 projects were supported under OP RDE (SO 1.2) for CZK 4.1 billion. The number of international patent applications reached 574. Under OP EIC (SO 1.2), 1 114 projects were supported for CZK 2.4 billion. Almost the whole allocation for supporting technology transfer from OP PGP (SO 1.1) is committed in the territory of Prague. Support continued to be provided in the successful Potential, Application and Innovation subsidy programmes under OP EIC (SO 1.1) with the aim of **business innovation performance**. In total 1 855 projects were supported for CZK 21.6 billion. Subsidy support also continued for expanding innovation infrastructure within Prague (SO 1.2 of OP PGP). Investments in innovation, consulting and cooperation between research and agricultural enterprises are what are primarily utilised for **better use of R&D results in the field of agriculture**.

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 researchers Excellent		R&D capacities in Prague		Research by needs of market and society, commercialisation of results, innovation in		Cooperation and knowledge transfer between businesses		Developing research teams, international partnerships		Popularisation of science, visitors' centres	

results				businesses		and RO					
	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 and 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 intersector cooperation stimulated by regional government*
		SC 1.2: Easier creation and development of knowledge-intensive companies

Source: Partnership Agreement; MRD, 2017 (own compiling)

3.2 HORIZON 2020 Framework Programme

A pivotal instrument for funding RDI at the EU level is what are called the framework programmes. For the programming period 2014–2020, this is Horizon 2020 (H2020) with a financial allocation of EUR 77.028 billion. H2020 is supplemented by the European Atomic Energy Community's Research and Training Programme for 2014–2018 (financial allocation of EUR 1.603 billion). H2020 focuses particularly 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.

H2020 is comprised of three main pillars (excellent science, industrial leadership, societal challenges), as well as "horizontal areas" (spreading excellence and widening participation, science with and for society). The budget of the individual pillars and the horizontal areas are listed in Table 3.1. Converting to CZK at a rate of EUR 1 = CZK 26.5, the H2020 budget is CZK 2.041 trillion and the EURATOM budget CZK 42 billion.

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**	
Marie Skłodowska-Curie Event	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**	

	Abbrev.	% of total budget	EUR mil.	CZK mil.*
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**	
Direction actions of the Joint Research Centre		**34.90**	**560**	
EURATOM 2014–2018		**100.00**	**1,603**	**42,480**

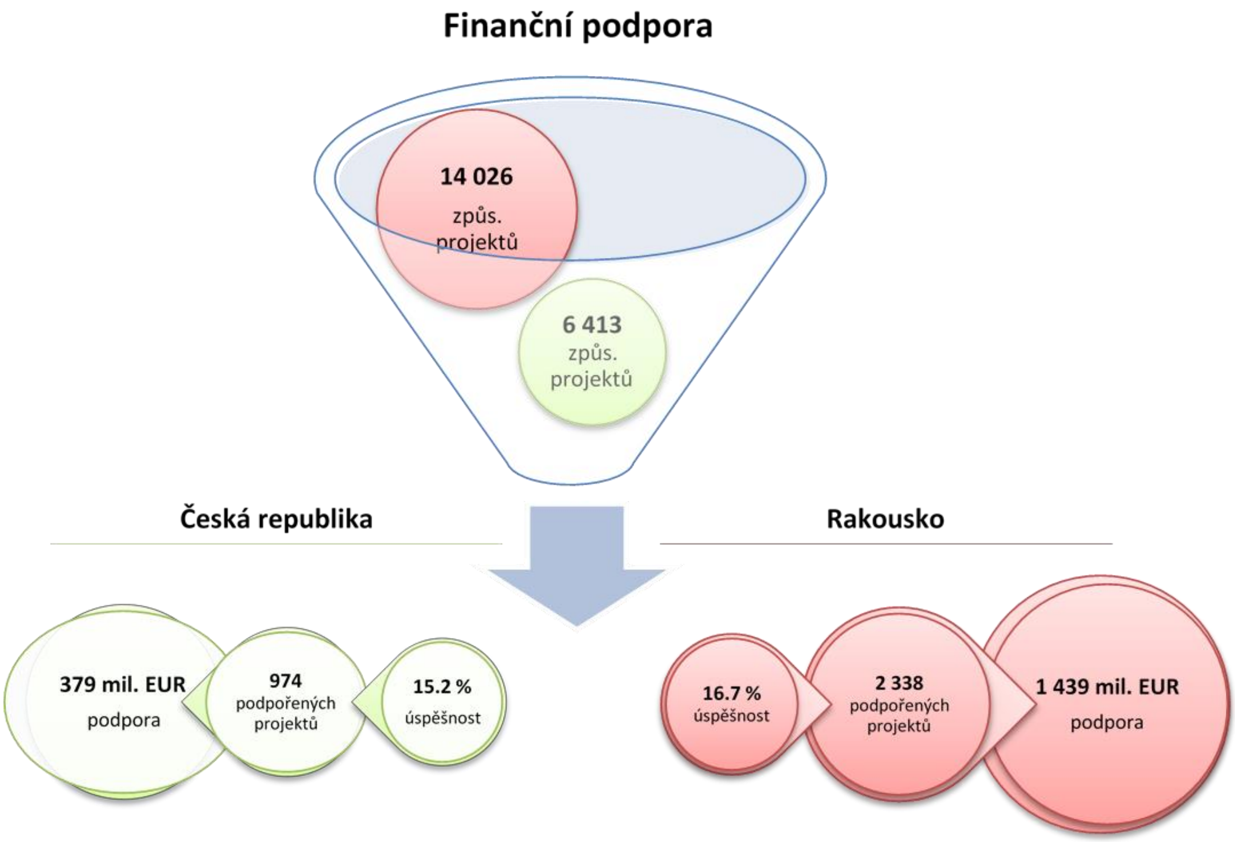
**converted at approximate rate of EUR 1 = CZK 26.50*
Source: European Commission, TC CAS

ANALYSIS OF PROJECT AND FINANCIAL SUCCESS RATE OF THE CZECH REPUBLIC UNDER H2020[14]

The following Figure 3.2 captures the project and financial success rate of H2020 project proposals, comparing the Czech Republic and Austria. Austria was chosen because it seems to be a suitable benchmark for comparing the position of the Czech Republic and the country's potential direction in terms of participating in the H2020 programme so that it can become a country with growing competitiveness.

[14] This analysis was conducted on the basis of data provided by the TC CAS, with the TC CAS evaluation report serving as a second starting point.

Figure 3.2: Project and financial success rate of proposed H2020 projects, comparison of Czech Republic and Austria



Financial Support
eligible projects
Czech Republic Austria

EUR 379 mil. support
974 supported projects
15.2% success rate

16.7% success rate
2,338 supported projects
EUR 1.439 billion support

Source: TC AS ČR, data extracted from E-CORDA database as of 12 March 2020

Both the Czech Republic and Austria have a higher project success rate than the average for all participating countries. The Czech Republic has a project success rate of 15.2% and Austria 16.7%. However, the Czech Republic only submits 45% of the project proposals that Austria does. This is naturally reflected in the number of projects supported and consequently also the volume of funding allocated. The Czech Republic only attains 26% of the amount of financial support allocated to Austria. Converted into CZK (EUR 1 =

CZK 26.5), Austria received a financial allocation of CZK 38.1 billion and the Czech Republic CZK 10.0 billion.

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 they are taking part in (i.e. since 1999, with the first framework programme having been launched in 1984). Our low participation in the framework programme is caused by low involvement in preparing project proposals, which is not the result of low quality of Czech research teams and workplaces, but in that their capacities are likely focused on other activities (e.g. researching projects funded from the ESIF or the state budget). 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.

Outside the framework of the period in question for this Analysis, we can state that as of June 2020 the e-CORDA database contained a total of 29 729 projects with a signed grant agreement that had obtained financial support from H2020. EUR 66.1 billion has been budgeted for these projects and they require EUR 54.2 billion in support from H2020. The Czech Republic is involved in 1 031 projects, in which 1 297 teams from 361 institutions are working. The budget of the given projects with Czech participation amounts to EUR 459.6 million and the requested support from H2020 is EUR 387.3 million (for more see TC CAS).

Figure 3.3 compares the success rate of the Czech Republic, Austria and the average of all participating countries (ALL)[15] by individual H2020 pillars and priority areas. In each graph, the left vertical axis displays the aid in millions of EUR and the right axis shows the project success rate in a percentage. The most significant thematic areas in terms of volume of financial support are under the pillars Excellent Science, Industrial Leadership and Societal Challenges. Under these three pillars the Czech Republic shows a higher project success rate only in four thematic areas – INFRA, ICT, ADVMANU, FOOD (in the thematic area SPACE the Czech Republic and Austria have the same project success rate).

In the thematic area INFRA under Excellent Science, the Czech Republic reports a projects success rate of 55%, while Austria has a mere 37% (i.e. the same as the average project success rate for participating countries). In an absolute expression of the financial aid received however, Austria reaches an amount of EUR 29.54 million and the Czech Republic only EUR 19.97, despite its higher success rate. In the thematic areas ERC and MSCA, the Czech Republic attains a below-average project success rate. Participation in ERC projects is generally considered an indicator of the quality of scientific institutions, or even an

[15] Access 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.

important indicator of national research as a whole, and for this reason Chapter 3.2.1 is dedicated to this priority area.

In the pillar Industrial Leadership, the thematic area most financially significant for the Czech Republic is ICT, in which it reaches a project success rate that is higher (17%) than that of Austria (16%) as well as than the average project success rate of participating countries (9%). Under this pillar the Czech Republic lags most markedly behind Austria in terms of project success in the thematic areas NMP (Czech Republic 4%, Austria 19%) and RISKFINANCE (Czech Republic 0%, Austria 14%). The Czech Republic submitted 4 projects to the area Access to Risk Finance (RISKFINANCE) – support for emerging enterprises at all phases of their development through debt and equity financing, but none of them were supported. A weak spot of the Czech RDI system is insufficient investment of risk capital into innovative enterprise, which is evidenced by the values of the SII composite indicator (see Chapter 8 for more). Success in this area could also be important in the future from the perspective of meeting the goals of the 2019+ innovation Strategy.

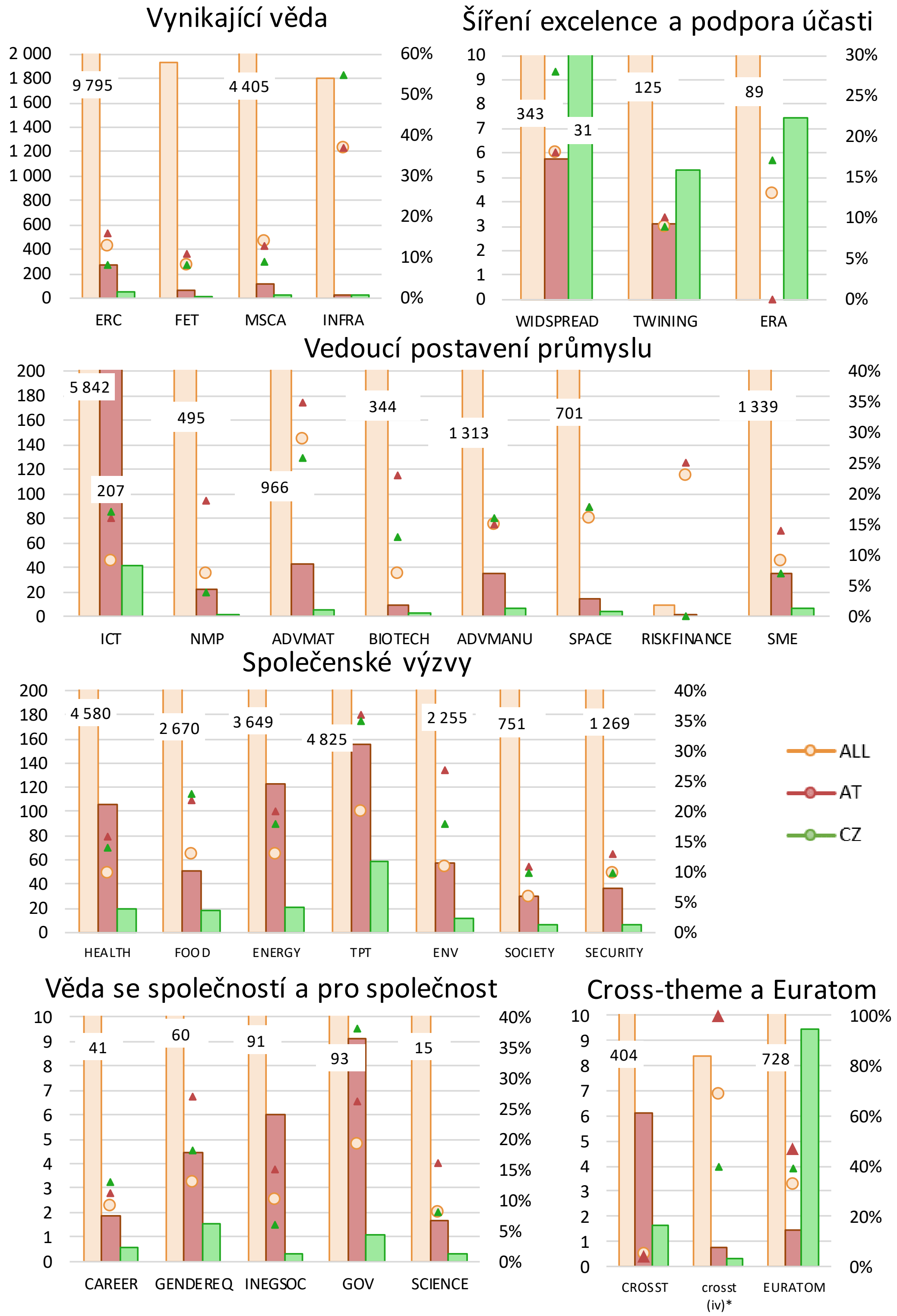
Under the pillar Societal Challenges, the Czech Republic achieves a higher project success rate than the average of participating countries in the listed thematic areas (only in SECURITY does the Czech Republic have the same success rate as the average of participating countries). Aside from the thematic area FOOD, Austria achieves a higher project success rate than the Czech Republic, though the success rate in the thematic areas under Societal Challenges is very close for the Czech Republic and Austria. The greatest different between the two is in the thematic area ENV (Czech Republic 18%, Austria 27%).

Of the other H2020 horizontal activities, the Czech Republic was successful in the area EURATOM (2014–2018). In this area, 39% of the 101 submitted Czech project proposals were supported. The financial allocation for the supported projects was EUR 9.47 million. Austria only submitted 17 project proposals in this area, of which 8 were supported with a total budget of EUR 1.45 million. Another positive fact is that together the participating countries submitted a total of 196 project proposals (of those 101 Czech) and 65 projects were supported (with the Czech Republic accounting for 39 of those), meaning 60% of the supporting projects under EURATOM are Czech projects.

In the area Spreading Excellence and Widening Participation, the Czech Republic managed to achieve a 17% project success rate and acquired financial support of EUR 7.5 million under the ERA thematic area, 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).

In the area Science with and for Society, the Czech Republic lags considerably behind the project success rate of Austria, except for the thematic areas CAREER and GOV. In terms of financial allocations, the Czech Republic always receives lower values than Austria.

Figure 3.3: Project and financial success rate of the Czech Republic in the H2020 programme bypillar in international comparison (EUR million)



Excellent Science — Spreading Excellence and Widening Participation

Industrial Leadership

Societal Challenges

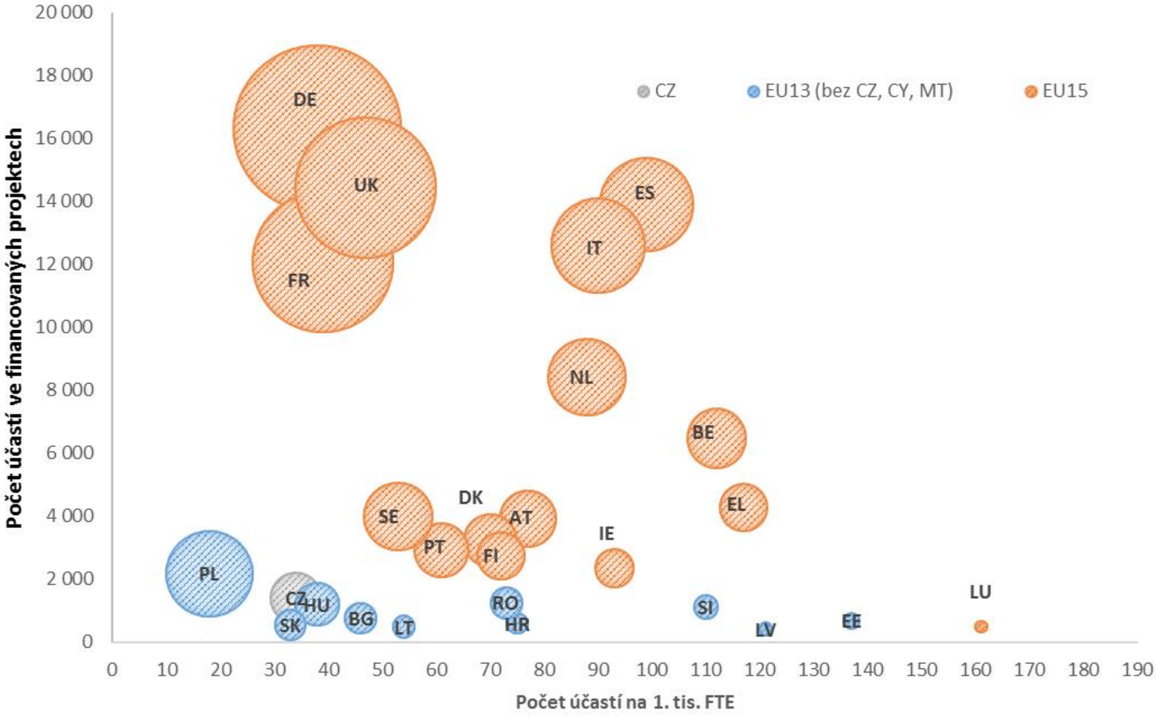
Science with and for Society — Cross-theme and Euratom

Source: TC CAS, data extracted from E-CORDA database as of 12 March 2020 | Left vertical axis: financial support in EUR millions, right vertical axis: project success rate in %; crosst (iv) Spreading excellence and* *widening participation – crosst. Not shown 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; the cross-theme (ii) Industrial Leadership – crosst is also not shown, as the Czech Republic had a zero success rate therein.*

According to the analytic studies of the European Commission and the TC CAS, the Czech Republic still numbers among the EU Member States with the lowest participation in the framework programme.

Per 1 000 researchers (FTE), there are only 34 participations in H2020 projects in the Czech Republic, which attests to the country's insufficient representation in H2020 projects. The Czech Republic thus lags significantly behind countries with a similar research capacity (such as for example Austria, Finland, Denmark, Portugal), as well as most EU-13 countries. The given situation is evident from Figure 3.4, where the vertical axis shows the number of participations in financed projects and the horizontal axis the number of participations per 1 000 scientific and academic employees (FTE), with the size of the circle depending on the number of researchers. The low participation of Czech scientists is reflected in the permanently low values of many indicators assessing our activity in projects supported under H2020. 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 1000 FTE

Source: H2020 Dashboard (as of 24 October 2020), EUROSTAT, processed by TC CAS
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 in the given EU state (FTE). The size of the circle corresponds to the number of researchers in the state. The graph does not show the small European countries of CY and MT, whose R&D systems have a specific structure.

Above and beyond the period in question for this Analysis, the Czech Republic has achieved relatively good success rates despite the very low activity of researchers in H2020. The participatory success rate as of June 2020 had reached 16.29%, which is the highest rate among the EU-13. The Czech Republic thus has the highest success rate among EU-7 states and exceeds most of the EU-15 states (including Sweden, Finland, the UK and others). On the other hand, as stated above, the Czech Republic's activity in H2020 from the perspective of participation in projects per 1 000 FTE is one of the lowest in the EU (25th place) and among the EU-13 (12th place).

EUROPEAN RESEARCH COUNCIL (ERC)

In 2007, the European Commission established the European Research Council (ERC) as part of the EU's Seventh Framework Programme for Research (FP7, 2007–2013) as the first European organisation for supporting cutting-edge research in all fields, what is termed frontier research. The ERC's mission is to encourage the highest quality research in Europe and support it in all scientific fields. The ERC manages the financing of projects that have the ambition of standing out in the given field and influencing it, expanding the existing expertise and opening up completely new avenues of research on a global scale. The ERC was established above all to boost the excellence, dynamic and creativity of European research. This strengthening and shaping of the European research team is carried out through high quality evaluation, establishing international benchmarks for success and providing current information on successful applicants. The most important goal of the ERC is to prepare the European research base to be able to react to the needs of a knowledge-based society and provide Europe with the possibilities necessary to address global challenges.

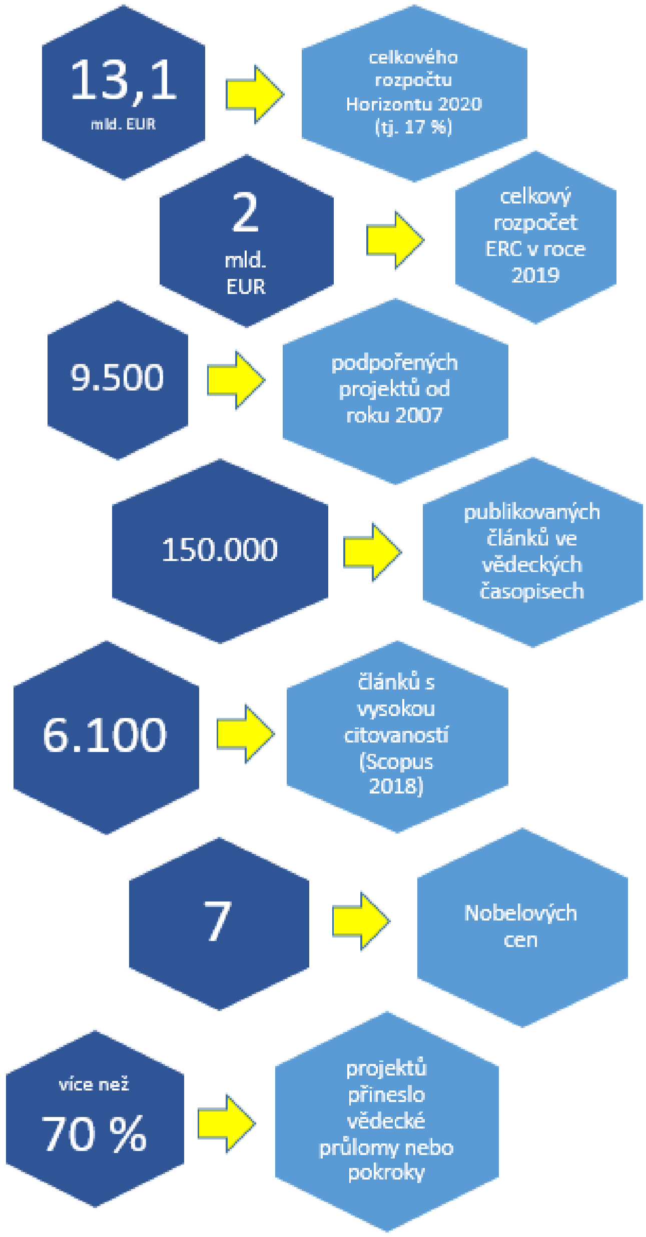
The ERC is part of the first pillar "Excellent Science" of the Horizon 2020 programme. ERC financial support is based on a "bottom-up" approach, which allows researchers identify new opportunities and directions in all areas of research. This directs funding into new promising areas of research with a greater level of flexibility that can form the foundation for new industries, markets and broader social innovations of the future.

ERC grants are awarded in open competition to projects led by individual early-career and established researchers (Principal Investigator, PI) and their research teams, regardless of their origin. The PI must choose a host institution in an EU Member State for realising their research plan, or in an H2020 associated country. ERC grants are tied to the person of the Principal Investigator, who can change the host institution over the course of the project. The ERC represents 17% of the Horizon 2020 budget, i.e. EUR 13.1 billion (2014–2020).

Every recipient of an ERC grant employs an average of six team members, thereby helping to train a new generation of excellent researchers. Currently there are over 70 000 post-doctoral and doctoral students and other employees working on their research teams. More than 70% of projects assessed by an independent study led to scientific breakthroughs or major advances, while around 25% made incremental contributions (newest studies).[16]

[16] European Research Council [online]. European Commission [accessed 2 September 2020]. Available at: https://erc.europa.eu/news/impact-erc-funded-research-confirmed-independent-study

Diagram 3.2: Important facts on ERC grants



EUR 13.1 bn	*total Horizon 2020 budget (i.e. 17%)*
EUR 2 bn	*total ERC budget in 2019*
9,500	*projects supported since 2007*
150,000	*articles published in scientific journals*
6,100	*articles with high citation rates (Scopus 2018)*
7	*Nobel Prizes*
over 70%	*of projects made scientific breakthroughs or advances*

Source: own processing based on European Research Council [online]. European Commission [accessed 11 August 2020]. Available at: https://erc.europa.eu/projects-figures/facts-and-figures

Table 3.2: Funding from H2020 is currently divided into five types of ERC grant:

Type of ERC grant	Purpose of grant	Qualifications	Scientific results (corresponding to field and career level)	Max. amount of funding (mil. EUR)	Max. length of funding (in years)
Starting Grants	supporting the independent career of talented young scientists in the phase of creating their own research teams/programmes	first Ph.D. title 2 to 7 years ago as of 1 January of the year to which the current ERC work programme applies	at least 5 publications in major international peer-reviewed journals, invited lectures, etc.	1.5	5
Consolidator Grants	supporting the independent career of talented young scientists at the phase of consolidating their own independent research teams/programmes	first Ph.D. title 7 to 12 years ago as of 1 January of the year to which the current ERC work programme applies	at least 10 publications in major international peer-reviewed journals, invited lectures, academic awards, etc.	2	5
Advanced Grants	supporting internationally recognised experts who have a track-record in the field – exceptional leaders in research on a global scale	breakthrough, highly original scientific results in the last 10 years before the call is published	in the last 10 years before the call is published, these scientists must have demonstrably influenced the given field by achieving breakthrough, highly original results	2.5	5
Synergy Grants	for groups of 2–4 principal investigators and their teams addressing a joint project of cutting edge research; the potential and value arising from the synergy, complementary knowledge and resources of the investigators must be great enough that a breakthrough discovery is expected			10*	6
Proof of Concept	testing out the possibilities for commercial use of a research result realised as part of an ERC grant	for successful ERC grant investigators whose project is still underway or ended less than 12 months before the date the call is published	ERC grant investigator	0.15	1**

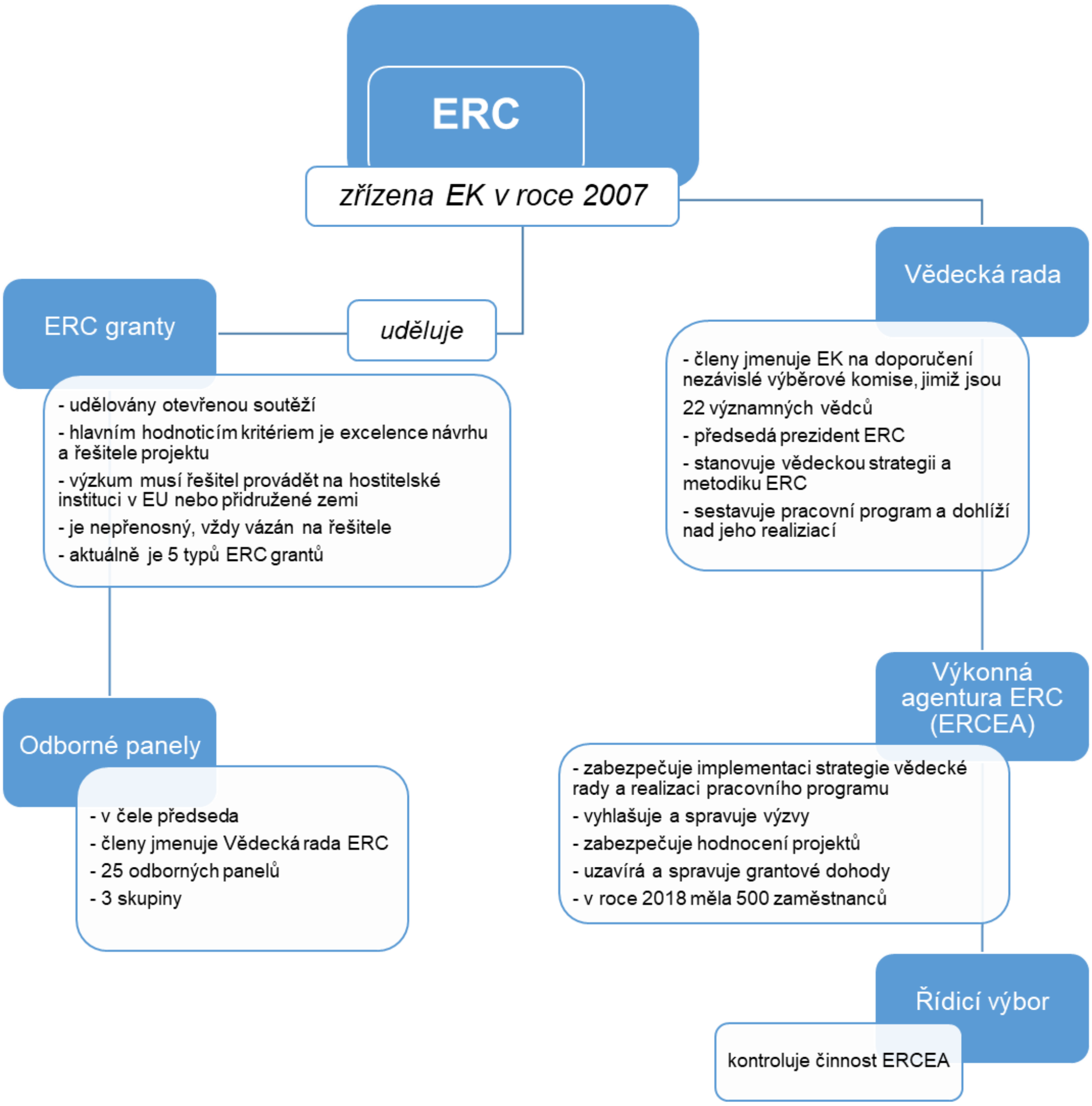
*Note.: * in exceptional cases up to EUR 14 mil; ** exceptionally up to 18 months*
Source: HORIZON 2020 [online]. Technology Centre of the CAS [accessed 6 August 2020]. Available at: https://www.h2020.cz/cs/vynikajici-veda/evropska-vyzkumna-rada-erc/informace

STRUCTURE OF ERC AND EVALUATION PANELS

The European Research Council published the structure of panels for evaluating ERC grants in the new Horizon Europe framework programme for the challenges of 2021 and 2022. Two new panels were added: PE11 (Materials Engineering) and SH7 (Human Mobility, Environment and Space). The structure of the panels is regularly revised for both scientific and practical reasons reflecting the number of project proposals received.

The main reasons for the revision were to renew the balance between modernisation and continuity, maximise the clarity for applicants, limit the number of new panels to what is absolutely necessary and ensuring their integrity and coherence. For grant applicants, the new panel structure will only have a positive impact and will not cause any change in the evaluation process. The main goal of this change is to make full use of the potential of applicants in all areas of science.

Diagram 3.3: ERC structure and activity



ERC	
established by the EC in 2007	
awards	Scientific Council
ERC grants	- members named by EC at recommendation of independent selection committee with 22 leading scientists as members - chaired by ERC President - sets out scientific strategy and ERC methodology - sets up work programme and watches over its realisation
- awarded through open competition - main evaluation criterion is excellence of proposal and project investigator - investigator must conduct research at host institution in EU or associated country - non-transferrable, always tied to investigator - currently 5 types of ERC grant	ERC Executive Agency (ERCEA)
Expert panels	- ensures implementation of Scientific Council strategy and implementation of work programme - announces and manages calls - provides for project evaluation - concludes and manages grant agreements - had 500 employees in 2018
- headed by a chair - members named by ERC Scientific Council - 25 panels - groups	Steering Committee
	supervises activity of ERCEA

FUNDING OF EXCELLENT SCIENTISTS AT THE NATIONAL LEVEL

The ERC CZ programme for the support of research, experimental development and innovation (ERC CZ), which was adopted and approved by Czech Government Resolution No. 885 of 7 December 2010 and is subject to Act No. 130/2002 Coll., on Support for Research, Experimental Development and Innovation, is focused on supporting projects of what is termed "frontier research" (i.e. projects that advance the frontiers of knowledge regardless of tradition divisions) by Czech and internationally recognised researchers, who have succeeded in submitting their highly promising and quality projects in both rounds of evaluation by international assessment panels but could not be financed due to a lack of international funding. According to Section 4 (1) b) of Act No. 130/2002 Coll., on Support for Research, Experimental Development and Innovation, the provider of targeted aid for investigation of ERC CZ programme projects is the **MEYS**. By Government Resolution No. 885 of 7 December 2010, ERC CZ was announced for the years 2012–2019 and subsequently extended **until 2026** by Government Resolution No. 293 of 29 April 2019. The maximum duration of ERC CZ projects assessed under Category A is 5 years and in Category B 2 years. A total of **CZK 1.1 billion has been allocated** in the ERC CZ programme budget, from which eight project proposals were supported in the 5th public competition with approved aid of CZK 276.9 million.[17]

Further funding allocated in the state budget for groups of grant projects as part of excellent research associated with the ERC is provided by the CSF in the form of targeted support. in 2016 the call **"Support for ERC Applicants"** was declared, the purpose of which is to help scientists gain experience and increase their success rate in obtaining funding from EU structures and strengthening excellence and **basic research in the Czech Republic**. The main evaluation criteria are scientific excellence, innovation and originality, the prior academic and publication activity of the applicant, and the applicant's professional qualifications to submit a project to one of the main ERC calls with a host organisation in the Czech Republic. Aid will be provided **for 3–6 months up until the year 2022** with allocated funding of **CZK 61.5 million.**

In 2019, the CSF announced the **"EXPRO"** call, the aim of which is to create conditions for the expansion of excellent research, establishing standards of excellent science, and also helping overcome barriers that reduce the success of ERC project proposals and thus facilitate the acquisition of the necessary knowledge and experience. Projects are support **for 5 years** and can cover all areas of **basic research**. The **basic condition** for successful fulfilment of the project is submitting a project proposal to one of the main ERC calls with a host organisation in the Czech Republic within one year of the project being completed. **CZK 13.5 million is allocated for the call.**

At the current time, Europe is facing many challenges to which it must react and adopt difficult decisions. It is essential to secure a proper balance between basic research led by an excellent researcher and more targeted research focused on a mission. Unfortunately, every year the ability to finance a significant number of truly excellent proposals is limited, which damages the potential of Europe to become a leading region in terms of transformation and innovation. Due to the current pandemic, the ERC Scientific Council had to deal with a significant reduction of the Horizon Europe budget. At this moment, **a mere EUR 86 billion is allocated** for the EU budget for research and development,[18] while just back in 2017 this amount was EUR 120 billion and in the following year of 2018 the budget fell to EUR 94 billion. If the current EU budget for research and development were to be approved, it would mean the first ever stagnation of the EU basic

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[17] MEYS [online]. MEYS [accessed 7 September 2020]. Available at: https://www.msmt.cz/vyzkum-a-vyvoj-2/erc-cz (available in Czech only)

[18] European Research Council [online]. European Commission [accessed 15 August 2020]. Available at: https://erc.europa.eu/news/erc-scientific-council-dismayed-european-council-president%E2%80%99s-budget-proposal

budget for research and development. In the coming years we will be faced with the task of not only securing sufficient funding for excellent scientists, but we will also have to rely on their commitment and ability to fight against the ongoing global pandemic and prepare to deal with unexpected future challenges.

PREPARED CALLS FOR ERC GRANTS[19]

The European Research Council made a **2021 preliminary calendar of calls** available for ERC grants under Horizon Europe. Horizon Europe should be launched 1 January 2021. Grant applicants should remember that the opening of calls will be subject to approval of the multiannual financial framework for 2021–2027. It is not anticipated that calls for ERC Synergy grants will be opened in 2021. Until the end of 2020, no new calls will be published under Horizon Europe.

Table 3.3: ERC calls – expected launch and completion

	Starting Grant	Consolidator Grant	Advanced Grant	Proof of Concept Grant
Call Opens	12. 1. 2021	21. 1. 2021	20. 5. 2021	14. 1. 2021
Submission deadline (cut-off dates for PoC)	09. 3. 2021	20. 4. 2021	31. 8. 2021	16. 3. 2021 17. 6. 2021 20. 10. 2021

Source: HORIZON 2020 [online]. Technological Centre CAS [accessed 9 July 2020]. https://www.h2020.cz/cs/vynikajici-veda/evropska-vyzkumna-rada-erc/informace/novinky/predbezny-kalendar-vyzev-2021-pro-granty-erc-v-horizontu-evropa?ProjNewsItem_page=3 (available in Czech only)

Calls for applications to ERC grants are announced every year. The project proposals can only be submitted electronically to open calls through the Participant Portal. Applicants log into the system via their existing personal account, their ECAS account (European Commission Authentication Service) or they create a new account. When submitting project proposals, it is necessary to proceed according to the current ERC Work Programme and especially according to the information for applicants, which is on the Participant Portal for every call and every type of ERC project.[20]

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[19] HORIZONT 2020 [online]. Technology Centre of the CAS [accessed 6 August 2020]. Available at: https://www.h2020.cz/cs/vynikajici-veda/evropska-vyzkumna-rada-erc/informace/novinky/predbezny-kalendar-vyzev-2021-pro-granty-erc-v-horizontu-evropa?ProjNewsItem_page=3 (available in Czech only)

[20] HORIZONT 2020 [online]. Technology Centre of the CAS [accessed 12 August 2020]. Available at: https://www.h2020.cz/cs/storage/5d89783d554b89ef79b63154496270303015e4df?uid=5d89783d554b89ef79b63154496270303015e4df (available in Czech only)

In order to help increase the success rate of Czech applicants for ERC grants, the TC CAS not only organises seminars, but also every year organises "mock interviews" for applicants for ERC Consolidation Grants who have advanced to the 2nd round of the given call.

UPCOMING CALLS FOR ERC GRANTS AT THE NATIONAL LEVEL

On 10 December 2019, the MEYS announced a further **continuation of the ERC CZ programme**, which is intended to support what is called frontier research. The main goal of the ERC CZ programme is to support excellent research within the Czech Republic, specifically by realising projects submitted to one of the European Research Council's calls that were included in the international peer review process carried out by the ERC's expert panels. The **5th public competition** is open to projects submitted in the ERC calls which received an A or B grade but were not financially supported from EU funds. Eight project proposals were submitted to the 5th public competition in research, experimental development and innovation in the ERC CZ programme before the deadline and all of them met the conditions for acceptance into the public competition. Charles University was successful with three grants for a total approved eligible costs of CZK 112 million. The University of Chemical Technology in Prague, Biology Centre of the CAS and Brno University of Technology obtained one grant each.[21]

In accordance with Section 21 (7) of Act No. 130/2002 Coll., on Support for Research, Experimental Development and Innovation, the Ministry of Education, Youth and Sport decided on the resulting ordering of project proposals admitted to the 5th public competition in research, experimental development and innovation in the ERC CZ programme and on the amount of support for realisation thereof. The MEYS decided in accordance with the recommendations of the advisory body.

ERC GRANTS FOCUSED ON COVID[22]

Research carried out by grant recipients for addressing the crisis caused by COVID-19 has a social, economic and also political significance. More than 50 projects supported by ERC grants contribute to various scientific perspectives to bring light to COVID-19 in several different fields: virology, epidemiology, immunology, paths for new diagnosis and treatment, public health, medical devices, artificial intelligence, social behaviour, crisis management. In

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[21] MEYS [online]. MEYS [accessed 13.8.2020]. Available at: https://www.msmt.cz/vyzkum-a-vyvoj-2/erc-cz (available in Czech only)

[22] HORIZON 2020 [online]. Technology Centre of the CAS [accessed 8 December 2020]. Available at: https://www.h2020.cz/cs/vynikajici-veda/evropska-vyzkumna-rada-erc/informace/novinky/granty-erc-pomahaji-v-boji-proti-koronaviru?ProjNewsItem_page=4 (available in Czech only)

reaction to the pandemic crisis, scientists carrying out ERC grants can thematically adapt their research project. The above shows that the European Union is striving to actively react to the current situation. EU Member State ministers responsible for research and innovation have adopted the first **"ERAvsCorona" Action Plan** consisting of 10 priorities,[23] which will lead to a coordinated approach. Some of them are listed here:

- coordination of R&D funding against coronavirus
- new funding for innovative and rapid health-related approaches to respond to coronavirus and deliver quick results relevant to society and a higher level of preparedness of health systems
- increasing support to innovative companies
- creating opportunities for other funding sources to contribute to R&D on coronavirus
- establishing a one-stop shop for coronavirus R&D funding
- establishing a high level R&D task force for coronavirus
- improving access to research infrastructures
- research data sharing platform

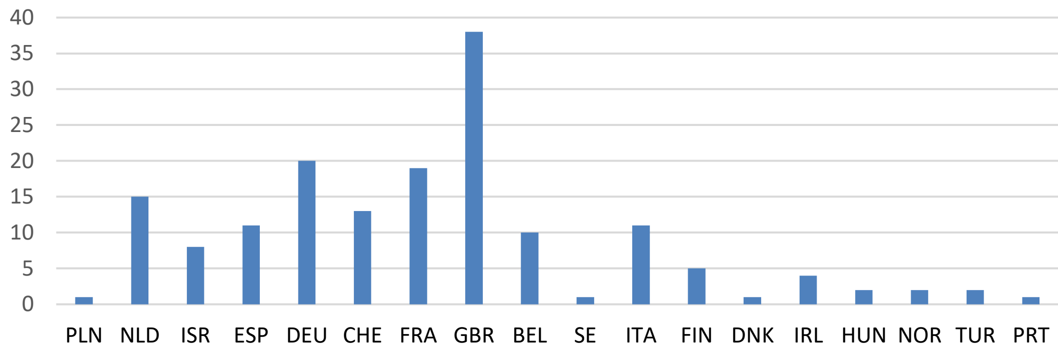
The whole scientific world has got involved in dealing with the crisis caused by COVID-19. Seventeen countries have joined the fight against COVID-19 as part of ERC grants,[24] with their research teams participating in carrying out 164 grants funded by the ERC in six different areas – Diagnostics and Treatments, Environmental Impacts, Medical Devices, Digital Tools, Social Behaviour and Crisis Impact and Management, and Structural and Molecular Mechanisms and Functions.

The most active countries in the fight against COVID-19 as part of ERC grants with 38 grants was the UK, which got involved in all six areas. Germany participated in five of the above areas with 20 grants and right behind them was France with 19 grants funded from the ERC.

[23] First "ERAvsCORONA" Action Plan [online]. European Union [accessed 18 August 2020]. Available at: https://www.h2020.cz/files/capkova/COVID-R-I-action-plan.pdf

[24] European Research Council [online]. European Commission [accessed 23 August 2020]. Available at: https://erc.europa.eu/list-erc-funded-research-projects-related-coronavirus

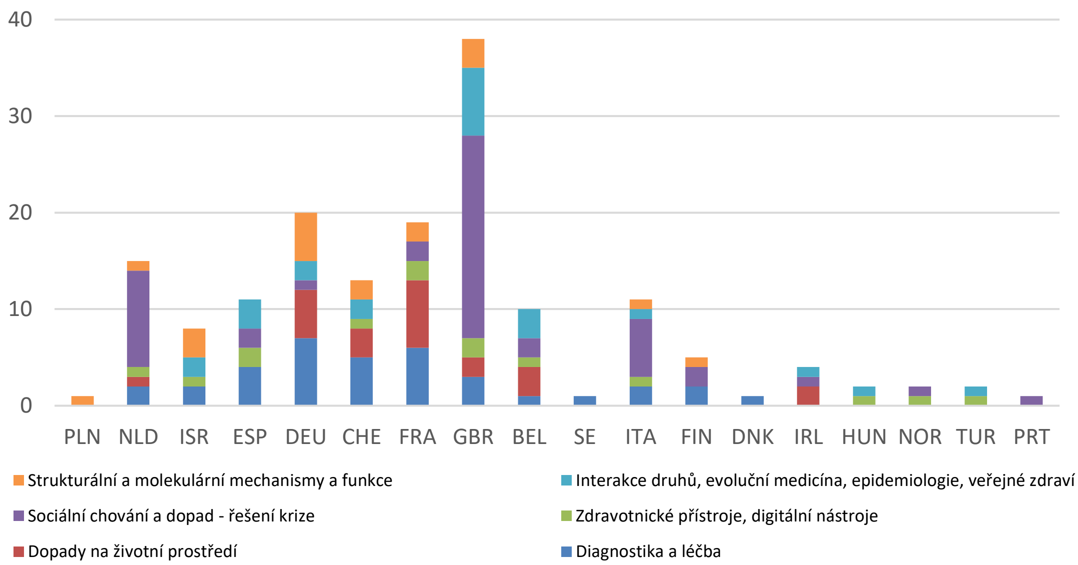
Figure 3.5: Number of ERC grants focused on COVID



Source: European Research Council [accessed 30 August 2020], available at: https://erc.europa.eu/list-erc-funded-research-projects-related-coronavirus

Investigators devoted the greatest attention to the area Social and economic behaviour, wellbeiing and crisis management with 49 grants and Diagnostics and treatments with a share of 36 of the grants funded from the ERC.

Figure 3.6: Number of ERC grants with a focus on COVID by area



Structural and Molecular Mechanisms and Functions	Species interactions, evolutionary medicine, epidemiology, public health
Social Behaviour and Crisis Impact and Management	Medical Devices, Digital Tools
Environmental Impacts	Diagnostics and Treatments

Source: European Research Council [accessed 30 August 2020], available at: https://erc.europa.eu/list-erc-funded-research-projects-related-coronavirus

A sample of grants that deal with the issue of COVID-19 have been chosen as a reference.[25] The grant "ReservoirDOCS" shows how viral evolutionary analysis can be useful for studying the origin of SARS-CoV-2. Other ERC grants "ANTIVIR", "REGMAMKID" and "Trep-AB" contribute to the characterisation, development or new use of antivirals and drugs against SARS-CoV-2. In the area of artificial intelligence, "EAR" recently launched a new COVID-19 Sounds App 5 for mobile phones, which collects data for the purpose of developing machine learning algorithms that could automatically detect whether a person is suffering from COVID-19 based on the sound of their voice, breathing and cough. In the realm of social sciences, the "HEY BABY" grant recently created six pages of "tips" that deal with individual positive guidance and praise, structures and procedures, prevention and reaction to behavioural problems, dealing with stress and talking about COVID-19. And then the "COMPROP" project depicts how to behave in order to prevent the spread of unreliable information on the COVID-19 pandemic.

Position of the Czech Republic within the EU

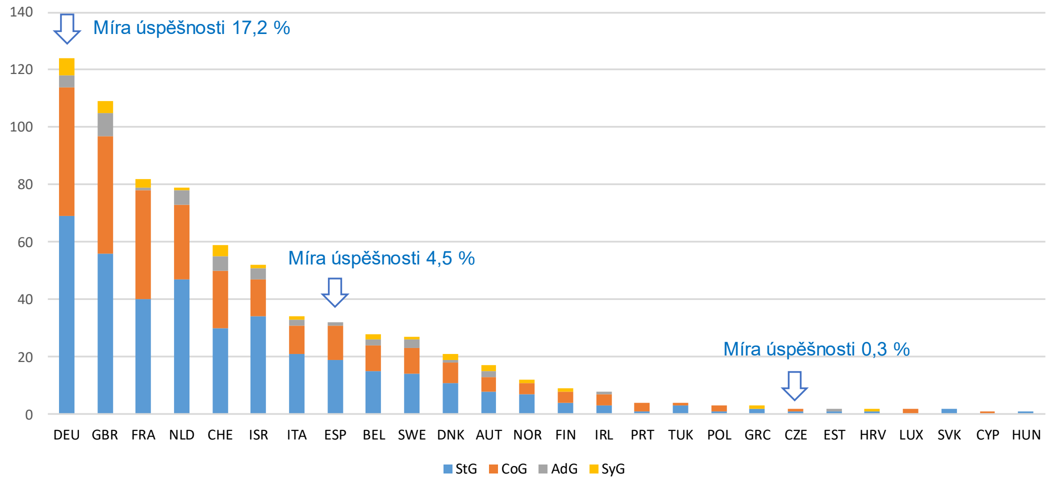
There are many excellent scientists and whole teams in the Czech Republic trying to establish themselves internationally in the field of science and research and bring interesting findings to the world. Despite this fact, however, the Czech Republic numbers among the countries that lag significantly behind in activity in ERC. The most successful country in obtaining ERC grants is Germany, which reaches a success rate of 17.2% with a total of 124 successfully obtained ERC grants. Close behind them is the UK, which has a 15.2% success rate with its 109 obtained ERC grants, followed by France and the Netherlands with a success rate of 11%. In 2019, the Czech Republic was only involved in two ERC grants, thus ranking among the countries with the lowest number of ERC grants approved for funding. Other (EU-13) Member States similar lag behind, such CASoatia, Hungary, Slovakia and Cyprus. The main cause of this is not the rate of success in obtaining ERC grants, but the number of applications submitted. The TC CAS organised a lecture for scientists in November of 2019 that aimed to dispel the concerns of the scientific public about the difficulty of the paperwork for obtaining a grant under ERC. This year the TC CAS once again organised a "National Information Day on European Research Council Grants" in cooperation with Charles University, which took place 23 September 2020.[26] The aim of the information

[25] HORIZON 2020 [online]. Technology Centre of the CAS [accessed 24 August 2020]. Available at: https://www.h2020.cz/files/capkova/ERC-COVID-response.pdf (available in Czech only)

[26] HORIZONT 2020 [online]. Technology Centre of the CAS [accessed 31 August 2020]. Available at: https://www.h2020.cz/cs/vynikajici-veda/evropska-vyzkumna-rada-erc/akce/narodni-informacni-den-o-grantech-erc-national-information-day-4 (available in Czech only)

day was to acquaint attendees with the ERC philosophy, provide them with information on the profile of competitive applicants, on the rules of participation, project proposal structure and the method of evaluation with a focus on 2021 calls.

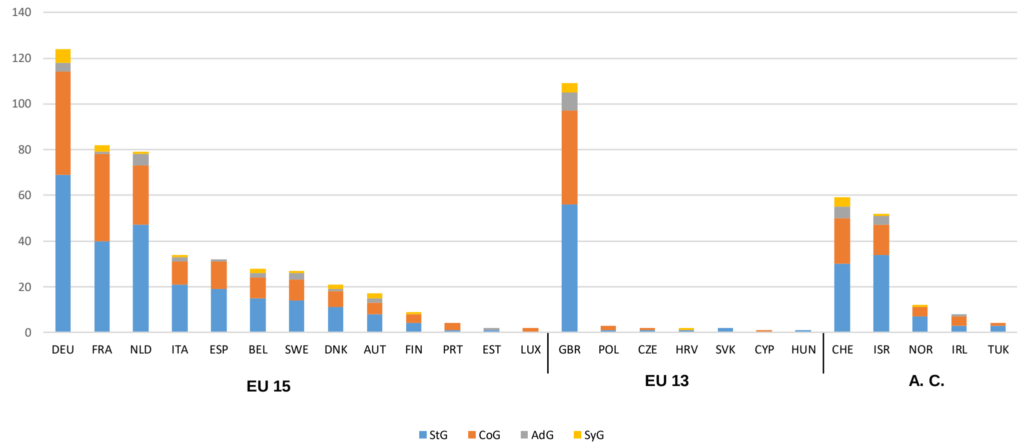
Figure 3.7: Number of ERC grants recommended for funding in 2019



Success rate

Source: European Research Council [accessed 30 August 2020], available at: https://erc.europa.eu/projects-figures/erc-funded-projects/

Figure 3.8: Number of ERC grants recommended for funding in 2019 (EU-15, EU-13 and A.C.)

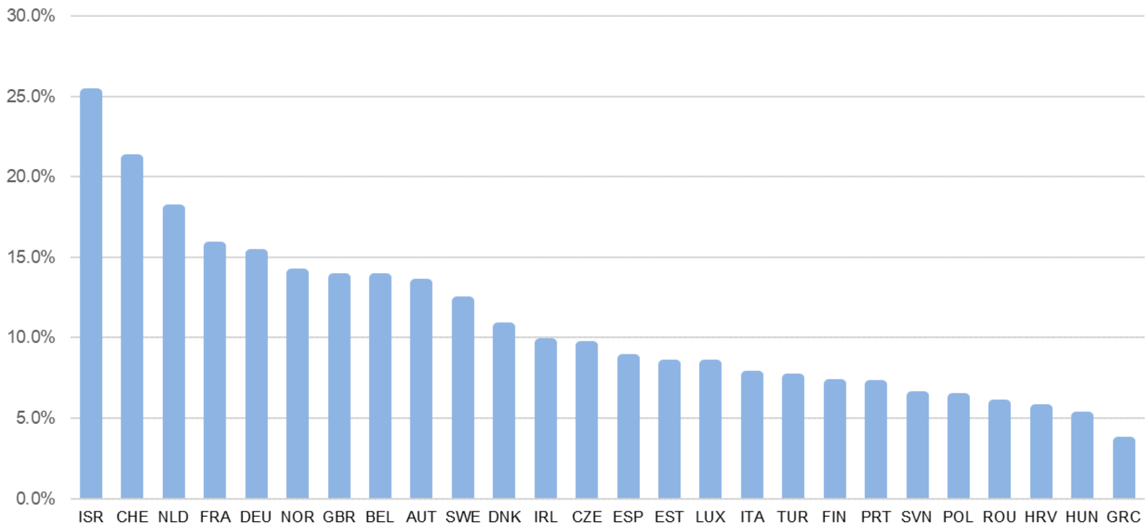


Source: European Research Council [accessed 30 August 2020], available at: https://erc.europa.eu/projects-figures/erc-funded-projects/

CZECH ACTIVITIES IN ERC GRANTS AND THEIR SUCCESS RATE

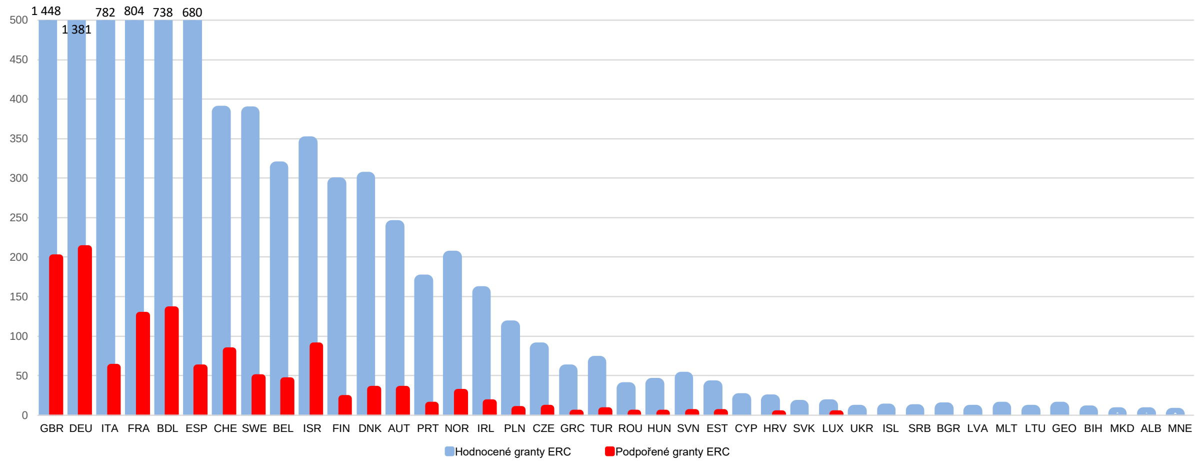
In the period 2015–2019, researchers from the Czech Republic submitted 84 ERC grants for evaluation under Starting Grants, of which only 8 succeeded, which is a success rate of 9.5%. Even this low rate of success is however above the average success rate for StG, which is 7%. The highest success rates belong to Israel (25.5%), Switzerland (21.1%), the Netherlands (18%), France (15.7%) and Germany (15.2%). The most projects were submitted for evaluation by the UK (1 448 projects), but their success rate only reached 13.7% (i.e. 199 grants accepted for funding). For the Czech Republic the year 2018 was extraordinarily successful out of the last five years, with 5 StG projects receiving a grant. In contrast, in 2019 the Czech Republic experienced a major drop, with researchers submitting 38 StG projects for assessment and receiving only one funding grant, i.e. a 2.6% success rate.

Figure 3.9: Starting Grant success rate (2015–2019)



Source: European Research Council [accessed 2 September 2020], available at: https://erc.europa.eu/projects-figures/statistics

Figure 3.10: Activity of ERC applicants and their success rate in Starting Grants (2015 – 2019)

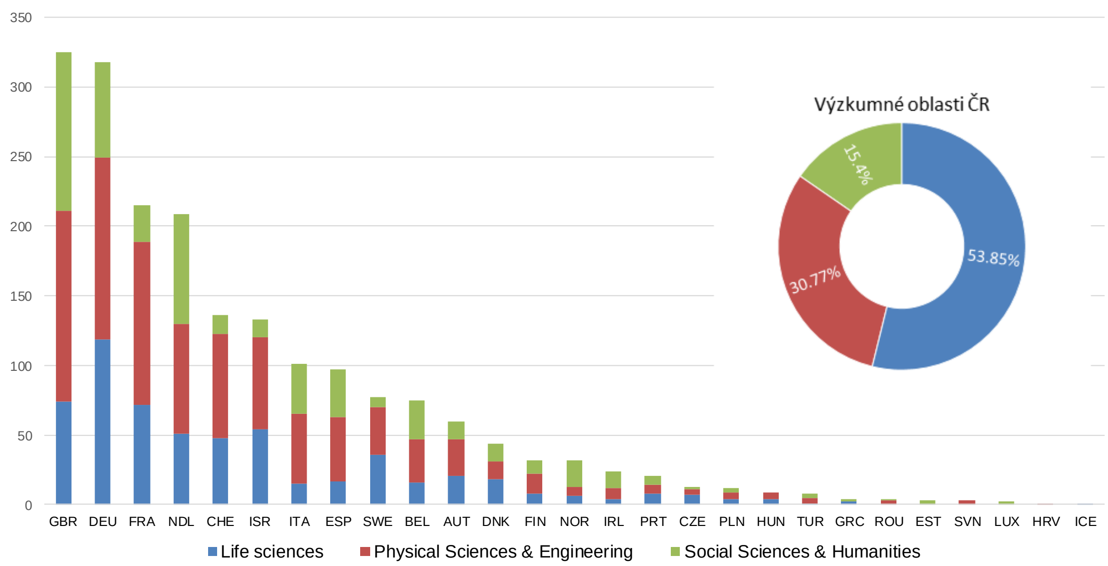


evaluated ERC grants supported ERC grants

Source: European Research Council [accessed 2 September 2020], available at https://erc.europa.eu/projects-figures/statistics

In terms of StG research areas, researchers got most involved in Life Sciences with 53.8 % (i.e. 7 grants), followed by Physical Sciences & Engineering, where 4 grants were approved for funding (30,8%) and Social Sciences & Humanities with 2 grants (15.4%).

Figure 3.11: Starting Grant – research areas (2015 – 2019)

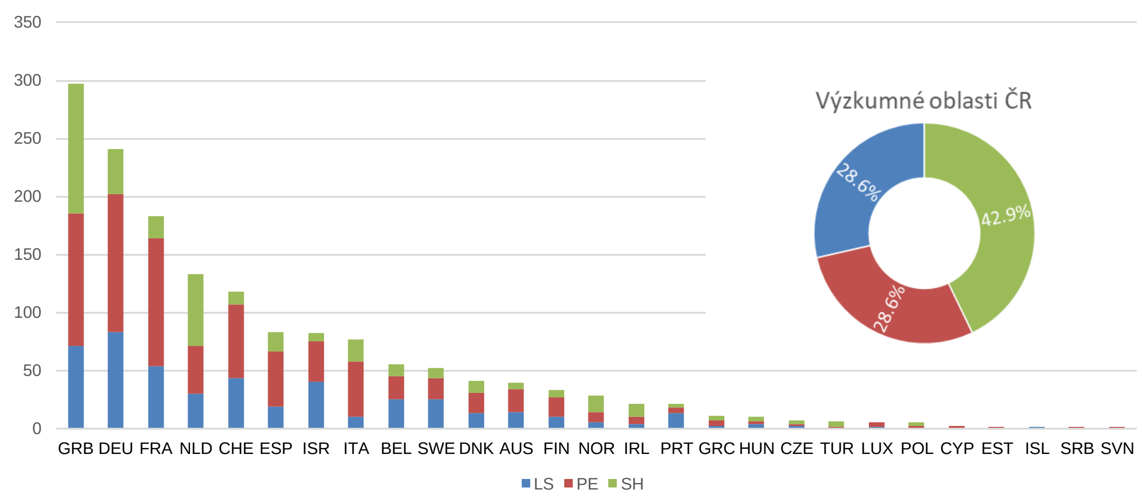


Czech research areas

Source: European Research Council [accessed 2 September 2020], available at https://erc.europa.eu/projects-figures/statistics

Under CoG, researchers obtained 3 grants in the field of Social Sciences & Humanities (i.e. 42.9%) and 2 each in Life Sciences a Physical Sciences & Engineering.

Figure 3.12: Consolidator Grants – research areas (2015–2019)

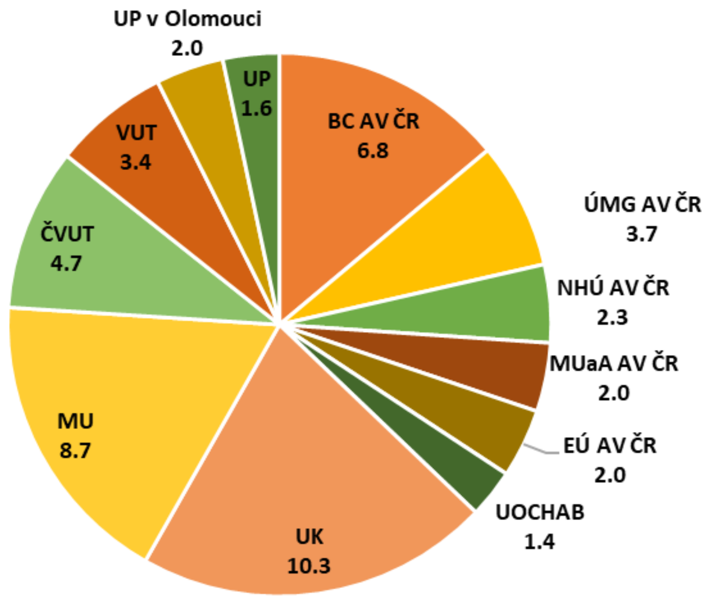


Source: European Research Council [accessed 2 September 2020], available at https://erc.europa.eu/projects-figures/statistics

Recipients of ERC grants in the Czech Republic

The Czech Republic also joined top researchers and their teams and in the years 2014–2019 a total of 12 institutions obtained funding amounting to EUR 39.7 million. Of this total amount, Charles University received 26%, followed closely by Masaryk University with 22%, the Biology Centre of the CAS with 17% and the Czech Technical University in Prague with 12%. Other institutions ranged from 3.5–9% of the amount obtained by Czech research teams from ERC grants.

Figure 3.13: Czech ERC grant recipients in 2014–2019 (in EUR millions)

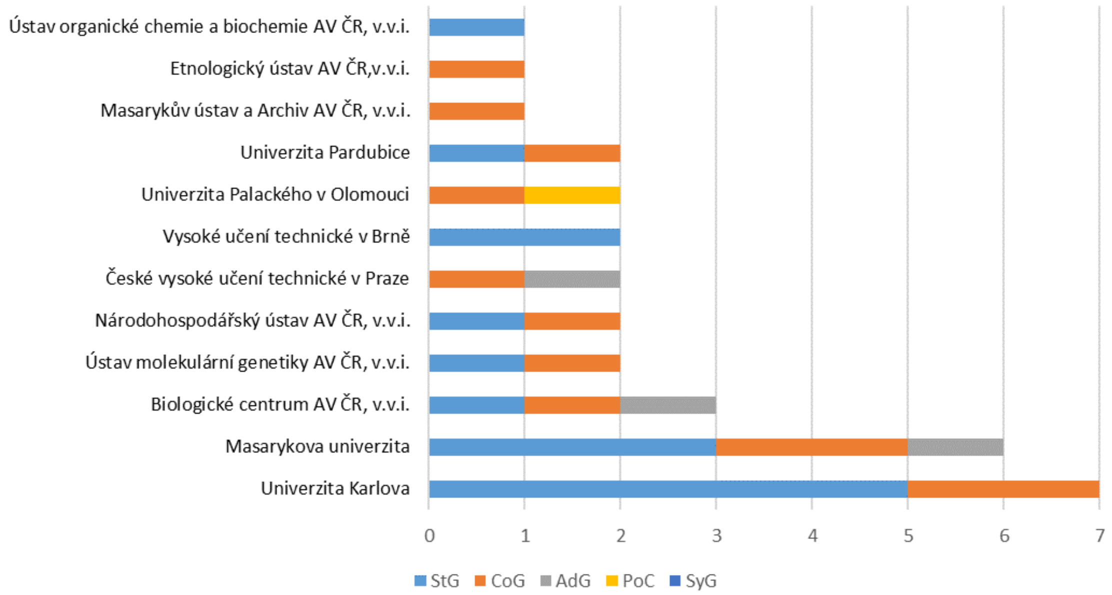


Source: European Research Council [accessed 30 August 2020], available at: https://erc.europa.eu/projects-figures/statistics

BC AV ČR – Biology Centre CAS; ÚMG AV ČR – Institute of Molecular Genetics CAS; NHÚ AV ČR – Institute of National Economy; MUaA AV ČR – Masaryk Institute and Archive CAS; EÚ AV ČR – Institute of Ethnology CAS; UOCHAB – Institute of Organic Chemistry and Biochemistry CAS; UK – Charles University; MU – Masaryk University; ČVUT – Czech Technical University in Prague; VUT – Brno University of Technology; UP v Olomouci – Palacký University in Olomouc; UP – University of Pardubice

The most successful beneficiary was Charles University, which obtained a total of 7 grants for a total value of EUR 10.3 million. Research teams succeeded with 5 Starting Grant (StG) projects, where the main aim is to support the independent careers of excellent young scientists at the phase of creating their own independent research teams or programmes and 2 projects of Consolidator Grants (CoG), which focus on supporting the career of young scientists at the phase of consolidating their own independent teams and programmes. For other types of ERC grants, Charles University was not successful. Scientific teams from Masaryk University obtained a total of 6 ERC grants with a total value of EUR 8.7 million, in 5 cases for Starting Grants and in 2 for Consolidator Grants, with 1 project obtaining an Advanced Grant. The Biology Centre of the CAS obtained one project each under StG, CoG and AdG. In addition to one project under Consolidator Grants, Palacký University in Olomouc was the only one to succeed with a single project under Proof of Concept, the aim of which is to support successful ERC grant investigators in the early phases of commercialising the output of their research activities. The average amount for each research team under the project was EUR 1.3 million.

Figure 3.14: Czech ERC grant recipients in 2014–2019 by grant type



Source: European Research Council [accessed 30 August 2020], available at: https://erc.europa.eu/projects-figures/statistics

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

In December 2013, the EU Council formally approved the new rules and legislation governing the management of investments as part of the EU cohesion policy for 2014–2020. In connection with this, the EU came up with the concept of research and innovation **strategies for smart specialisation – the RIS Strategy**.[27] The point of this concept is to create a strategy that directs research and development funding[28] into competitive areas with a high innovation potential and thanks to this make a targeted contribution to the economic growth of the given country or given regions.

Smart specialisation must be understood as a tool for guiding public investment and creating suitable general conditions in order to strengthen a competitive advantage in the global economy. The point of specialisation is to produce a unique combination of capacities, knowledge and skills based on the economic, societal and knowledge potential of a country. Smart specialisation includes both investment in public research and investment in business innovation; a fundamental aspect for its success is involving actors with knowledge of possible market application of new ideas, findings and innovations, those able to identify new opportunities for innovation activities in both the private and public sector. Without this condition being met, it is not possible to expect realisation of innovation in the sense of products and services that benefit customers, or society (in the case of public consumption), and as a result the boosting of competitiveness.

4.1 Characteristics of the National RIS3 Strategy

In 2016, the **National RIS3 Strategy of the Czech Republic** was approved (updated in 2018),[29] containing the priorities of guided and applied research and the national and regional level based on the framework laid down by the RDI NP 2016–2020. In cooperation with academics and representatives of the state and private sectors (National Innovation Platform, NIP), these are further processed into research topics.

[27] see *NATIONAL/REGIONAL INNOVATION STRATEGY FOR SMART SPECIALISATION (RIS3) [accessed 1 August 2020],* Available at: https://ec.europa.eu/regional_policy/sources/docgener/informat/2014/smart_specialisation_cs.pdf

[28] In the 2014–2020 period these are funds from the EU, public and non-public (private) resources from the Czech Republic and abroad totalling CZK 210 billion.

[29] See https://www.mpo.cz/cz/podnikani/ris3-strategie/dokumenty/dokumenty-k-ris3-strategii-pro-rok-2019-–-242942/ *[accessed 1 August 2020]* (available in Czech only)

The Czech National RIS3 Strategy is one of the fundamental **implementation instruments** in the field of applied and guided research in the Czech Republic and at the same time, in the context of EU public policies, it represents a precondition for implementing EU policies focused on supporting the economic growth of EU countries using the principles of smartness, sustainability and inclusiveness. It thus fulfils the **EC's precondition** for carrying out EU regional policy interventions in the field of research, development and innovation.

The priorities of the Czech RIS3 Strategy are what are called **horizontal objectives** (boosting the research and innovation capacity of businesses; supporting technological cooperation among companies; increasing the quality of research facilities; strengthening cooperation between research organisations and companies; support for qualified workers from abroad; support for using ICT in enterprise, etc.). The second structural level is the RIS3 research and economic specialisation. These are priorities that should be supported with regard for the national research and economic performance in the European and global context. The level of RIS3 economic specialisation is comprised of the **RIS Application Sectors** (mechanical engineering – mechatronics; industrial chemistry; automotive; aerospace industry; digital economy and digital content; sustainable management of natural resources, etc.), while the level of RIS research specialisation is made up of **Knowledge Domains** (advanced materials; nanotechnology; biotechnology; artificial intelligence; security and connectivity; social innovation, etc.). The RIS3 priorities are not fixed – the refinement and focus thereof is a constant process arising from implementation of the outputs from the Entrepreneurial Discovery Process, or **EDP**.

In the **2021–2027 programming period**, the importance of the RIS3 Strategy will continue to grow. It is a basic condition for the release of EU funds intended for funding interventions focused on oriented and applied research in EU countries. It is also gradually becoming the coordination mechanism for interventions funded from national sources. The primary mission of RIS3 2021–2027 will be focusing on the Czech Republic being a prospering, technologically advanced, environmentally friendly and digitally friendly industrial country with an open innovation ecosystem and a good reputation abroad.

Figure 4.1: Benefits of Czech National RIS3 Strategy

Benefits for businesses

- support for research and development in important industrial sectors
- product and process innovation at businesses
- support for international business research
- support for collaboration between research organisations and companies
- commercial use of research results
- support for ICT at companies, etc.

Benefits for the Czech Republic

- improved public research quality
- increased economic benefit of public research
- better availability of human resources for RDI in number and quality
- development of eGovernment
- use of advanced technologies in addressing societal problems
- involving the Czech Republic in international cooperation

On the one hand, smart specialisation must ensure to an appropriate extent investment in the advanced technologies necessary for maintaining and strengthening existing competitive advantages, while at the same time also creating the conditions for development of new application areas and opportunities, including those that react to identified economic and societal challenges.

The Ministry of Industry and Trade is responsible for **producing and implementing** the National RIS3 Strategy. The main guiding element of the strategy is the RIS3 Steering Committee, which works primarily with the central administrative authorities and other institutions from the field of RDI support. Key partners for the committee's activity are the managing authorities of the operational programmes co-funded from EU fund and the providers of national and ministerial aid programmes. In relation to the regional RIS3 strategies, the national level plays a coordination role.

Monitoring of the RIS3 strategy focused primarily on the drawing of funds for realised interventions broken down by the main strategy priorities and fulfilment of strategy indicators broken down by their strategic and specific objectives. The operational programme managing authorities provide the RIS3 analytical team information on relevant projects realised and submitted in the stipulated data structure, on the basis of which an own RIS3 Strategy database is created. **Evaluation** of the RIS3 Strategy means processing and interpreting information obtained under regular monitor and outside of it and formulating conclusions and recommendations to improve implementation and the overall strategic set-up of the strategy. The annual progress **report**[30] on the Czech RIS3 Strategy is published on the MIT website following approval by the RIS3 Steering Committee.

Coordination and implementation of the RIS3 strategy in the 2014–2020 programming period is tied to the following priority axes of the **ESIF operational programmes**:

Operational Programme Enterprise and Innovation for Competitiveness (**OP EIC**)
PRIORITY AXIS 1: Promotion of research and development for innovation
PRIORITY AXIS 2: Development of SMEs' entrepreneurship and competitiveness
PRIORITY AXIS 4: Development of high-speed internet access networks and information and communications technologies

[30] See https://www.mpo.cz/cz/podnikani/ris3-strategie/dokumenty/ *[accessed 30 October 2020]* (available in Czech only)

Operational Programme Research, Development and Education (**OP RDE**[31])
PRIORITY AXIS 1: Strengthening capacities for high-quality research
PRIORITY AXIS 2: Development of universities and human resources for research and development
PRIORITY AXIS 3: Equal access to high-quality pre-school, primary and secondary education
Operation Programme Prague – Growth Pole of the Czech Republic (**OP PGP**)
PRIORITY AXIS 1: Strengthening research, technological development and innovation

Integrated Regional Operational Programme (**IROP**)
PRIORITY AXIS 3: Good territorial administration and improvement in the effectiveness of public institutions

Operational Programme Employment (**OP E**)
PRIORITY AXIS 3: Social innovation and international cooperation

In terms of **national programmes** focused on supporting research and development, implementation of the RIS3 Strategy concerns the following:

TA CR programmes:

- Competency Centres (CK)
- EPSILON
- GAMA
- DELTA
- DELTA 2
- ÉTA
- THÉTA
- ZÉTA
- National Competency Centres (NCK)

Czech ministerial programmes:

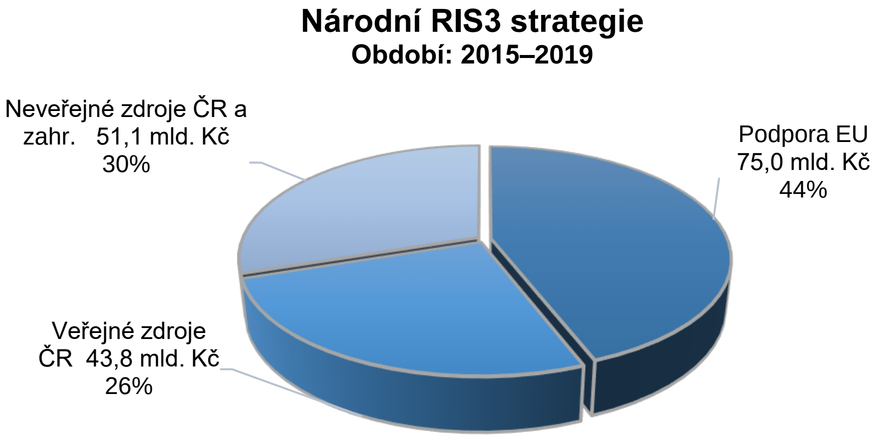
- TRIO (provider MIT)
- Programme to support applied medical research and development 2015–2022 (provider: MH)
- Ministry of Agriculture applied research programme 2017–2025, ZEMĚ (provider: MA)
- Czech security research programme 2015–2022 (provider: MI)
- Security research for the needs of the state programme 2016 – 2021 (provider: MI)

4.2 Financing, Meeting Specific Objectives and Application Focus with Regard for Regional Concerns

In the period in question of 2015–2019, the National RIS3 Strategy for supporting applied and oriented research (see Figure 4.2) has seen CZK 43.82 bn earmarked from Czech public funds (26%), EU support of CZK 74.99 bn (44%) and the private sector contributed CZK 51.12 bn (30%).

[31] In OP RDE, the National RIS3 Strategy is an ex-ante condition for all PO1 specific objectives (SO1-SO4) and specific objective SO5 IP1 PO2. All other specific objectives under OP RDE are primarily managed by different strategies than the National RIS3, though some specific objectives do in fact contribute to fulfilment of the National RIS3 Strategy. For OP RDE calls in PO3 and SO1-SO4 IP1 and all of IP2 PO2, the RIS3 Strategy is not an ex-ante condition, with its contribution to the RIS3 objectives being only partial, and from the stated total allocation for the call, the share of allocation with relevance for RIS3 is set out based on a qualified estimate.

Figure 4.2: Support for applied and targeted research in the Czech Republic



National RIS3 Strategy

Non-public Czech and foreign sources CZK 51.1 bn 30%
Czech public sources CZK 43.8 bn 26%
EU support CZK 75.0 bn 44%

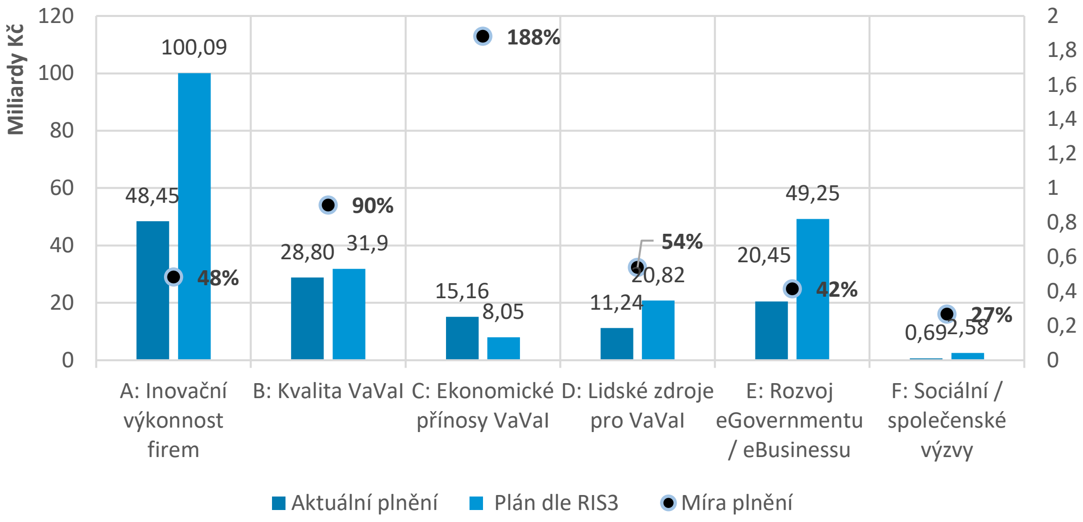
Source: Managing Authority data; MIT

Fulfilment of the National RIS3 Strategy objectives for the period in question 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 4 103 projects in the programme OP EIC, 13 552[32] projects under OP RDE, 65 projects for OP PGP, 333 projects of IROP and 46 projects of OP E. In total this is thus **18 099** projects with an issued legal act on provision of support and subsequent state. There is a total of **2 571** projects 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, 660 in the Epsilon programme, 37 in the GAMA programme, 13 in the National Competency Centres programme, 229 projects in the Éta programme, 114 in the Théta programme, 239 in the Zéta programme, in the TRIO programme (MIT) – 495 projects, in the Czech Security Research Programme (MI) – 129 projects, in the Security Research for the Needs of the State Programme (MI) – 43 projects,

[32] The large number of projects in the OP RDE programme tied to the RIS3 Strategy is in part dictated by the fact that monitoring of the RIS3 Strategy also includes projects carried out under the OP RDE calls focused on support for schools in the form of simplified reporting projects – templates for nursery, primary and secondary schools and universities. These projects also contribute (if only in part) to fulfilling the horizontal objectives of the National RIS3 Strategy.

in the Medical Research and Development for 2015–2022 Programme (MH) – 391 projects and in the MH Research Programme for 2017–2025 ZEMĚ – 151 projects.

Figure 4.3: Fulfilment of key areas of change (objectives) of National RIS3 Strategy in operational programmes (ESIF)



CZK billion

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 challenges

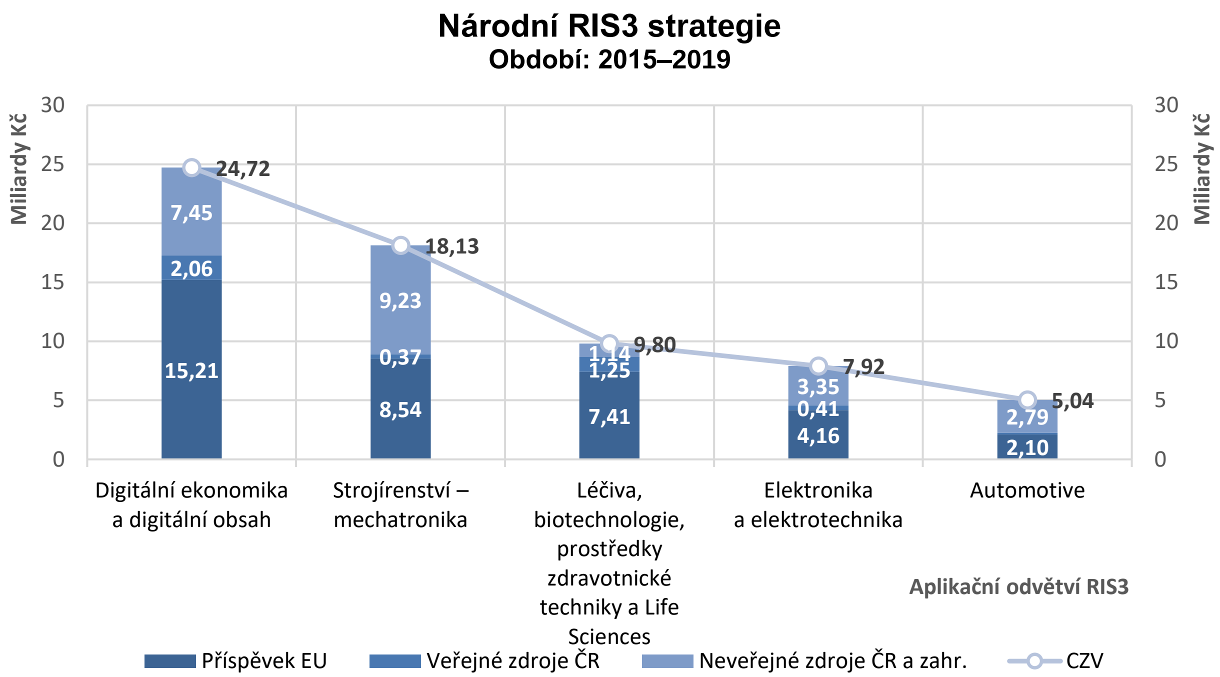
Current fulfilment Plan under RIS3 Level of fulfilment

Source: data OP MA; own work 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 48.45 billion**, but this is only just under half (48%) of the overall support for this area planned for the 2014–2020 programming period. For the other objectives the planned expenditures are considerably lower. The greatest 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 with an amount of CZK 28.80 billion, which represents 90% 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) has been supported during the monitored period with an amount of CZK 20.45 billion (42% of the planned support). A total of CZK 8.05 billion is planned for the key area ***Economic Benefits of RDI*** (cooperation between research organisations and companies and commercial application of results of research and development), and during the monitored period of 2015–2019 projects were approved with total expenditures of CZK 15.16 billion, meaning that the planned support for this objective of the National RIS3 Strategy has already been fulfilled. For more detail see **Figure 4.3**.

Figure 4.4 shows the five application branches of RIS3 most supported under operational programmes. The application branch most supported from **European funds and Czech public funds** is *Digital economy and digital content* (CZK 15.21 bn and CZK 2.06 bn respectively), which is the most supported application branch overall. The branch most supported from **private sources** is *Mechanical engineering – mechatronics* (CZK 9.23 bn), which is the second most supported branch of the National RIS3 Strategy right after the digital economy.

Figure 4.4: Economic specialisation of the National RIS3 Strategy (operational programmes)



National RIS3 Strategy
Period: 2015–2019

CZK billion

Digital economy and digital content Mechanical engineering – mechatronics Pharmaceuticals, biotechnology, medical devices Electronics and electrical Automotive

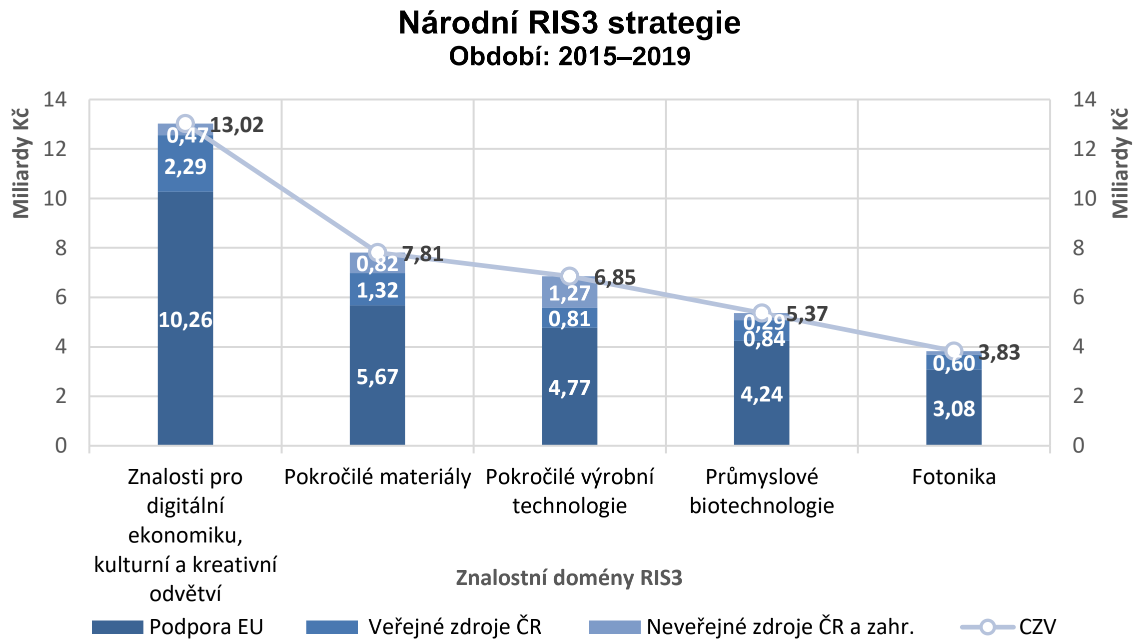
RIS3 application branches

- EU contribution - Czech public resources - Non-public Czech and foreign sources - CZV

Source: MA data; own work of MIT

In the field of research, development and innovation, the knowledge domain under the research specialisation of the RIS3 strategy most supported from **European funds** is *Knowledge for the digital economy, cultural and creative sectors* (CZK 10.26 bn), which is also the most supported from **Czech public resources** (CZK 2.29 bn). The most supported from **Czech and foreign private sources** is the knowledge domain *Advanced manufacturing technologies* (CZK 1.27 bn). For more detail, see Figure 4.5, which shows the five most supported knowledge domains of the RIS3 Strategy.

Figure 4.5: Research specialisations of the National RIS3 Strategy (operational programmes)



National RIS3 Strategy
Period: 2015–2019

CZK billion

Knowledge for the digital economy, cultural and creative sectors Advanced materials
Advanced manufacturing technology Industrial biotechnology Photonics
RIS3 knowledge domains
- EU support - Czech public resources - Non-public Czech and foreign sources
- CZV

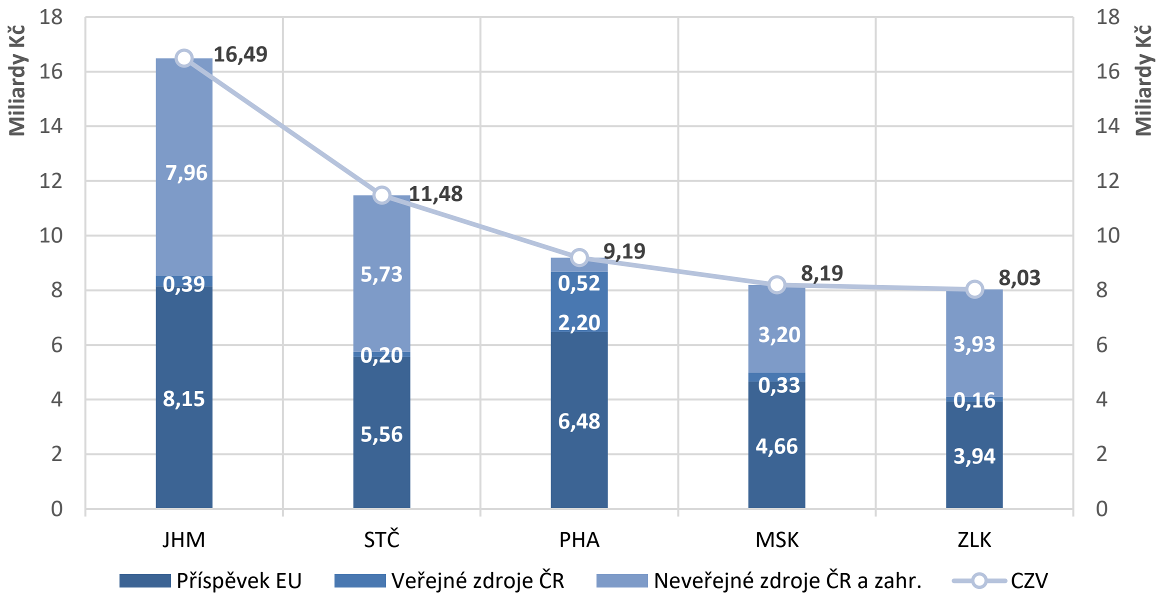
Source: MA data; own compiling of MIT

4.3 Regional Dimension

The established system for monitoring the National RIS3 Strategy allows for a closer look at the impact of nationwide operational programmes on individual Czech regions.[33]

Figure 4.6 shows the five regions most supported under the Czech National RIS3 Strategy. The most funding from the operational programmes goes to the **South Moravian Region** (CZK 16.49 bn), in which the most **European funds** (CZK 8.15 bn) and **funds from Czech and foreign private sources** (CZK 7.96 bn) are also used. In contrast, **Czech public resources** for support of the National RIS3 Strategy in regions are most used in the City of Prague (CZK 2.20 bn), which is due to the EU rules for co-financing of more developed regions.

Figure 4.6: National RIS3 Strategy support in Czech regions broken down by funding sources (ESIF operational programmes) for 2015–2019



CZK billion
South Moravia Central Bohemia Prague Moravia-Silesia Zlín Region
EU contribution Czech public sources Non-public Czech and foreign sources

Source: MA data; own work of MIT

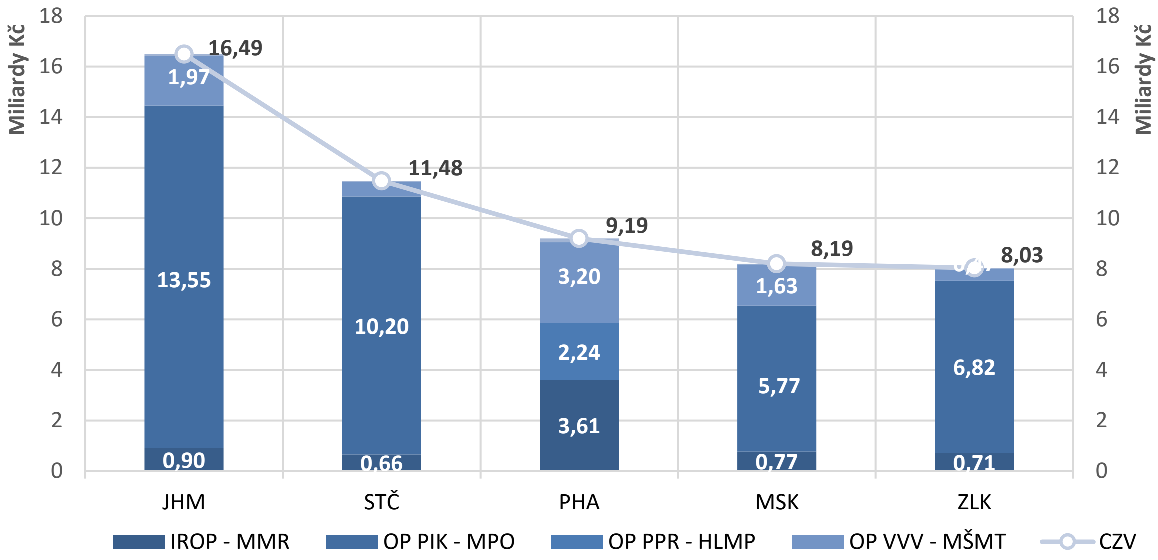
If we monitor the **reach of operational programmes** to the individual Czech regions (see **Figure 4.7**), the most supported under OP EIC[34] is the South Moravian Region (CZK 13.55 bn), under OP RDE it is the City of Prague (CZK 3.20 bn). Under the IROP

[33] For operational programmes, the division of funding (European, public Czech, non-public Czech and foreign) is assessed based on project site location.

[34] The Prague Capital Region (the City of Prague) is not a target territory for OP EIC.

programme, the City of Prague is the most supported (CZK 3.61 bn). Support under OP E is distributed to a relatively small extent (about CZK 0.02 to 0.15 bn) in all the listed Czech regions.

Figure 4.7: National RIS3 Strategy support in Czech regions broken down by ESIF operational programmes for 2015–2019



CZK billion

South Moravia	Central Bohemia	Prague	Moravia-Silesia	Zlín Region
IROP – MRD	OP EIC – MIT	OP PGP – Prague	OP RDE – MEYS	CZV

Source: MA data; own work of MIT

5 Human Resources in Research and Development

Human resources are often referred to as the most important factor for all activities. This is also the case for R&D activities. It is the personal and professional qualities of human resources from which the volume and quality of R&D derive, as does of course the subsequent success of the process of transforming R&D output into new practical knowledge. Human resources are not understood solely as researchers, but also technical workers and professionals in R&D and other support staff without which it would not be possible to effectively realise 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 has also found its place in analyses of human resources in recent years.

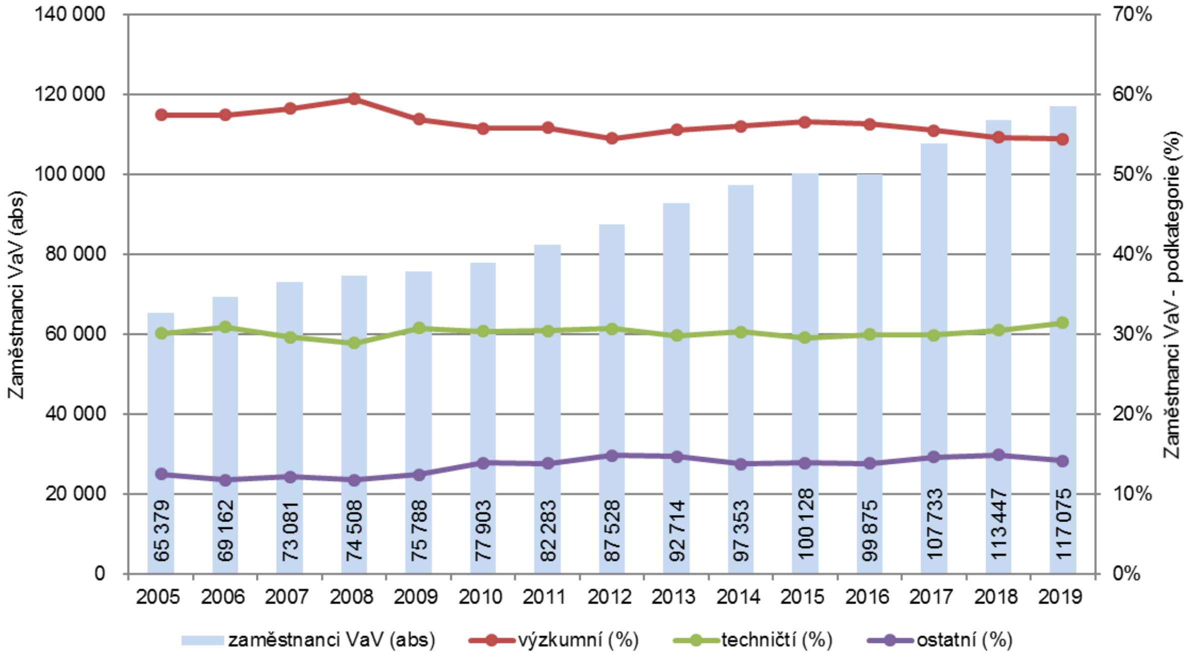
The importance of human resources in R&D is also apparent from the amount of human resource data being seen in R&D. The number of records and statistics presented by the CZSO is further proof of this. This chapter presents only selected data about human resources in R&D; other data published by the CZSO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

5.1 Employment 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 also has its limitations, it nevertheless best describes the actual time R&D employee spend on R&D activities.

Figure 5.1 depicts the evolution of number of R&D employees (HC) and research, technical and other employees as a percentage of total R&D workers. During the period in question (2005–2019), there was a regular year-on-year increasing number of R&D employees with the exception of 2016. Also interesting is the development of the indicator number of R&D workers per 1 000 employed persons in the Czech Republic. While this indicator was at a value of 15.4 in 2010, in 2019 there were 21.6 R&D workers per 1 000 employed persons in the Czech Republic (by HC). Converting to FTE, in 2010 there were 10.2 R&D workers per 1 000 employed persons in the Czech Republic; in 2019 it is 14.6. The development of R&D workers by FTE is the same as for HC (year-on-year positive trend, only year-on-year decline recorded in 2016). In 20196 there were 79 245 workers employed in R&D by FTE. Of the total number of R&D employees, the greatest share is research workers (54.4%), followed by technical workers (31.4%) and the lowest share is other workers (14.2%).

Figure 5.1: Evolution of employees (HC) and proportion according to work activity (2005–2019)



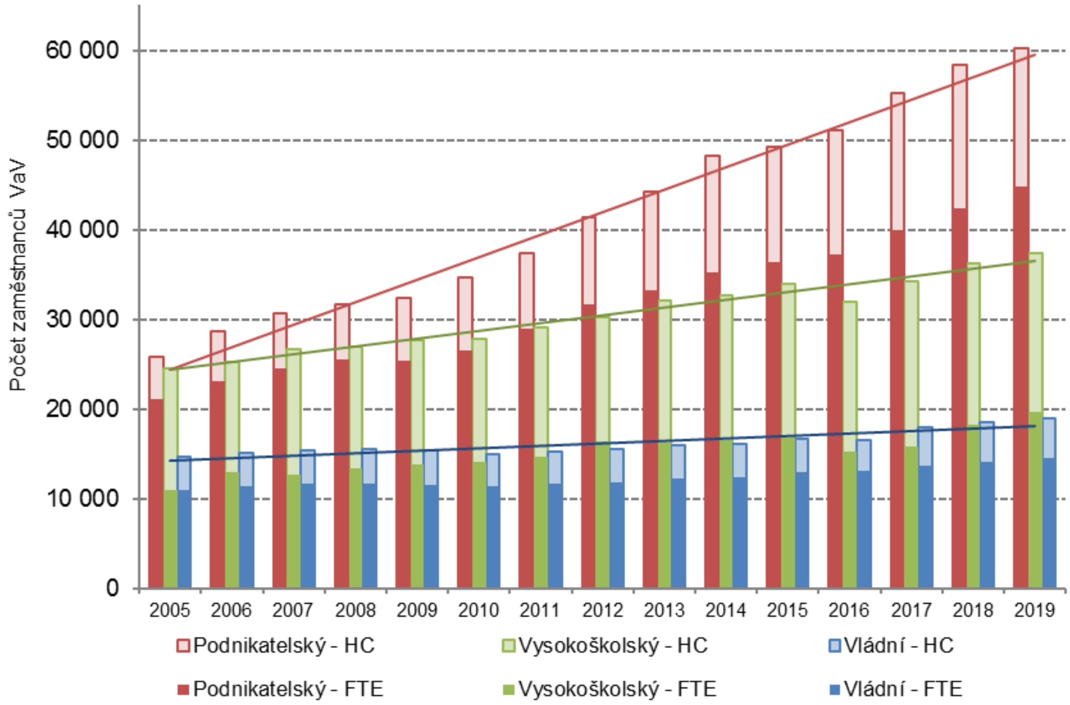
R&D employees (abs)
R&D employees – subcategories (%)
R&D employees (abs)
Researchers (%)
Technicians (%)
Other (%)

Source: adapted from CZSO

Figure 5.2 shows the evolution of R&D employees by R&D activity sector according to both the HC and FTE indicators. It is evident that the greatest number of R&D workers throughout the entire reference period can be found in the business sector. In 2019, 60 247 workers were employed in R&D (HC), or 44 792 by FTE. In terms of number of workers in R&D, the business sector is followed by higher education (HC 37 442 employees, FTE 19 647 employees) and the least R&D employees were in the government sector (HC 19 009 workers, FTE 14 530 workers). A CZSO study also includes the non-profit sector. The number of R&D employees in this sector is quite insignificant (HC 377 workers, FTE 276 workers). Just as in the previous year, in 2019 again 51.5% of all R&D employees working in R&D were the business sector (FTE 56.5%), while 32% of all R&D workers were in the university sector (FTE 24.8%) and 16.2% in the government sector (FTE 18.3%). 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,[35] 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 2005–2019



Number of R&D employees
Business – HC / FTE
University – HC / FTE
Government – HC / FTE
Source: CZSO, line: HC linear trendline

Table 5.1 captures an international comparison of the number of R&D employees in the EU-28 for 2010 and 2018 according to both the FTE and HC indicators, and for 2018 also the relative expression of the proportion of RDI employees to all employees according to the FTE indicator. The countries are ordered by absolute FTE values for 2018. It is important to

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

be aware that the absolute numbers indicated in Table 5.1 are substantially influenced by the population size of each country.

Germany is in first place among the EU-28 in terms of the number of FTE R&D employees (707 700), followed by the UK (463 500), France (451 400), Italy (345 600), Spain (225 700), Poland (162 000), and the Netherlands (156 900), with other countries reporting less than 100 000 employees in R&D. Within the EU-28, the Czech Republic ranks 11th with 75 000 employees in R&D.

From the point of view of the proportion of R&D employees to all employees for 2018 (by FTE), Denmark ranks the highest at 2.4%, followed by Finland and Luxembourg (both 2.0%), and Austria, Belgium and Sweden (all 1.9%). In the Czech Republic, the proportion is 1.5%. At the opposite end of the imaginary scale is Romania (0.4%) and Cyprus (0.5%).

Table 5.1: Number of R&D employees compared internationally (2010 / 2018)

	2010		2018			
			FTE			
	FTE	HC	ABS	% of all employees	HC	
EU-28	**2,541,885**	**3,793,265**	**3,302,709**	**1.48**	**4,783,505**	*
Germany	548,723		707,704	1.74	971,157	*
Great Britain	350,766	524,333	463,476	1.49	771,139	
France	397,756	523,648	451,423	1.69	618,612	*
Italy	225,632	348,215	345,625	1.53	526,620	
Spain	222,022	360,229	225,696	1.18	369,291	
Poland	81,843	129,792	161,993	1.00	266,283	
Netherlands	100,544	127,154	156,875	1.84	216,994	
Sweden	77,418		92,011	1.87	131,783	*
Belgium	60,075	88,803	88,031	1.87	129,002	*
Austria	59,923	.	80,750	1.90	131,032	*
Czech Republic	**52,290**	**77,903**	**74,969**	**1.46**	**113,447**	
Denmark	56,623	84,562	64,591	2.36	90,862	*
Portugal	47,616	91,917	58,154	1.26	116,864	
Hungary	31,480	53,991	54,654	1.24	79,387	
Greece			51,279	1.37	94,560	*
Finland	55,897	79,979	50,011	2.03	73,905	
Ireland	19,722	33,630	35,817	1.64	50,460	*
Romania	26,171	39,065	31,933	0.38	44,733	
Bulgaria	16,574	20,823	25,809	0.84	34,610	
Slovakia	18,188	28,128	20,268	0.80	35,770	
Slovenia	12,940	17,972	15,686	1.63	23,633	
Croatia	10,859	18,459	13,029	0.80	21,226	
Lithuania	12,315	18,913	11,956	0.90	24,591	
Estonia	5,277	10,074	6,183	0.98	9,479	

Latvia	5,563	9,174	5,806	0.67	12,129
Luxembourg	4,972		5,624	2.02	6,856 *
Cyprus	1,302	2,628	1,826	0.47	3,754
Malta	1,102	1,807	1,530	0.65	2,502

Source: Eurostat, ranked according to FTE values 2018 | data for 2017*

5.2 Research Worker Numbers

The following chapter pertains only to researchers as a category of R&D workers. In Table 5.2, an international comparison of the number of researchers according to both the FTE and HC indicators in 2010 and 2018 is recorded, plus the proportion of researchers to all employed inhabitants (according to FTE 2018). The countries are ordered by absolute FTE values for 2018. Just as in Table 5.1, the absolute number of researchers should be viewed in connection with the population size of each country.

From the perspective of absolute number of researcher FTE in 2018, Germany is in first place (433 700), then France (306 500), the UK (305 800), Italy (152 300), Spain (140 100) and Poland (117 800). Other countries have fewer than 100 000 researchers. At the opposite end of this ranking are Luxembourg (3 000), Cyprus (1 200) and Malta. Within the EU-28, the Czech Republic ranks 13th with 41 200 researchers.

Relatively speaking, the countries leading the EU-28 table in terms of the proportion of researchers to all employed inhabitants (FTE 2018) are Denmark with 1.7%, followed by Finland and Sweden (both 1.5%), Belgium (1.2%) and Austria (1.2%). 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 / 2018)

	2010		2018			
	FTE	HC	FTE		HC	
			ABS	% of all employees		
EU 28	**1,602,748**	**2,429,084**	**2,098,445**	**0.94**	**3,103,137**	*****
Germany	327,996		433,685	1.07	623,125	*
Great Britain	256,585	394,755	305,795	0.98	535,477	
France	243,533	324,551	306,451	1.15	416,217	*
Italy	103,424	149,807	152,307	0.67	210,419	
Spain	134,653	224,000	140,120	0.73	234,798	
Poland	64,511	100,934	117,789	0.73	192,833	
Netherlands	53,703	64,829	95,475	1.12	130,153	
Sweden	49,312		75,151	1.53	107,042	*
Belgium	40,832	59,403	57,898	1.23	78,867	*
Austria	36,581		50,484	1.19	83,648	*
Denmark	37,435	54,813	46,396	1.69	61,961	*
Portugal	41,523	80,259	47,652	1.03	96,123	
Czech Republic	**29,228**	**43,418**	**41,198**	**0.80**	**61,966**	
Finland	41,425	57,163	37,891	1.54	55,415	
Greece			36,688	0.98	61,616	*
Hungary	21,342	35,700	37,606	0.85	54,970	
Ireland	14,176	20,801	25,265	1.16	34,721	*
Romania	19,780	30,707	17,213	0.21	27,471	

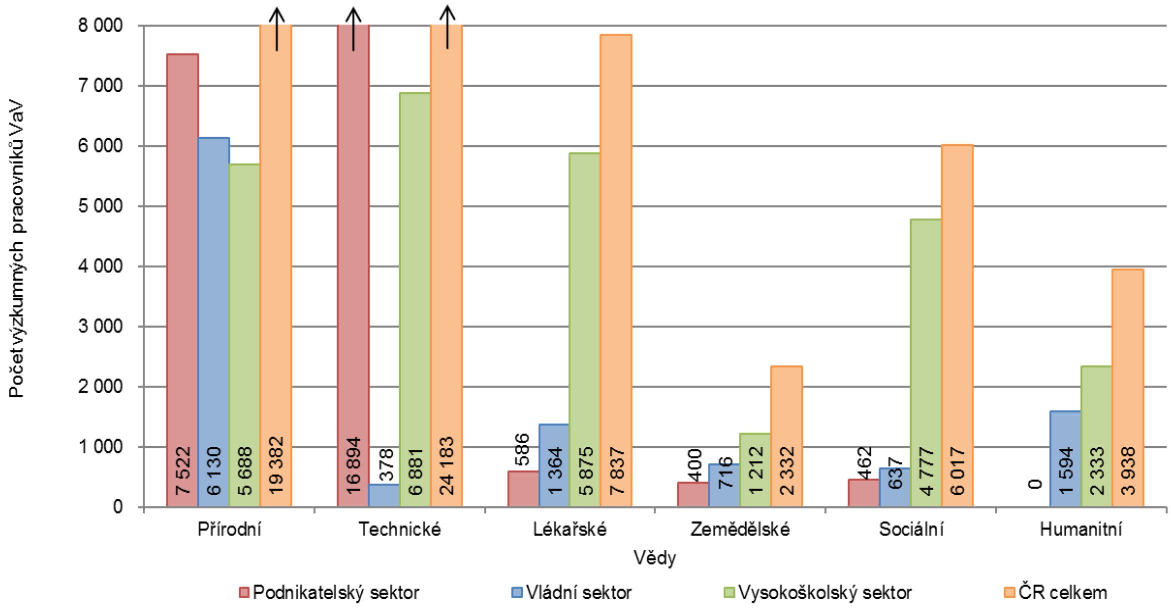
	2010		2018		
			FTE		
	FTE	HC	ABS	% of all employees	HC
Slovakia	15,183	24,049	16,337	0.65	28,755
Bulgaria	10,979	14,138	16,521	0.54	22,792
Slovenia	7,703	11,056	10,068	1.05	15,388
Lithuania	8,599	14,056	8,938	0.68	19,198
Croatia	7,104	12,527	7,985	0.49	13,958
Estonia	4,077	7,491	4,968	0.79	7,281
Latvia	3,896	6,517	3,456	0.40	7,439
Luxembourg	2,613		2,986	1.07	3,540 *
Cyprus	905	1,776	1,217	0.31	2,652
Malta	587	1,062	906	0.39	1,513

*Source: Eurostat, ranked according to FTE 2018 values | * data for 2017*

Figure 5.3 shows researcher numbers (HC) for 2019 in connection with the scientific fields and sectors in which the R&D activity is carried out. In terms of the number of researchers, the most important sectors are the university sector (26 766 researchers, FTE 12 663) and business sector (25 865 researchers, FTE 21 707). The government sector employs just 10 819 researchers (FTE 7 968). In terms of number of researchers, the most numerous sector is that of higher education, with the greatest number of researchers working at public and state-run universities (24 062), followed by teaching hospitals (2 125) and private universities (579). Following higher education in terms of number of researchers is the business sector, where the most researchers are found at foreign-owned companies (13 847 researchers), private domestic companies (11 024 researchers) and the least are at public enterprises (993). Of the researchers employed by the government sector, 61% are employees of the CAS (6 603 researchers), and similar numbers of researchers are at other public research institutions (1 222) and medical facilities (1 137), followed by other workplaces (932) and libraries, archives and museums (925).

In terms of scientific fields, most researchers carry out their work in the technical sciences (24 183 researchers) and the natural sciences (19 382). In the business sectors, most researchers carry out their work in the technical sciences (16 894 researchers), while in the government sector it is the natural sciences (6 130 researchers) and in the university sector the technical sciences (6 881 researchers). Researchers are most spread across all scientific fields in the university sector.

Figure 5.3: R&D researcher numbers in the Czech Republic (HC) by sector worked and scientific field (2019)



Number of R&D researchers
Natural
Technical
Medical
Agricultural
Social
Humanities
Sciences

Private sector
Government sector
University sector

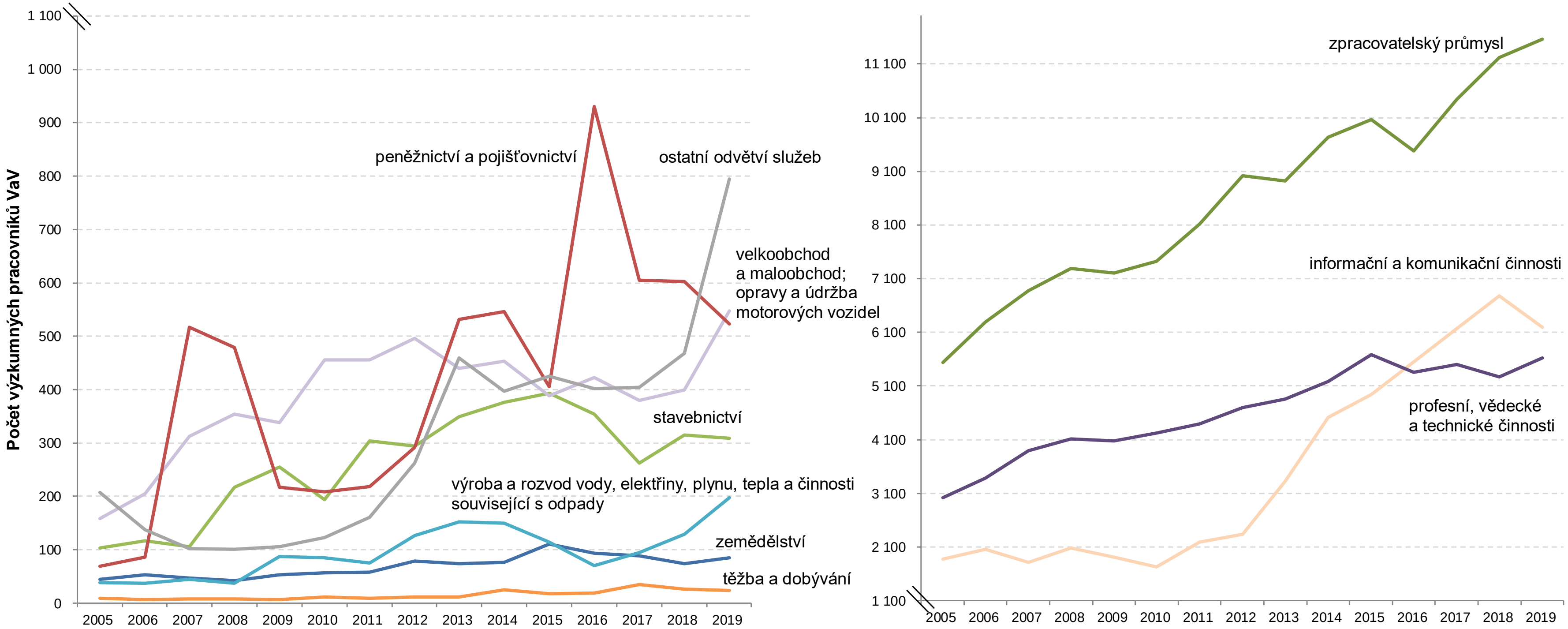
CR total

Source: adapted from CZSO

Within the business sector, use of the CZ NACE classification system to categorise the number employees is more exact. Figure 5.4 shows the number of researchers in the business sector according to the various groups under CZ NACE by the HC indicator for the time period 2015–2019 The greatest number of researchers across the whole monitored period were active in manufacturing (11 565 researchers in 2019). 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 6 199 in 2019. The sector with the highest growth in terms of researcher numbers is finance and insurance. While in 2005 this sector employed 70 researchers, in 2019 this number was 523 researchers.

As mentioned above, the manufacturing industry enjoyed the greatest number of researchers in 2019, followed by information and communication (6 199 researchers) and other professional, scientific and technical activities (5 621 researchers). Of the other sectors, which are shown on the right-hand side of Figure 5.4 for greater clarity, the most represented are other service sectors (794), wholesale and retail; motor vehicle repair and maintenance (548) and finance and insurance (523). Conversely, mining and quarrying has the fewest (24).

Figure 5.4: Number of R&D research workers in the business sector according to CZ NACE in 2005–2019 (HC)



Number of R&D researchers

financial and insurance activities
other service sectors
wholesale and retail trade; maintenance and repair of motor vehicles
construction
production and distribution of water, electricity, gas, and heat, waste management
agriculture
mining and quarrying

manufacturing
information and communication
professional, scientific and technical activities

Source: adapted from CZSO

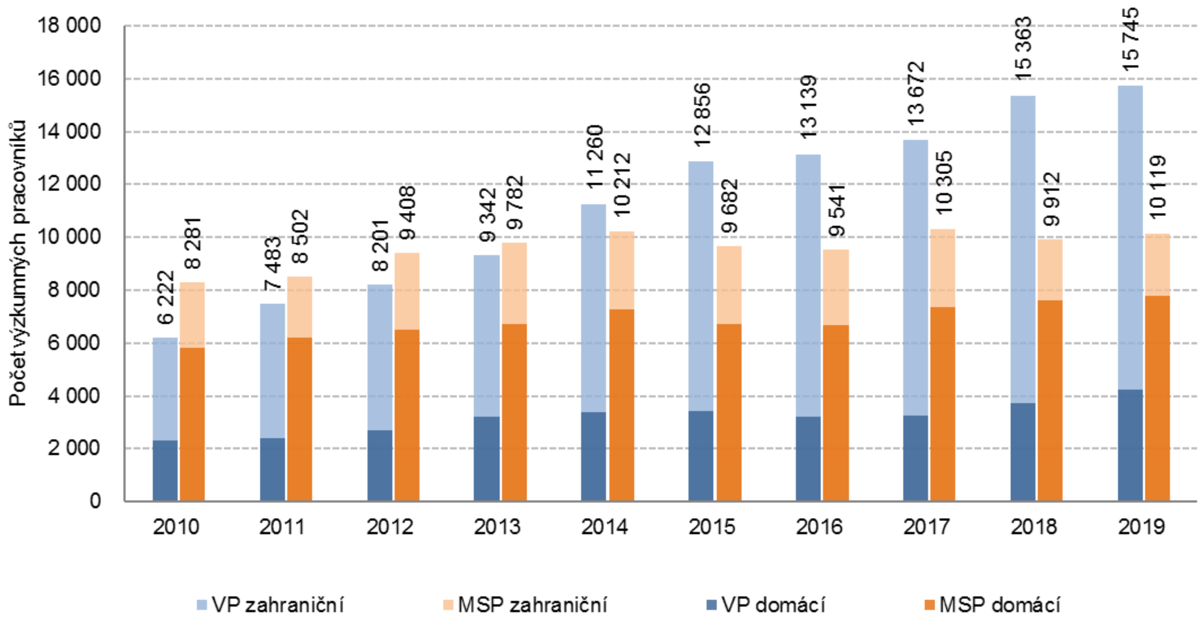
The issue of researchers in the business sector can also be analysed from the point of view of enterprise ownership. Enterprises can be divided by domestic and foreign control as well as by size. The size category can be set by number of employees, i.e., SMEs have up to 249 employees and large enterprises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

In the initial year of 2010 the number of researchers at SMEs was over 2000 more than in LEs. In later years, the number of researchers in LEs grew more rapidly than at SMEs. By 2013, this number was practically the same and since 2014, LEs have reported a greater number of researchers. 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 2019, 15 745 researchers were employed at LEs and 10 119 at SMEs.

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 3 906 to 11 518 (i.e., 294.9% in 2019 compared to 2010). Domestic LEs also saw an appreciable increase in number researchers (in 2010 there were 1 512 researchers, in 2019 there were 3 434). Changes in the case of SMEs are not so substantial: for SMEs under foreign control, there was a slight drop and for domestic SMEs there was an increase of 1 950 researchers compared to 2019.

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: adapted from CZSO

5.3 Gender

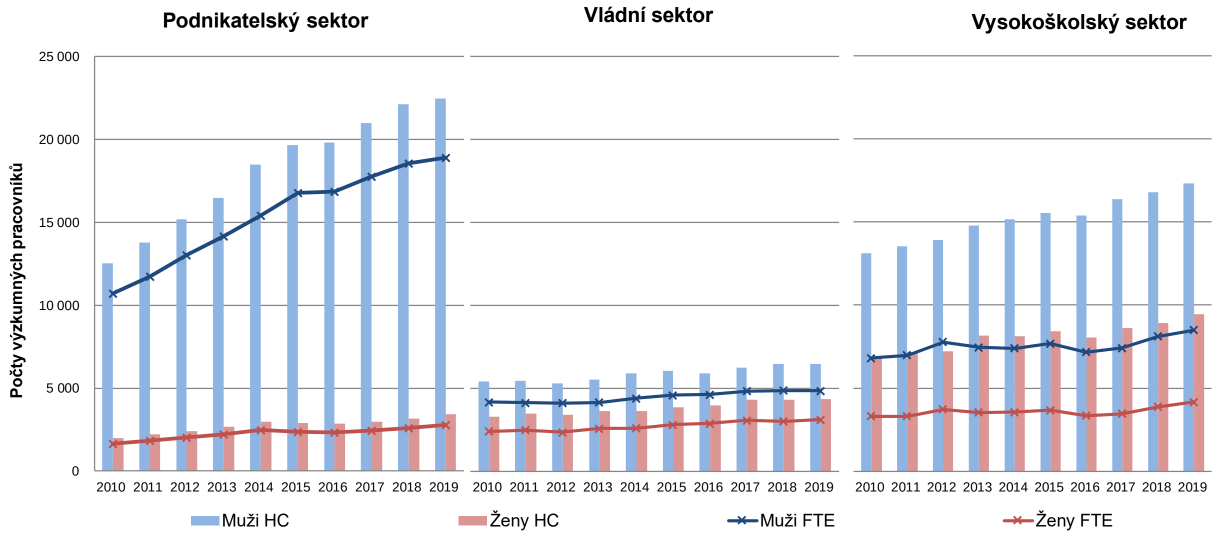
Figure 5.6 shows the numbers of researchers in individual R&D execution sectors for the period 2010–2019 broken down by sex. The number of researchers is captured both by HC and FTE. The percentage of women among the total number of researchers in the Czech Republic in 2019 is equal to 27.2% by HC and 23.9 by FTE. Both values increased by approximately 0.7 percentage points compared to 2018.

As is evident from Figure 5.6, the smallest representation of women at research sites for the whole monitored period is in the business sector. In 2019, female research workers were represented to the tune of 13.2% (HC) and 12.9% (FTE), which is a year-on-year increase of 0.7 percentage points for both indicators. Despite this growth, this percentage does not reach the level of the initial year (2010), when the percentage of women was 13.6% (HC) and 13.3% (FTE). It is evident from the above that the number of researchers in the business sector is growing more quickly than the number of female researchers in the business sector.

While the representation of female researchers is the lowest in the business sector, their highest representation is in the government sector. According to the HC indicator, this percentage is 40.2% and by FTE 39.0%. In contrast to the business sector, the listed values for female representation in the government sector are higher in 2019 than in the initial year of 2010.

The representation of female researchers in the university sector is 35.3% according to the HC indicator (in 2010, this share was 34.3%) and 32.9% according to the FTE indicator (in 2010, this share was 32.7%).

Figure 5.6: Number of researchers in the Czech Republic by gender (2010–2019)



Number of researchers

Private sector
Government sector
University sector

Men HC / FTE
Women HC / FTE

Source: adapted from CZSO

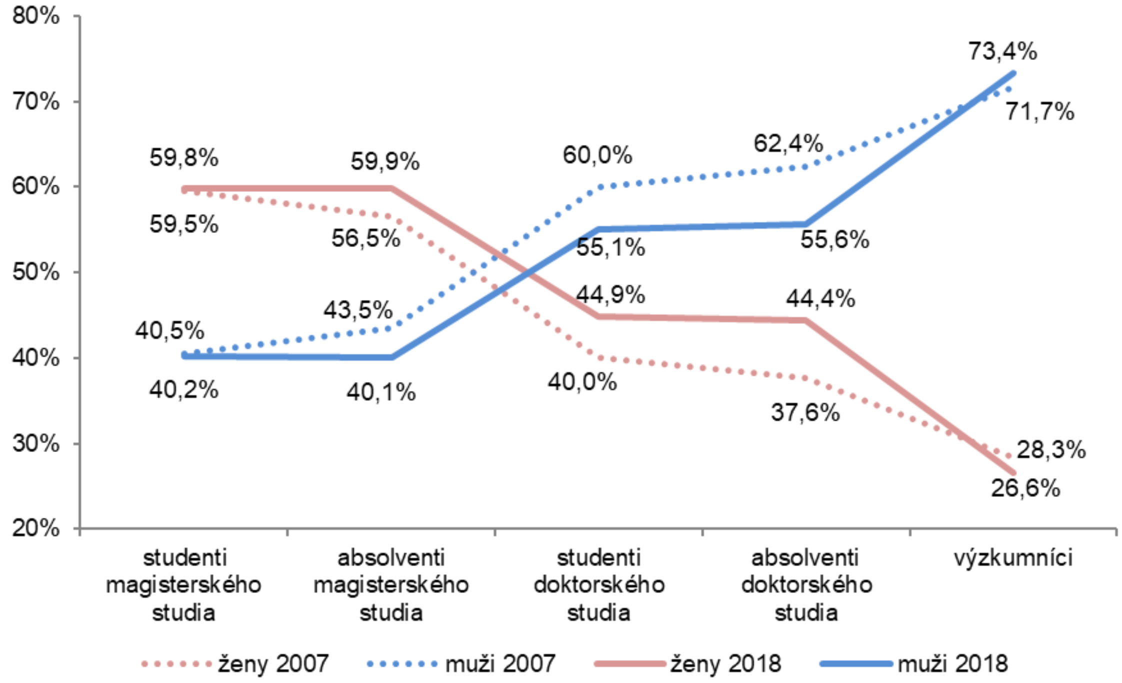
Figure 5.7 depicts the representation of women and men at individual levels of an ideal science career (in HC %), i.e. from a Master's degree, through a Doctoral degree, to research work, for the years 2007 and 2018 for all fields of study and scientific fields. A quite evident trend is clear from Figure 5.7 of a widening gap in the representation of women and men.

While women predominate during Master's studies (in 2018 the percentage of women among Master's students was 59.8%), men formed a majority (55.1%) of those doing Doctoral studies and in scientific practice the predominance of men is even more pronounced (73.4%). A more balanced representation of women and men compared to 2007 can be seen primarily in Doctoral studies (in 2007 the percentage of women among Doctoral graduates was only 37.6%, in 2018 it was 44.4%).

The greatest drop-off in the percentage of women on the ideal path to a scientific profession comes between graduating from Doctoral studies and scientific practice. This drop-off is largest in the technical and natural sciences. The difference between these levels in terms of representation of women is 13.2 percentage points for technical sciences and a full 20.3 percentage points in the case of the natural sciences.

In general it can thus be said that the greatest difference in the share of women is in the phase after graduating from Doctoral studies and before entering scientific practice in technical, natural and agricultural sciences; in medical sciences and the humanities/social sciences, the greatest difference is in the transition between Master's and Doctoral studies.

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 2007 / 2018
Men 2007 / 2018

Source: Situation of women in Czech science, Monitoring Report for 2018 (NKC – gender and science)

Table 5.3 shows the proportion of women among R&D workers and among researchers for 2010 and 2018 in the EU-28. The countries are ranked according to the HC indicator in both parts of the table in 2018. 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, the greatest proportions of women among R&D workers are found in Latvia (FTE 52.4%, HC 53.4%), Croatia (FTE 48.2% and HC 50.2%) and Lithuania (FTE 46.3%, HC 49.6%). In the Czech Republic, the proportion of women among R&D workers is 28.6% according to the FTE indicator and 30.4% according to the HC indicator. The only EU-28 countries with a lower share based on HC are 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 23.2%, HC 26.6%), having the lowest values of countries with available data. Of the EU-28, only France is behind the Czech Republic in terms of the proportion of women among researchers (according to HC), and this is because its indicator values are not available. As in the case of 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 (50.7%), Croatia and Lithuania (both 49.0%). 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, it is rather disconcerting that, aside from the Czech Republic, the countries where the proportion of women among R&D workers is less than or near 30% the Netherlands, France, Germany, Malta, Luxembourg and Austria – not countries that can be seen as backward or unsuccessful. 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 / 2018)

R&D workers (women)				
	2010		2018	
	FTE	HC	FTE	HC
Latvia	47.9%	50.1%	52.4%	53.4%
Croatia	51.0%	50.1%	48.2%	50.2%
Lithuania	53.1%	53.5%	46.3%	49.6%
Estonia	43.6%	46.6%	44.8%	47.0%
Bulgaria	53.5%	51.8%	46.1%	46.6%
Romania	45.5%	45.2%	43.5%	45.1%
Portugal	43.2%	42.9%	43.3%	43.4%
Greece				41.9% *
Spain	40.0%	39.8%	40.0%	40.9%
Slovakia	44.1%	43.7%	38.9%	40.8%
Cyprus	40.5%	40.0%	38.7%	40.0%
Poland		41.3%	35.8%	39.1%
Denmark	35.4%	36.3%	38.5% *	38.0% *
Ireland	33.1%	37.5%	35.9% *	36.0% *
Belgium	34.2%	36.4%		36.0% *
Malta	24.8%	29.8%	30.6%	35.6%
Finland		34.2%		35.4%
Great Britain		37.1%		35.3%

Researchers (women)				
	2010		2018	
	FTE	HC	FTE	HC
Latvia	46.8%	50.8%	49.1%	50.7%
Croatia	49.1%	46.9%	48.2%	49.0%
Lithuania	50.8%	51.2%	45.3%	49.0%
Romania	44.5%	44.0%	45.9%	46.2%
Bulgaria	50.2%	48.6%	44.4%	45.9%
Estonia	41.4%	43.4%	42.2%	43.9%
Portugal	43.8%	43.9%	42.9%	43.3%
Slovakia	42.0%	42.4%	39.3%	41.2%
Spain	38.5%	38.4%	38.8%	40.8%
Great Britain		38.3%		38.6%
Poland	38.4%	39.0%	35.2%	37.9%
Greece				37.8% *
Cyprus	37.2%	36.0%	36.7%	37.3%
Ireland	33.0%	34.4%	35.4% *	36.3% *
Denmark	31.1%	32.6%	35.5% *	35.8% *
Belgium	31.7%	33.2%		34.8% *
Italy	34.6%	34.5%	34.1%	33.8%
Finland		31.9%		33.7%

Sweden			30.1% *	35.2% *
Slovenia	36.3%	38.1%	35.0%	35.1%
Hungary	38.2%	40.9%	29.8%	33.0%
Italy	34.4%	35.7%	31.6%	31.8%
Germany			26.3% *	31.8% *
Austria			22.8% *	30.6% *
Czech Republic	**30.5%**	**32.6%**	**28.6%**	**30.4%**
Netherlands			28.6%	27.9%
Luxembourg			25.5% *	26.3% *
France	23.7%	28.9%		

Sweden			28.6% *	32.6% *
Slovenia	34.6%	36.3%	31.4%	32.5%
Malta	25.6%	28.0%	30.4%	32.2%
Austria			23.7% *	30.1% *
Luxembourg			27.3% *	28.1% *
Hungary	30.2%	32.0%	24.6%	28.0%
Germany			22.6% *	27.9% *
Netherlands			27.3%	27.0%
Czech Republic	**25.4%**	**28.1%**	**23.2%**	**26.6%**
France	18.9%	25.3%		

*Source: Eurostat, ranked according to HC 2018 | * data for 2017*

6 Research Infrastructures

The importance of research infrastructures as one of the key components of the Czech national research and innovation system has gradually increased in the Czech Republic in recent years. A number of steps have been taken to help create a stable environment for their construction, operation and further development. The Ministry of Education, Youth and Sports became the principal government agency responsible for support of "large research infrastructures" and, in the role of manager of the Czech Republic's international cooperation in research and development, began supporting their internationalisation or involvement in international legal groupings, in particular ERIC (European Research Infrastructure Consortium) legal entities.

In recent years, financial instruments have emerged that should contribute to the construction and development of a system of research infrastructures in the Czech Republic. Support for research infrastructures from public sources can thus be divided into three groups: (i) operational programmes co-financed from the state budget; (ii) targeted support programmes or groups of grant projects focused on building infrastructures and their further development; and (iii) financial instruments aimed at supporting the operation of RDI infrastructures and ensuring their sustainability (see Table 6.1 for more details). In addition to these financial instruments, institutional support for the long-term conceptual development of research organisations plays a significant role in the development of research infrastructures.

Table 6.1 provides an overview of the financial instruments that that have been implemented to support RDI infrastructures in the Czech Republic since 2005. Data from the RDI IS show that the costs for the entire period of existence (i.e., until 2024) of national grant and programme projects aimed at supporting infrastructures total CZK 70.2 billion and the support actually drawn from the state budget through 2019 amounted to CZK 37.7 billion. Under the Operational Programme Research, Development and Education (OP RDE), a total of 166 infrastructure-related projects have been implemented so far (list of calls – see note under Table 6.1) and the allocated support amounts to CZK 14.6 billion (i.e., including both the EU and SB components). An example of an important project is the National Centre for Electronic Information Resources - CzechElib, which builds on the already completed Information – The Basis of Research (LR) programme. Furthermore, five targeted support programmes and two groups of grant projects that focus on the operation of infrastructures and their further development were identified. In 2019, EXPRO Grant Projects of Excellence in Basic Research (CSF), Competence Centres (TA CR) and National Competence Centres (TA CR) were among the funding programmes in place. Large research infrastructure projects (LM) can be considered the focus of support from public funds for the operation of research infrastructures, with National Sustainability Programmes I and II (LO and LQ) acting as an important supplement to support for development and sustainability. Under these three programmes, a total of 207 projects have been implemented so far, with allocated support from the SB in the amount of CZK 26.4 million.

Table 6.1: Financial instruments for the support of RDI infrastructures in the Czech Republic in 2005–2024 **(for running financial instruments, planned costs of running projects are indicated)**

Provider	Programme code in RDI IS	Financial instrument / programme	Start	End	Aggregate costs for the entire execution period (CZK millions)	Allocated support from SB for the entire execution period (CZK millions)	Actual utilised support from SB through 2019 (CZK million)	Number of supported projects
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	**73**
	EF**	Operational Programme Research, Development, Education (selected calls)	2014	2020	15,377	14,603	11,691	**166**
Targeted support programmes and groups of grant projects aimed at the building and developing infrastructures								
MEYS	1M	Research Centres (National Research Programme)	2005	2011	6,723	5,932	4,321	**36**
	LC	Basic Research Centres	2005	2011	4,072	3,164	2,407	**51**
	LR	Information – The Basis of Research	2013	2017	1,991	1,017	1,017	**9**
CZSF	GB	Projects for Support of Excellence in Basic Research	2012	2018	3,079	3,063	3,112	**37**
	GX	EXPRO Grant Projects of Excellence in Basic Research	2019	2030	2,479	2,404	331	**58**
TA CR	TE	Competence Centres	2012	2019	9,070	6,184	6,169	**34**
	TN	National Competence Centres	2018	2026	1,996	1,557	554	**13**
		Total targeted support programmes			**29.410**	**23.321**	**17,910**	**238**
Financial instruments focused on supporting operation of RDI infrastructures and ensuring their sustainability								
MEYS	LM	Large RDI infrastructure projects	2010	2022	17,868	15,816	10,200	**141**
	LO	National Sustainability Programme I	2013	2020	16,967	7,139	6,833	**60**
	LQ	National Sustainability Programme II	2016	2020	5,909	3,417	2,714	**6**
Total instruments for operating RDI infrastructures and ensuring their sustainability					**40.744**	**26.372**	**19,747**	**207**
Total financial instruments for RDI infrastructure support in the Czech Republic					**70.154**	**49.693**	**37,657**	**445**

Source: RDI IS, date of export: 7 October 2020 | For financial instruments that continue past 2019, RDI IS data is from 7 October 2020; for unfinished projects and their related Total Costs and Support Allocated from the SB, planned expenditure on already commenced projects is taken into account (resources allocated for 2019 and planned for coming years).

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

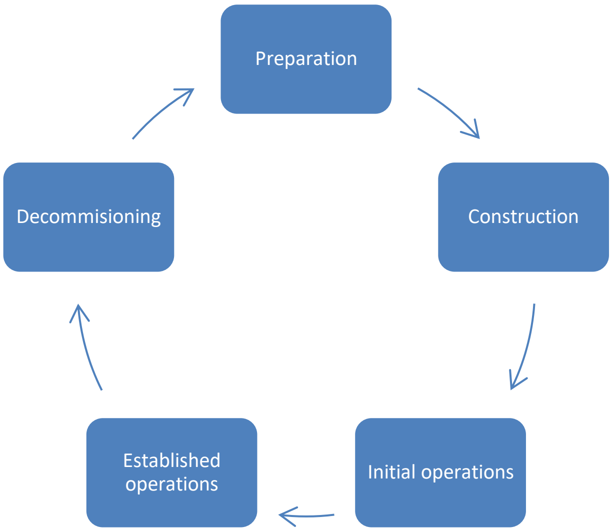
02_15_003 – Support of Excellent Research Teams (only with the IF – Infrastructure designation in RDI IS)
02_15_006 – Teaming (HiLASE Centre of Excellence)
02_15_008 – Phased Projects
02_16_013 – Research Infrastructures
02_16_014 – Building Expert Capacities – Technology Transfer
02_16_017 – Research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

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 II
02_18_072 – Research e-infrastructures

Research infrastructures go through a life cycle that is, at this time, financed from other public finance sources. In some cases, this may be a combination of such sources.

Figure 6.1: Life cycle of research infrastructures



Source: own work

By joining the European Union, research organisations and research teams in the Czech Republic have been given the opportunity to participate fully in EU framework programmes, while researchers gained the opportunity to participate in committees that co-decide what European research and development policy will focus on. With its accession to the EU, the Czech Republic also gained the opportunity to draw funds from cohesion policy instruments, i.e., the structural funds. In the coming years, synergies between the resources of the Framework Programmes (Horizon Europe 2021–2027), national funding and the resources of the Structural Funds (Operational Programme Jan Amos Komenský 2021–2027) are expected to be of key importance for the renewal of infrastructures or co-financing of access to research infrastructure capacity.

6.1 Legal Framework

As the importance of research infrastructures in the Czech Republic grows, the definitions of such infrastructures in Act No. 130/2002 Coll., on the Support of Research, Experimental Development and Innovation, are modified accordingly. The most significant change was brought about by the amendment of Act No. 110/2009 Coll, on the Support of Research and Development, which divided infrastructures into two types: (i) **infrastructure** and (ii) **large infrastructure for research, development and innovation**. In 2009, the concept of large research infrastructure (LRI) was introduced into the Czech legal framework, which made it possible to draw support from public sources for both construction and operation. Other RDI support activities carried out by organisations fell under the infrastructure category.

In 2014, EC Regulation (EU) No 651/2014 was adopted. It declared certain categories of aid compatible with the internal market ("GBER") in accordance with Articles 107 and 108 of the

Treaty. The term **research infrastructure** is defined in Article 2(91) of GBER. Infrastructures may be located in one place or may be "deployed" within a network (organised network of resources) in accordance with Article 2(a) of Council Regulation (EC) No 723/2009 of 25 June 2009 and the Community legal framework for a European Research Infrastructure Consortium (ERIC). This regulation contains exceptions to the prohibition of public support for certain areas that can be considered compatible with the internal market under certain conditions. It also contains the definition of research infrastructure. It became necessary to harmonise national legislation with the new regulation. In Act No. 130/2002 Coll., on the Support of Research, Experimental Development and Innovation, as amended by Act No. 194/2016 Coll., **large research infrastructure** has been defined in accordance with GBER: *"large research infrastructure (is understood to be) research infrastructure*[73] *required by research facilities to carry out comprehensive research and development that is highly demanding financially and technologically, approved by government and established for use by other research organisations as well."* The 2009 definition of "infrastructure" has been removed from the wording of this law. At the same time, EU legislation regulating the conditions for providing support for research, development and innovation from public funds in 2014 provided a legislative definition of research infrastructure and took into account the specifics of its funding. The current valid wording of Act No. 130/2002 Coll., on the Support of Research, Experimental Development and Innovation, contains, as of April 2020, the above definition of large research infrastructure without change.

Research infrastructures have a significant impact on the development of national research and innovation systems and other macro-regional or, as the case may be, global groupings. With the most modern and, especially, special equipment, they provide a unique opportunity for other scientists, both from academia and business in the form of a commercial regime, to carry out their exceptional scientific experiments and investigations and thus gain a greater opportunity for breakthrough discovery. With an open approach, it is possible to address the socio-economic challenges of our society more effectively. This system of sharing prevents duplication of research activities of researchers and fragmentation of public funds spent on RDI. Czech e-infrastructure provides individual LRIs and their users with adequate ICT services, adapted to their individual needs.

6.2 Large Research Infrastructures in the Czech Republic

Large research infrastructures are divided up according to their location. Each large research infrastructure goes through the specific stages of its life cycle – see Figure 6.1.

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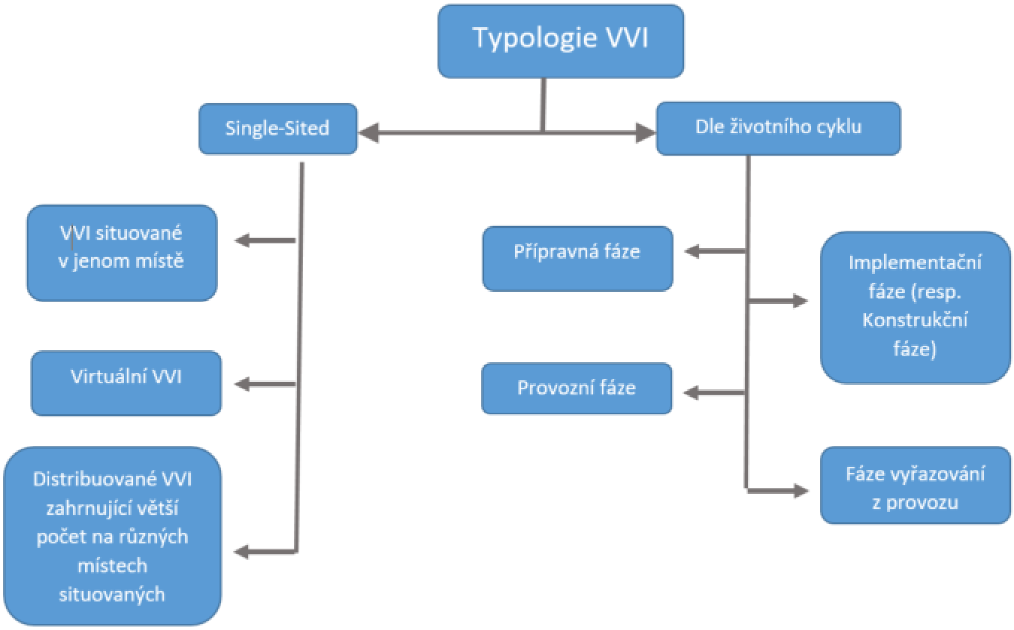
[73] See Framework for State Aid for Research, Development and Innovation (2014/C 198/01) and Commission Regulation (EU) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty.

Figure 6.1: Large Research Infrastructure typology



LRI Typology
Single-sited
Single physical site LRIs
Virtual LRIs
Distributed LRIs with multiple physical sites

According to life-cycle
Preparation
Implementation (or construction)
Operation
Decommissioning

Source: own work

The research infrastructures that are established on the basis of public international law, and of which the Czech Republic is a member, are: CERN, EMBC, EMBL, ESA, ESO and JINR. Through its membership in NATO, the Czech Republic has also become a member of the international organisation VKIFD, and thanks to the Czech Republic's involvement in EURATOM, the Czech Republic is also participating in the ITER project. The Czech Republic's last specific type of international involvement in R&D is ESRF, ILL and European XFEL, where involvement in these LRIs is provided by the research community itself without state aid. Within the framework of international cooperation, the Czech Republic became a member of 14 ERIC legal entities (BBMRI-ERIC, CERIC-ERIC, CESSDA ERIC, CLARIN ERIC, DARIAH ERIC etc.). In the near future, the Czech Republic is expected to become a member state of ERIC legal entities operating the European research infrastructures ACTRIS, AnaEE, CTA, DANUBIUS-RI and INFRAFRONTIER, and the host state of the registered office of the legal entity ELI ERIC, operating the ELI (Extreme Light Infrastructure) research infrastructure.

Czech Roadmap of Large Research Infrastructures and ESFRI Road Map

In 2019, the MEYS published the latest update of the "Czech Roadmap of Large Research Infrastructures for 2016-2022", [74] which represents the involvement of the scientific community in the various challenges and opportunities in the area of research infrastructure. The roadmap includes a total of 48 LRIs (approved by the Czech government for their funding from Czech public funds until 2022) operated across a wide range of scientific disciplines. At the same time, 12 of their projects mediate the participation of the Czech scientific community in international research infrastructures located outside the Czech Republic. [75]

The ESFRI Roadmap was first published in 2006 and subsequently updated in 2008, 2010, 2016 and 2018. It includes European research infrastructures with designs or concepts that have either been successfully implemented by their host countries ("ESFRI Landmarks") or are in the stage of preparation or construction ("ESFRI Projects").

The active membership of the Czech Republic in ESFRI culminated with the election of RNDr. Jan Hrušák, CSc. to the position of ESFRI President on 1 January 2019. He became the first ever ESFRI President from the countries of Central and Eastern Europe that have joined the EU since 2004. From 2016 to 2008, he served as a member of the ESFRI Executive Committee and Vice-Chairman of ESFRI.

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[74] https://www.vyzkumne-infrastruktury.cz/wp-content/uploads/2019/11/Aktualizace-Cestovn%C3%AD-mapy-2019_cz.pdf *[cit. 1.9.2020]* (available in Czech only)

[75] I.e., above and beyond Czech membership of international RDI organisations established according to international public law.

INTERNATIONAL PEER-REVIEW EVALUATION OF LARGE RESEARCH INFRASTRUCTURES

During 2021, the MEYS is carrying out the third international peer-review evaluation of large research infrastructures in the Czech Republic, an evaluation that is directly inspired by the ESFRI methodology used to evaluate research infrastructures of European character, importance and impact. [76] The evaluation is carried out in accordance with the measures of the action plan for the implementation of Innovation Strategy 2019+ and NP RDI 2021+. The evaluation will aim to obtain independent expert documents for the adoption of an informed political decision of the Czech government on the support of large research infrastructures from public funds in the Czech Republic in the 2023–2029 period, as well as to further update the Czech Roadmap of Large Research Infrastructures.

The methodology includes a broad spectrum of evaluation criteria covering a wide range of attributes of knowledge and technological quality, operation and performance, as well as further investment development of large research infrastructures. A detailed description of the evaluation criteria is part of the form for evaluation by large research infrastructure. As part of the methodology, the MEYS also submitted a "landscape/gap" analysis of large research infrastructures in the Czech Republic, carried out by sector platforms established by the MEYS at the Council for Large Research Infrastructures (the “LRI Council”). **The landscape/gap analysis was performed between the fourth quarter of 2019 and the first quarter 2020** within six "sector platforms", which were to cover all six scientific fields: (1) physical sciences and engineering, (2) energy, (3) environmental sciences, (4) health and food (biological and medical sciences), (5) social sciences and humanities (social and cultural innovations) and (6) e-infrastructures (data, computing and digital research infrastructures).

The aim of the activities of the sectoral platforms of the LRI Council was to identify potential areas in which the Czech Republic could design large research infrastructures in the future, i.e., beyond the scope of existing projects. The analysis did not identify any large research infrastructures currently included in the Czech Roadmap of Large Research Infrastructures (last update from 2019) that would be in conflict with the sectoral policies of the Czech Republic. At the same time, the potential for the development of the research and infrastructure scenario in a number of other new areas was then identified. However, the identification of gaps in the landscape of large research infrastructures in the Czech Republic does not necessarily lead only to the submission of completely new proposals for large research infrastructures. Applicants do not have to create a completely new, large research infrastructure, but can work with existing large research infrastructures and further expand their thematic scope by activities covering the identified gaps.

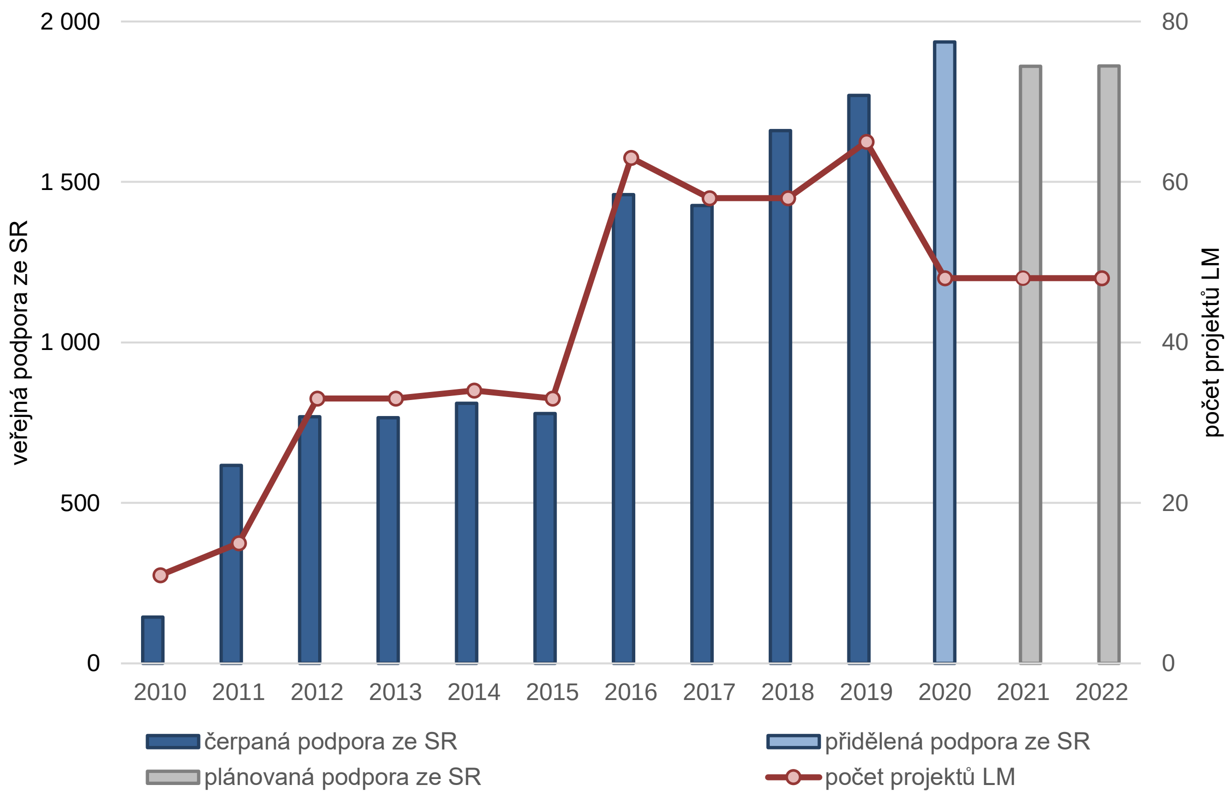
[76] European Strategic Forum on Research Infrastructures

LARGE INFRASTRUCTURE PROJECTS FOR RDI

As already mentioned in the introduction to the chapter, large research infrastructure projects (programme code LM) can be considered the focus of support from public funds for the operation of research infrastructures in the Czech Republic. Funding for large research infrastructure projects is provided in the form of targeted support in accordance with Section 3(d), Section 4(1)(e) and Section 7(5) of Act No. 130/2002 Coll., on the Support of Research, Experimental Development and Innovation.

An overview of the total amount of targeted support under the LM grant heading in 2010–2022 is shown in Figure 6.3. With regard to the gradual commencement of the implementation of the agenda of specific financing of large research infrastructures, the proposals for discussion thereof by the Czech government were submitted by the MEYS in several stages and gradually approved by Czech government resolutions.

Figure 6.3: Total targeted support for larger research infrastructure projects in 2010–2022 (CZK millions)



Public support from SB
Number of LM projects

Support drawn from SB
Planned support from SB
Allocated support from SB
Number of LM projects

Source: RDI IS data export 19 November 2020

Figure 6.4 below provides an overview of LM projects by field, number of research organisations involved and the amount public support drawn in 2019. It is clear that the highest proportion of support was obtained by projects focused on Physical Sciences and Engineering. The institutes of the CAS (primary promoter AS) form the largest group of projects, with universities (VS) trailing slightly.

Figure 6.4: Overview of large research infrastructure projects, structured by field, number of involved research organisations and support drawn in 2019 (CZK millions)

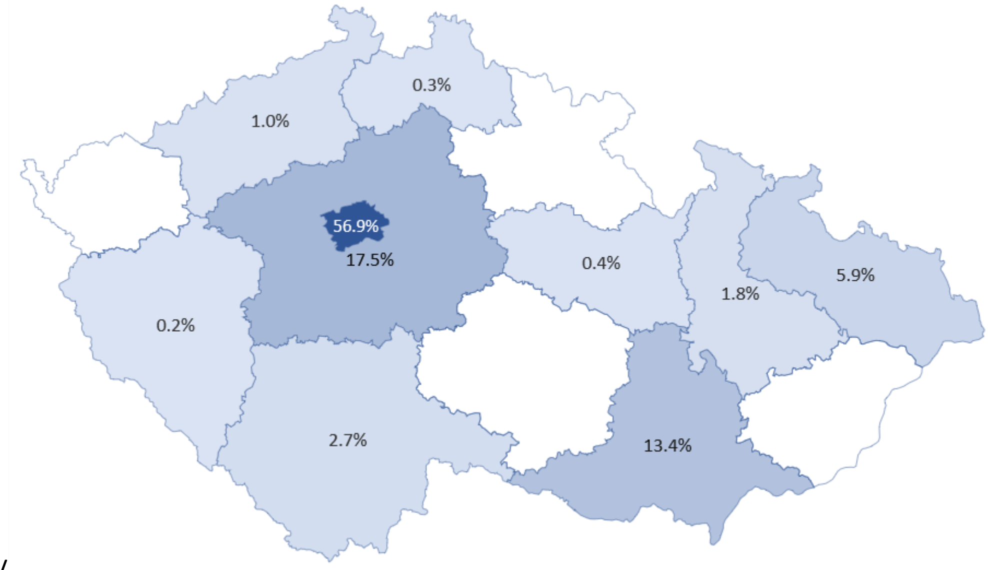
LM project fields (number of ROs involved as primary promoter / number of other participants)

Physical Sciences and Engineering
Energy
Environmental Sciences
Social Sciences and Humanities
E-Infrastructure

Number of LM projects by type of primary promoter
AV
UNI
Other
Total

Source: RDI IS, date of export 7 October 2020, and MEYS https://www.vyzkumne-infrastruktury.cz/wp-content/uploads/2019/11/Aktualizace-Cestovn%C3%AD-mapy-2019_cz.pdf a RDI IS [cit. 7.10.2020] (available in Czech only)

Image 6.5: Regional distribution of support drawn by participants in large research infrastructure projects in 2019



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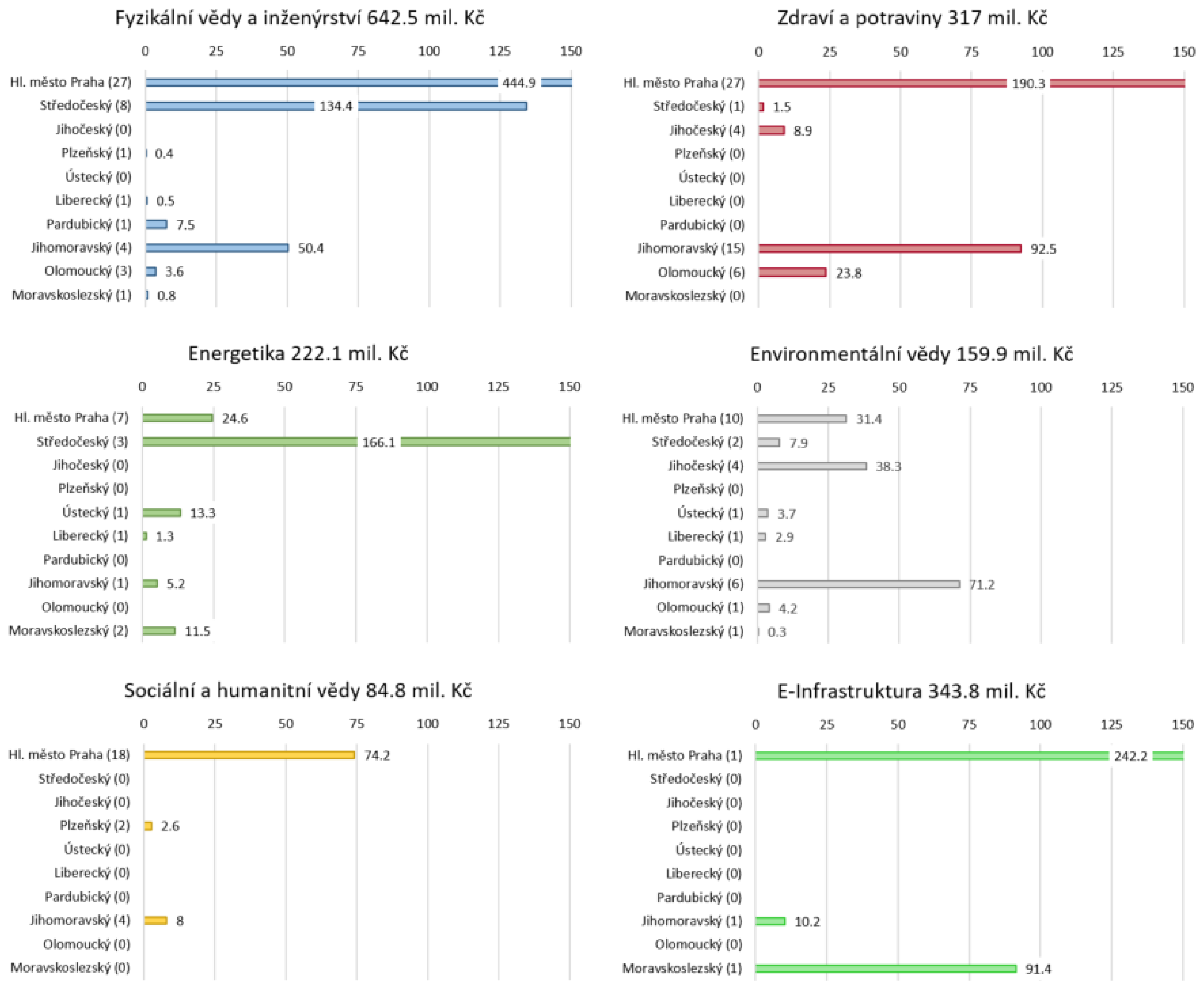
Source: RDI IS | Note: Number of LM project participants by region: Prague (90); Central Bohemia (14); South Bohemia (8); Plzeň (3); Ústí nad Labem (2); Liberec (3); Pardubice (1); South Moravia (31); Olomouc (10); Moravia Silesia (5).

It is evident from Figure 6.5 that the highest proportion of LM support is drawn in Prague. This region also has the highest number of project participants. The South Moravian and Central Bohemian regions are other important regions in terms of the number of participants in LM projects, and the amount of support drawn corresponds to this. The data in Figure 6.6 indicate that Prague is the dominant region in terms of drawing funds and the number of project participants by field. In almost all fields, with the exception of Energy and Environmental Sciences, most funds were used by research organisations based in Prague.

Image 6.6: Large research infrastructure projects and support drawn by region and field in 2019 (CZK millions)



Physical Sciences and Engineering CZK 642.5 million
Heath and Food CZK 317 million
Energy CZK 222.1 million
Environmental Sciences CZK 159.9 million
Social Sciences and Humanities CZK 84.8 million
E-Infrastructure CZK 343.8 million

Prague
Central Bohemia
South Bohemia
Plzeň
Ústi nad Labem
Liberec
Pardubice
South Moravia
Olomouc
Moravia-Silesia

Source of data: RDI IS, export date 7 October 2020, and MEYS https://www.vyzkumne-infrastruktury.cz/wp-content/uploads/2019/11/Aktualizace-Cestovn%C3%AD-mapy-2019_cz.pdf a RDI IS [cit. 7.10.2020] (available in Czech only)

OVERVIEW OF FINANCING OF LARGE RESEARCH INFRASTRUCTURE PROJECTS

Since 2002, the LRI agenda has registered clear progress on all levels of political, legal and financial coordination. The periodic updating of the ESFRI Roadmap provided the research and industrial community in Europe with the most advanced knowledge and technology required to implement excellent RDI. With regard to the lifecycle and knowledge- and technology-related demands of each LRI, the long-term political commitments related to financing LRIs to ensure their long-term sustainability have to be reflected along with the possibility of RDI to accept strategic decisions. At this time, EU Member States are called upon to give preference in their public expenditure to investments in research infrastructure. In the future, it is possible to expect much more intensive development of new, multidisciplinary research infrastructure.

Another significant area that funding should be directed at is strengthening capacities for storing and accessing scientific data in line with FAIR (Findability, Accessibility, Interoperability, and Reusability) principles in the context of the implementation of the European EOSC initiative,[77] which focuses on creating a European open science cloud. The launch of the EOSC project was announced in April 2016 and is planned to start in 2020.

The RDI Council, at its session in 2019, decided to set up a LRI working group, the purpose of which is to set suitable LRI financing going forward. This task is based on Pillar V of Innovation Strategy 2019+, which calls attention to the fact that many centres in the past were created through a system that lacked proper management or failed to take into account research and economic priorities. It further states that there are several systems of financing (institutional support for the long-term conceptual development of ROs, support for LRIs and support for National Competence Centres). The strategy also calls attention to the disunity of controlling bodies and providers on issues such as permitted public support, selection procedure and the rules of provided support. The objectives of Pillar V are as follows:

- Focus on supporting key trends where excellence in research, potential of Czech companies and future technology trends intersect
- "*Create a mutually complementary scheme for financing RDI capacities from institutional support for the long-term conceptual 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."*

RECORD OF RESULTS OF LARGE RESEARCH INFRASTRUCTURES

Based on Government Resolution No. 760, on 20 July 2020, a medium-term strategic document entitled "Research, Experimental Development and Innovation Information System Concept for 2021- 2025" ("RDI IS Concept 2021+") wCASeated. The purpose of RDI IS Concept

[77] European Open Science Cloud.

2021+ is to replace the concept valid until 2020[78] and determine the next direction of development of RDI IS, guarantee the efficient use of the data in it and propose suitable development measures in line with the requirements placed on RDI IS by way of Act No. 130/2002 Coll., on the Support of Research, Experimental Development and Innovation, NP RDI 2021+ and the Action Plan for Implementing the National Strategy of the Open Approach of the Czech Republic to Scientific Information for 2021–2025. The concept is further linked to the Digital Czechia (Digitální Česko) set of concepts and to the selected objectives of its various sub-strategies.

A part of RDI IS Concept 2021+ is measure 1.6 "Implement a module for large research infrastructures and their results". The need to expand RDI IS to include more large research infrastructures and their results stems from Section 32(4) of Act No. 130/2002 Coll., on the Support of Research, Experimental Development and Innovation. The recipient of targeted support for large research infrastructure shall, for this purpose, ensure that users of large scale research infrastructures shall appropriately label the results achieved from using large infrastructures when entering information about results in the register. If authors of results created through the use of large research infrastructure are foreigners, they fulfil the reporting obligation pursuant to Section 31(3) of Act No. 130/2002 Coll., on the Support of Research, Experimental Development and Innovation, on recipients of targeted support for large research infrastructure. This measure was introduced to make it possible to carry out complex analyses and evaluations of the status of research, development and innovation in the Czech Republic and compare them with the status abroad. Already in the previous concept,[79] measure 1.8 "Implement the large research infrastructures module in RDI IS" was announced and implemented in part.

After entry into force of the amendment of Act No. 130/2002 Coll., on Support for Research, Experimental Development and Innovation by Act No. 50/2020, by which the reporting of results was made a condition, the proposal "Procedure for Reporting Cooperation with Large Research Infrastructures" was presented at the 355th session of the RDI Council.[80] This proposal was then approved by the RDI Council and implemented. The objective of the document is to provide promoters of results with a clear procedure for reporting cooperation with large research infrastructures in the Register of Information on Results in the RDI Information System. This procedure lays down common terminology and specifies the content of each data entry, and determines the rules for reporting cooperation with large research infrastructures.

[78] Concept was approved by Czech Government Resolution No. 8 of 13 January 2016.

[79] Concept for the Research, Experimental Development and Innovation Information System for 2016-2020

[80] https://www.rvvi.cz/dokumenty/Postup_pri_vykazovani_spoluprace_s_VVI.pdf [cit. 1.9.2020] (available in Czech only)

6.3 International Research and Development Organisations Established According to International Public Law

International research organisations are established according to international public law; they differ from other international research infrastructures established based on the ERIC European legal framework and the national legal frameworks of the host countries only by the legal framework of their establishment. The national legal form provides these organisations with a host of benefits, e.g., complete tax exemption, freedom to modify their internal relations and diplomatic immunity. At this time, the Czech Republic is a member in eight international research and development organisations – see Table 6.2.

Table 6.2: International research and development organisations established under international private law

Abbreviation	Name	Country	CR's Annual contribution	Description and objective
CERN	European Organisation for Nuclear Research	Switzerland	CHF 11.5 million	CERN operates the world's largest laboratory in particle physics. The aim is to support the operation of the world's leading laboratory for basic physical research on elementary particles and the structure of matter. CERN's annual budget is CHF 1.2 billion
EMBC	European Molecular Biology Conference	Germany	EUR 230 thousand	Through its general programme, the EMBC provides a framework for European cooperation in molecular biology and closely related research areas.
EMBL	European Molecular Biology Laboratory	Germany	EUR 1 million	EMBL is an intergovernmental research organisation in the field of natural sciences with a focus on molecular biology. The aim is to gain easier and more preferential access to EMBL activities.
ESA	European Space Agency	France	EUR 13 million	Ensure and promote cooperation between Member States in space research and technology for purely peaceful purposes and their space applications. ESA's annual budget is EUR 56.8 billion.
ESO	European South Observatory	Germany, Chile	EUR 1.9 million	It currently covers 16 Member States, with a core objective of building and operating a network of astronomical observatories located in Chile. ESO's annual budget is EUR 160 million. The goals are: major astronomical projects, new instruments, cutting-edge science, new technologies, European cooperation and the dissemination of new scientific knowledge.
JINR	Joint Institute of Nuclear Research	Russia	USD 6 million	JINR is an international research and development organisation that deals with theoretical and experimental research in the fields of particle and nuclear physics, solid state physics and radiobiology. JINR's annual budget is USD 210 million.
ITER	International Thermonuclear Experimental Reactor	France	EUR 50 thousand	ITER is an international tokamak-type experimental facility aimed at researching the conditions for productive thermonuclear fusion. The aim is to build and operate an experimental thermonuclear fusion reactor. The total cost of the ITER project is expected to be EUR 20 billion by 2025.

Abbreviation	Name	Country	CR's Annual contribution	Description and objective
VKIFD	Von Karman Institute for Fluid Dynamic	Belgium	EUR 33 thousand	VKIFD is an international research and educational organisation that focuses on fluid dynamics, in all its forms: from experiments, through theory to computer simulations. VKIFD consists of three departments: Department of Environmental and Applied Fluid Dynamics, Department of Aviation and Airspace and Department of Turbo-Machines and Propulsion. The annual budget is EUR 13 million.

Source: https://www.vyzkumne-infrastruktury.cz/mezinarodni-organizace-vyzkumu/ [cit. 7.10.2020] (available in Czech only)

For a member state, membership in international research and development organisations usually constitutes a commitment to pay annual fees, which may be mandatory or voluntary. Membership then provides many opportunities and benefits for the research and industrial community of the member states. The research facilities of international organisations are usually provided for use to research teams based on a tender. The allocation of experimental/monitoring time is usually decided on by an independent evaluation body composed of renowned experts or the organisation itself. Many international organisations also offer their members educational and work internships and often give them preference when filling job vacancies. Suppliers from member states are often in a more advantageous position in tenders for the supply of technology or services. In some cases, these benefits can also be in the form of a guarantee that part of the membership fee will be invested in supplies from the respective member state.

EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM (ERIC)

The ERIC legal framework is the subject of Council Regulation (EC) No 723/2009 of 25 June 2009 on the Community legal framework for a European Research Infrastructure Consortium (ERIC), as amended by Council Regulation (EU) No 1261/2013 of 2 December 2013 amending Regulation (EC) No 723/2009 on the Community legal framework for ERICs and allowing ERIC legal entities to be recognised in all EU Member States. The ERIC legal entity allows for diverse and fully flexible models for managing European research infrastructures. It is operated on a non-profit basis with the possibility to develop economic activities exclusively to a limited extent. The benefits of an ERIC legal entity include a simpler establishment than in the case of a standard international organisation,[81] and the possibility of using tax benefits, such as VAT or excise duty exemptions. An ERIC may also adopt its own guidelines for awarding public contracts, provided that they comply with the principles of transparency and competition and that public contracts are awarded on a non-discriminatory basis. The establishment of an ERIC legal entity is carried out on the basis of a manual issued by the European Commission, under the responsibility of the European Commission's Directorate-General for Research and Innovation (DG RTD) and must

[81] Instituted based on international public law.

always be requested by at least three founding countries or, as they case may be, international organisations.

In the Czech Republic, memberships are in the remit of MEYS. The ministry ensures the exercise of the Czech Republic's membership in ERIC legal entities and represents the Czech Republic on the platforms of the governing bodies of these entities. In this role, the MEYS always works in close cooperation with representatives of the Czech research community, which ensures the performance of the scientific aspects of the Czech Republic's membership. In cases of "single-sited" European research infrastructures, the Czech research community is usually involved in "in-kind" technological supplies. Through the MEYS, the Czech Republic is currently a member of the following ERIC legal entities: BBMRI-ERIC, CERIC-ERIC, CESSDA ERIC, CLARIN ERIC, DARIAH ERIC, EATRIS-ERIC, ECRIN-ERIC, ESS ERIC, Euro-BioImaging ERIC, European Spallation Source- ERIC, EU-OPENSCREEN ERIC, EU-OPENSCREEN ERIC, ICOS ERIC, Instruct ERIC, and SHARE-ERIC.

The MEYS always decides on the entry of the Czech Republic into ERIC legal entities. A significant number of European research infrastructures are considering or have embarked on the path to acquiring the legal personality of an ERIC. In the near future, the Czech Republic should thus become a member of ERIC legal entities managing the following European research infrastructures: ACTRIS, AnaEE, CTA, DANUBIUS-RI, ELI and INFRAFRONTIER.

6.4 Response to the SARS-CoV-2/COVID-19 Pandemic

The SARS-CoV-2 coronavirus epidemic and the resulting COVID-19 disease have caused a number of health, social and economic impacts worldwide. LRIs, especially international LRIs, have an important role to play here. The Czech Republic, as a member state of a number of international research infrastructures, is an integral part of the efforts being expended by the global research community in response to the SARS-CoV-2/COVID-19 pandemic. The immediate response of research stakeholders to the current coronavirus pandemic leads to an effective concentration and coordination of facilities, resources and means available to research community in its fight against SARS-CoV-2/COVID-19.

The "ERAvsCorona" Action Plan, a document that provides a wide range of measures and answers to the current pandemic and presents initiatives being developed to combat SARS-CoV-2/COVID-19, has been produced on the platform of EU Member States and the European Commission. One of the key tools for implementing the Action Plan is the 8th EU Framework Programme for Research and Innovation Horizon 2020 (2014-2020), whose first specially targeted call supported a total of 18 European research projects focused on the development of diagnostics as well as the development of vaccines and drugs against SARS -CoV-2 COVID-19 for almost

EUR 50 million.[82] The Action Plan then includes the mobilisation of additional budget resources from the Horizon 2020 Framework Programme and the announcement of further calls specifically focused on SARS-CoV-2/COVID-19. The Technology Centre of the Czech Academy of Sciences, in the role of the National Contact Point of the Czech Republic for the EU Framework Programmes for Research and Innovation, hCASeated an updated signpost[83] containing information on the possibility of involving research institutions and companies in the Czech Republic in activities that contribute to addressing the challenges posed by the pandemic. The signpost includes, among other things, information on newly announced calls for studies and research carried out in response to the SARS-CoV-2/COVID-19 pandemic, as well as a number of other information of European relevance in connection with SARS-CoV-2/COVID-19. A proposal for another specially targeted call is currently being discussed.

On 15 July 2020, the MEYS organised a conference entitled "Science and research in the fight against the SARS-CoV-2/COVID 19 pandemic"[84] and subtitled "Research infrastructure as part of the state's critical infrastructure". The RDI Council, CRC/ČKR and the Czech Academy of Sciences also took patronage over this event. The conference aimed to learn more about the importance of research infrastructure, and the science and research sector in general, in combating the health and other socio-economic impacts of the pandemic of the novel SARS-CoV-2 virus pandemic and the COVID-19 disease.

[82] https://vedavyzkum.cz/z-domova/ministerstvo-skolstvi-mladeze-a-telovychovy/dopis-ministra-skolstvi-k-pandemii-sars-cov-2 [cit. 1.9.2020] (available in Czech only)

[83] https://www.tc.cz/cs/nabidky/evropa-proti-covid-19 [cit. 1.9.2020] (available in Czech only)

[84] Video recording of conference: https://www.vyzkumne-infrastruktury.cz/sciencefightsthepandemic/webstream/ [cit. 30.10.2020] (voice track in Czech only)

7 Results of Research and Development

Results constitute important proof of execution of research and development activities. Depending on the type of executed activity (basic or applied research, experimental development, innovation), results of different character arise. For the purpose of this analysis, the results were divided into two groups: publication and non-publication results, which 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. Of published results, the most valued are those of world class quality. **Non-publication applied results are created especially during** 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.

Figure 7.1: Types of results of research and development defined in the Czech Republic

<table>
<tr><td rowspan="3">Publication results
(J, B, C, D)</td><td colspan="4">Non-publication results</td></tr>
<tr><td colspan="3">Applied</td><td rowspan="2">Other
(A, M, W, E, O)</td></tr>
<tr><td>Patents (P)</td><td>Utility models and industrial designs (F)</td><td>Other applied
(Z, G, H, N, R, V, S, T)</td></tr>
<tr><td></td><td colspan="2">Results with special legal protection</td><td></td><td></td></tr>
</table>

Result codes are shown in brackets. The result code list may be found in Annex 3.

In the Czech Republic, RDI results affect greatly how research organisations are evaluated. In terms of the effective use of funding, it is necessary to monitor in particular the proportion of specific types of results to their total number and level of quality or, as the case may be, their potential for use in practice. The quality of publication results can, in the case of articles in periodicals, be inferred from the level of such periodicals[85] and the degree to which specific articles are cited, which usually testifies to the use of the findings in them by other authors in related research and development 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 in this module is assessment of selected results by an panel of experts in

[85] This is due to registration in recognised global databases, by bibliometric indicators determined based on the total number of articles in a certain journal 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 results in those fields.

terms of quality, originality and significance compared internationally. Emphasis is placed on the practical use of the results of applied research. 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, presented in this chapter in graphic form, provide a comprehensive overview of RDI productivity in the Czech Republic. In connection with the nature of the support for conducted RDI (institutional or targeted – 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 necessary to keep in mind the basic limitations connected to the use of result data:

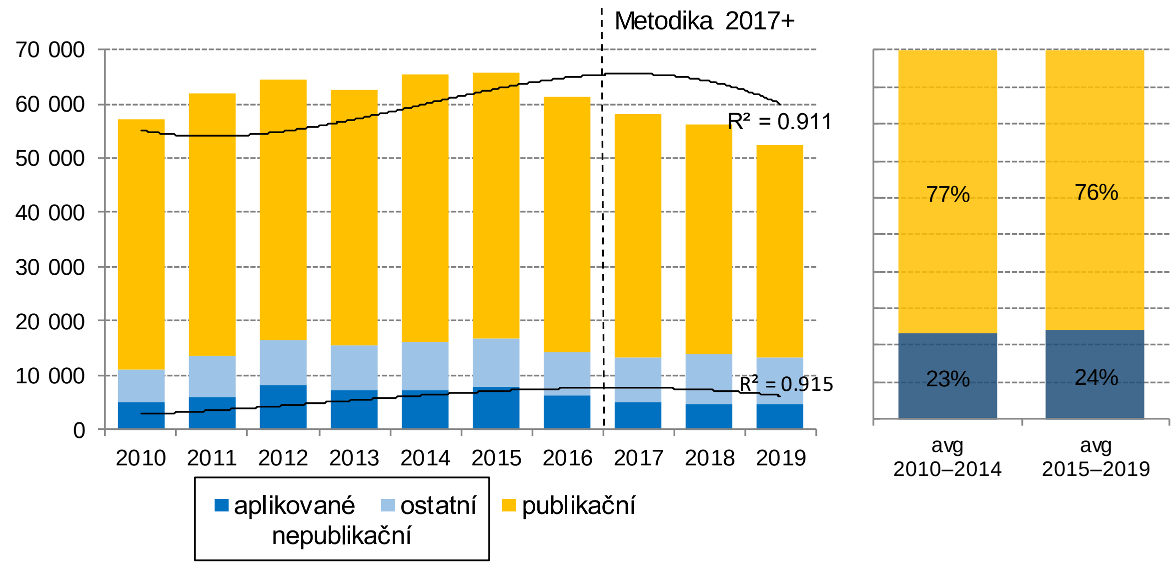
- Under Act No. 130/2002, on Support for Research, Experimental Development and Innovation, the submission of RDI data into RDI IS mandatory only for beneficiaries of RDI support from the public budgets. Information about results in the business sector are thereby substantially limited.
- Most of the 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 research and development activities.
- Research and development become a true contribution only upon the application of new findings, either already published or legally protected.

Since 2018, evaluation on the national level according to Methodology 2017+ has been taking place, which is uniform for the entire research, development and innovation system. Four types of reports are produced: evaluation of selected results in Module 1; bibliometric analyses in Module 2; for both modules classification by research organisation and by field (Module 2 also contains detailed commentaries by Expert Panels). The reports are intended for providers 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 result of the evaluation represent, in accordance with Methodology 2017, one of the supporting documents for funding the respective research organisation. 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, compared globally and vis-à-vis production in the EU15 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 shows the evolution of results in the Czech Republic for the period of 2010 – 2019. In the 10-year reference period, the evolution of the number of results until the end of 2015 trended predominantly upwards; however, in the last four years, it is possible to see a drop in the number of results. This reversal likely relates to the introduction of evaluations according to Methodology 2017+. The drop in the number of results in 2016–2019 was caused mainly by a drop in type D publication results (articles in proceedings) and type J publication results (article in journals). A decline can also be seen in non-publication results, especially in type V results (research reports). In 2019, the production of this type of result represented just under 50% of the number reached in 2015. A low proportion of non-publication results to the total number of results has long been observed, however; if a comparison is made of the average proportion of non-publication results calculated over two 5-year periods (2010–2014 and 2015–2019), it is possible to see that the proportion of non-publication results to total results grew by one percentage point (from 23% to 24%).

Figure 7.2: Numbers of publication and non-publication results in the Czech Republic in 2010–2019 and their average relative representation in 2010–2014 and 2015–2019

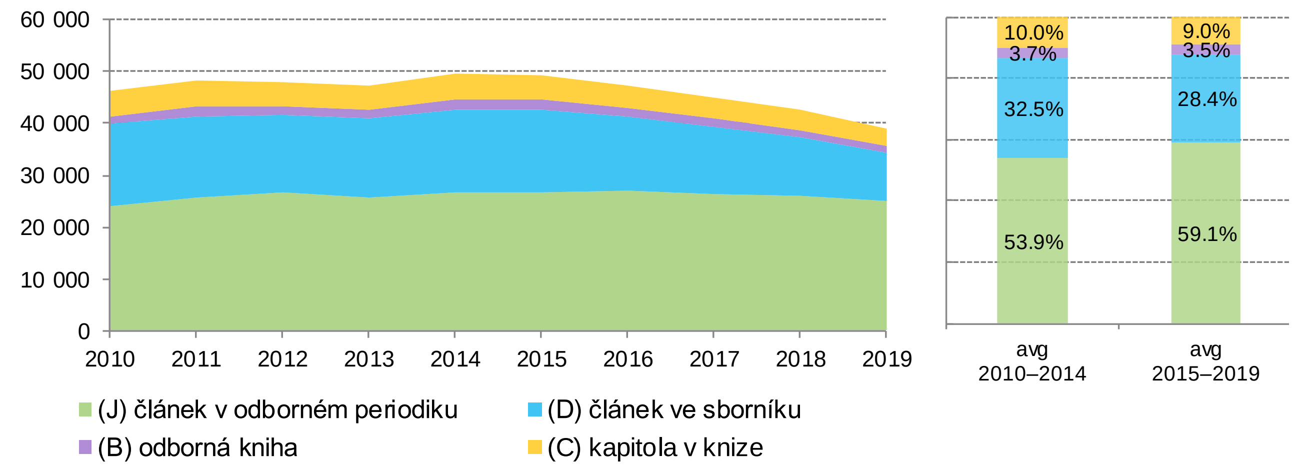


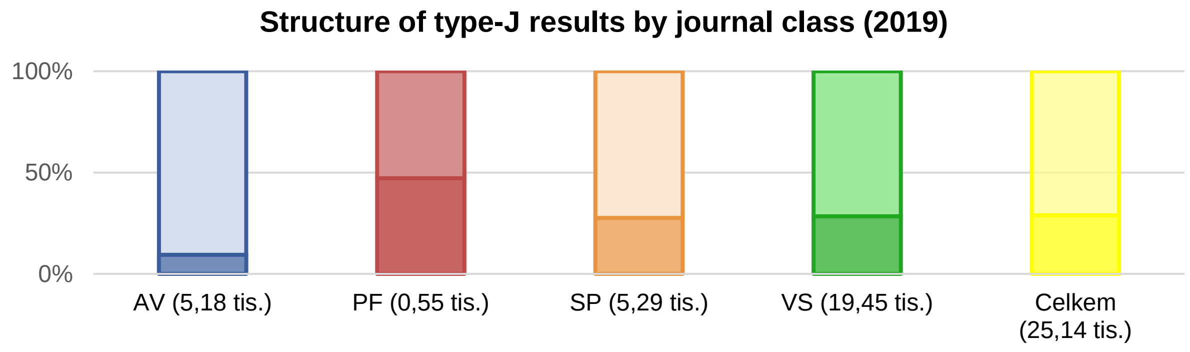
Methodology 2017+
Applied
Other non-publication
Publication

Source: RDI IS, status of database as at 30 June 2019, data exported on 31 July 2020

If one looks in detail at the type of publication results (Figure 7.3), it is clear that in the reference period, type J results (peer-reviewed professional articles) comprised more than a half of the entire number of publication results. The gradual reduction in type D results (articles in proceedings) can be seen as positive, especially as it favours growth of peer-reviewed professional articles, which can indicate that the quality of publication results is improving. Likely contributing substantially to this were changes in the approach to evaluating research organisations, where ever greater emphasis is being placed on publication in leading and internationally recognised journals. It is also possible to observe that the proportion of type B results (professional publications) and type C results (chapters in books) practically did not change in the reference period, which can be interpreted as the production of these results being less sensitive to changes in evaluation methodology, which is also be due to the greater time necessary to complete these types of results.

Figure 7.3: Types of publication results and their numbers in the Czech Republic in 2010–2019 and their average relative representation in 2010–2014 and 2015–2019





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

AS (5.18 ths), LP (0.5 ths), GO (5.1 ths), UNI (19.5 ths) Total (28 ths).

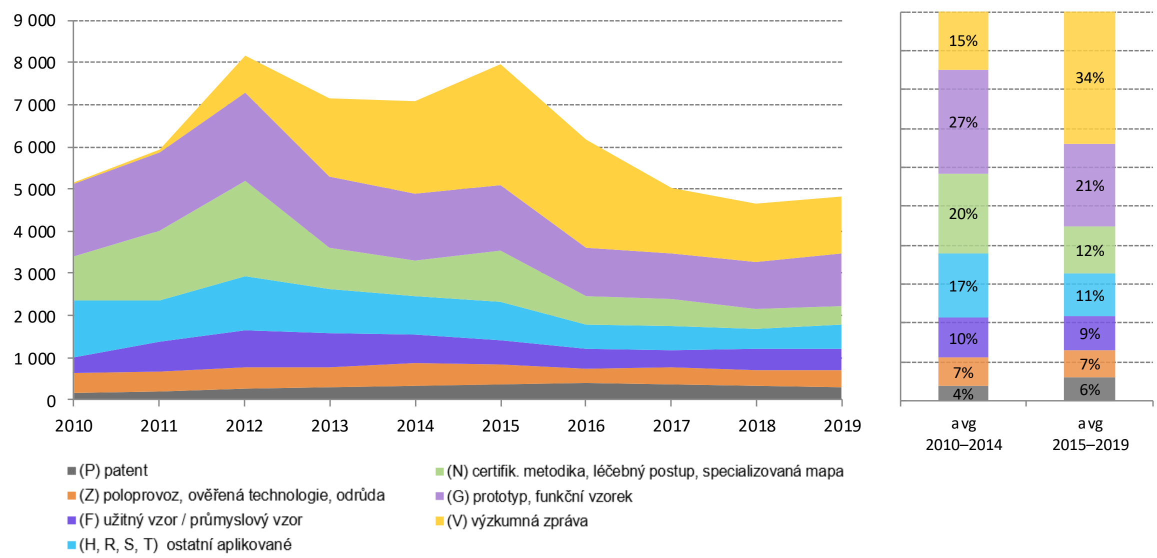
Source: RDI IS, status of the database as at 30 June 2020, data exported on 31 July 2020
The structure of type J results shows data valid for 2019. The top section of each column expresses the proportion of articles published in WoS and Scopus indexed journals; the bottom expresses the proportion of articles published in other peer-reviewed journals. ***AS** – public research institutions established by the Czech Academy of Sciences pursuant*

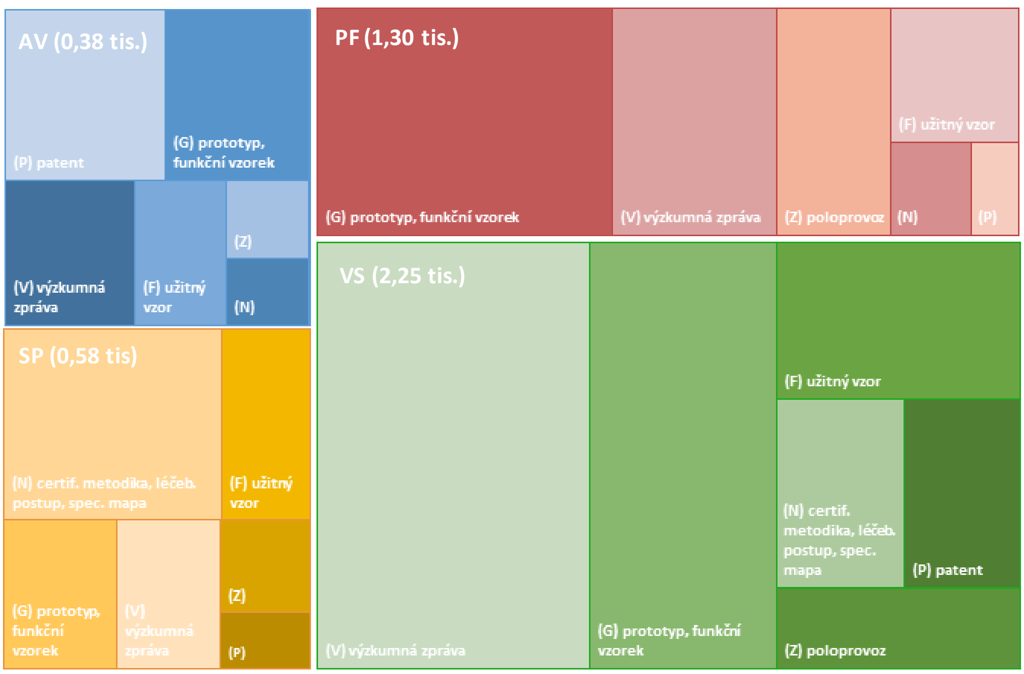
*to Act No. 341/2005 Coll.; **LP** – legal and natural persons, individuals and institutions not falling under any of the above groups, e.g. joint-stock companies, limited liability companies, public benefit companies, foundations, civic associations; **GO** – organisations co-funded by the state, organisational units of the state and public research institutions other than the institutions of the Czech Academy of Sciences and public universities; **UNI** – Universities (public, state and private).*

Figure 7.3 (at the bottom) shows the structure of type J results according to the type of research organisation that contributes to the creation of the result and according to the type of periodical in which the article was published. For the purpose of this analysis, periodicals were divided into periodicals indexed in journals in the WoS and Scopus databases and other peer-reviewed periodicals 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 Czech Academy of Sciences did, with teaching hospitals being the largest contributors of articles in the GO category; the LN group (i.e., predominantly companies) contributed an insignificant number of articles compared with other groups in 2019. 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 2019, the institutions of the Czech Academy of Sciences substantially surpass other groups of research organisations (over 90% of articles in WoS and Scopus). 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 peer-reviewed periodicals. In the case of businesses that focus on research and development, there is a tendency to publish in other peer-reviewed periodicals as well. That can be related to the effort of these entities to disseminate the results of research into practice, as especially Czech peer-reviewed periodicals can, similarly to conference proceedings, be more accessible and utilisable by national experts, the public and manufacturing. However, it can 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 the system that had been in place for evaluating research organisations until 2016. If it continues to persist, this practice can be expected to be eliminated by the new Methodology 2017+. To differentiate whether this is a positive effect (dissemination of knowledge into practice) or negative (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.), information is missing on the further use of publications by other entities, especially producers and manufacturers.

Figure 7.4 provides a detailed overview of the evolution of the number of non-publication applied results and clearly shows that in recent years, the number of type V results (research reports) suffered the biggest drop. The number of certified methodologies, medical procedures and specialised maps also dropped. 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 20010–2019 period (average growth was 14% for the 2010–2014 period and 15% for 2015–2019). The low production of patents in the Czech Republic is apparent also from international comparisons (see Chapter 8 – Innovation Performance of the Czech Economy and Its International Comparison). The growth in the proportion of patents in total results can be seen as a positive trend, which should, however, be accompanied by an increase in royalty revenues.

Figure 7.4: Types and number of applied results in the Czech Republic in 2010–2019 and their average representation in 2010–2014 and 2015–2019





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

AV – AS
PF – LP
SP – GO

(P) patent
(Z) pilot operation, verified technology, variety
(F) utility model / industrial design
(H, R, S, T) other applied
(N) certified 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

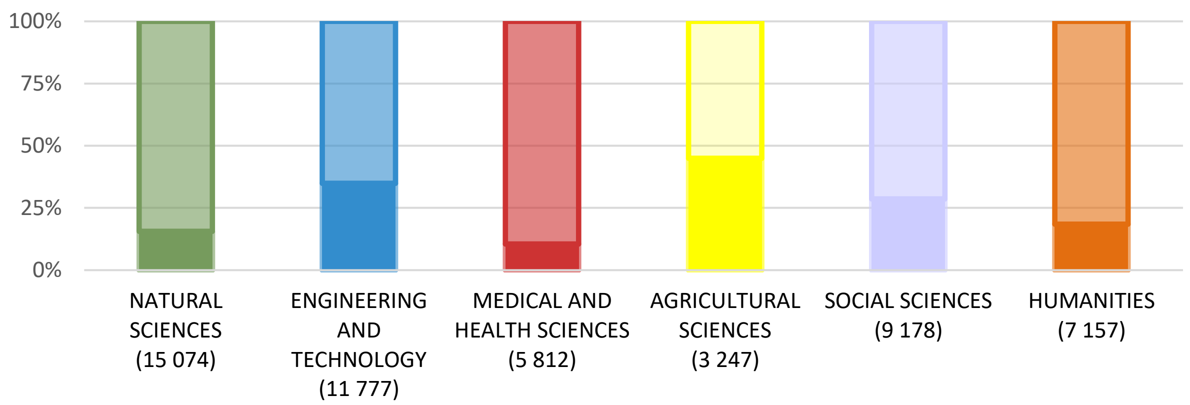
UNI *– universities (public, state and private);* ***GO*** *– organisations co-funded from the State budget and public research organisations outside CAS institutes and public universities;* ***LP*** *– legal and natural persons, individuals and institutions not falling under any of the above groups, civic associations. The numbers in parentheses next to the name of the RO category are the absolute numbers applied results without H, R, S, T. Type S / T results are summary categories used for applied research results up until 2006 / 2007.*

Furthermore, Figure 7.4 (bottom) 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). Almost 600 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 (about two-fifths of their results). In terms of absolute values, CAS institutes created the smallest number of non-publication applied results, focusing their production on three types of results: G – prototypes, functional models (24%); P – patents (21%); and F – utility models (21%).

The structure and number of results are dependent on the currently running targeted support programmes, where the production of results is determined by the formulated objectives and formal requirements for the type of outputs of these research activities. That is why it is extremely important to evaluate targeted 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 relates to modifications in the way results are projected in the evaluations of research organisations. For example, type N and type F results were awarded points in the past. Points began to be awarded to these types of results in 2007, which is probably why their number 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 began to fall again. 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.

Figure 7.5 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[86]). Since 2018, all results are recorded according to a new classification system; older results are still shown according to the previous classification system. This parallel existence of two sets of codes makes analysis of longer time periods difficult; therefore, for the purposes of this chapter, only the results for 2019 were analysed. It is clear that the greatest portion of non-publication results is in the Agricultural Sciences and Engineering and Technology groups. A low proportion of non-publication results has been observed in the Natural Sciences and Medical and Health Sciences groups. One of the benefits of the new classification system is that it allows monitoring of Social Sciences and Humanities, which had not been possible under the previous classification system.

Image 7.5: Publication and non-publication results in the Czech Republic by group of FORD fields (2019)



Source: RDI IS, status of database as at 30 June 2020, data exported on 31 July 2020. The dark areas (bottom) of the columns constitute the proportion of non-publication results in the respective field group; the light areas represent the proportion of publication results; the parentheses under the names of the field groups show the absolute number of results for the respective field group.

[86] As in the case of any classification, it must be taken into account that differences may arise between field groups due to the non-homogeneity of the various groups. The FORD classification comprises six field groups, which on a lower level comprise “fields” (FORDs). Group fields are then composed of 5 to 11 fields.

7.2 Quality of Results and Their International Comparison [87]

In terms of the quality of created publications, it is necessary, alongside monitoring the proportion of each type with respect to one another, to also 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, CAS institutes and other research organisations focus on. The greatest number of articles indexed in WoS or Scopus are created at universities. 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 Educational Sciences field (see Figure 7.7) has the lowest normalised citation impact ("NCI") of all FORD fields in the Czech Republic.. It can be inferred from this finding that universities focus more on what is taught than on teaching alone.

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 number of first-rate publications is growing year-on-year. Figures 7.6 and 7.7 show changes in the number of articles by Czech authors and co-authors in the 2010–2019 period and, at the same time, their citation impact (as at May 2020), both on the level of field groups and on the level of the various FORD fields. The greatest increase in the number of publications in WoS between 2010 and 2019 occurred on the level of the following field groups: Social Sciences (almost 129% increase), Engineering and Technology (almost 84% increase) and Natural Sciences (approx. 55% increase) – see the top right corner of Figure 7.6 for more details. Based on a comparison of NCI values at the field level, it can be said that a big proportion of fields hover under the global average (index lower than 1). Only 11 out of 34 FORD fields have an NCI value higher than 1. Clinical Medicine attains the highest NCI value, with it being likely that this field has a high citation impact 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.

When comparing citation impact among fields, it is important to keep in mind that citation impact can be influenced by the different publication habits of certain fields, for example, in Mathematics or Social Sciences, where it is customary to publish in the form of monographies. Furthermore, the differences among fields are, to a certain degree, influenced by the existence of

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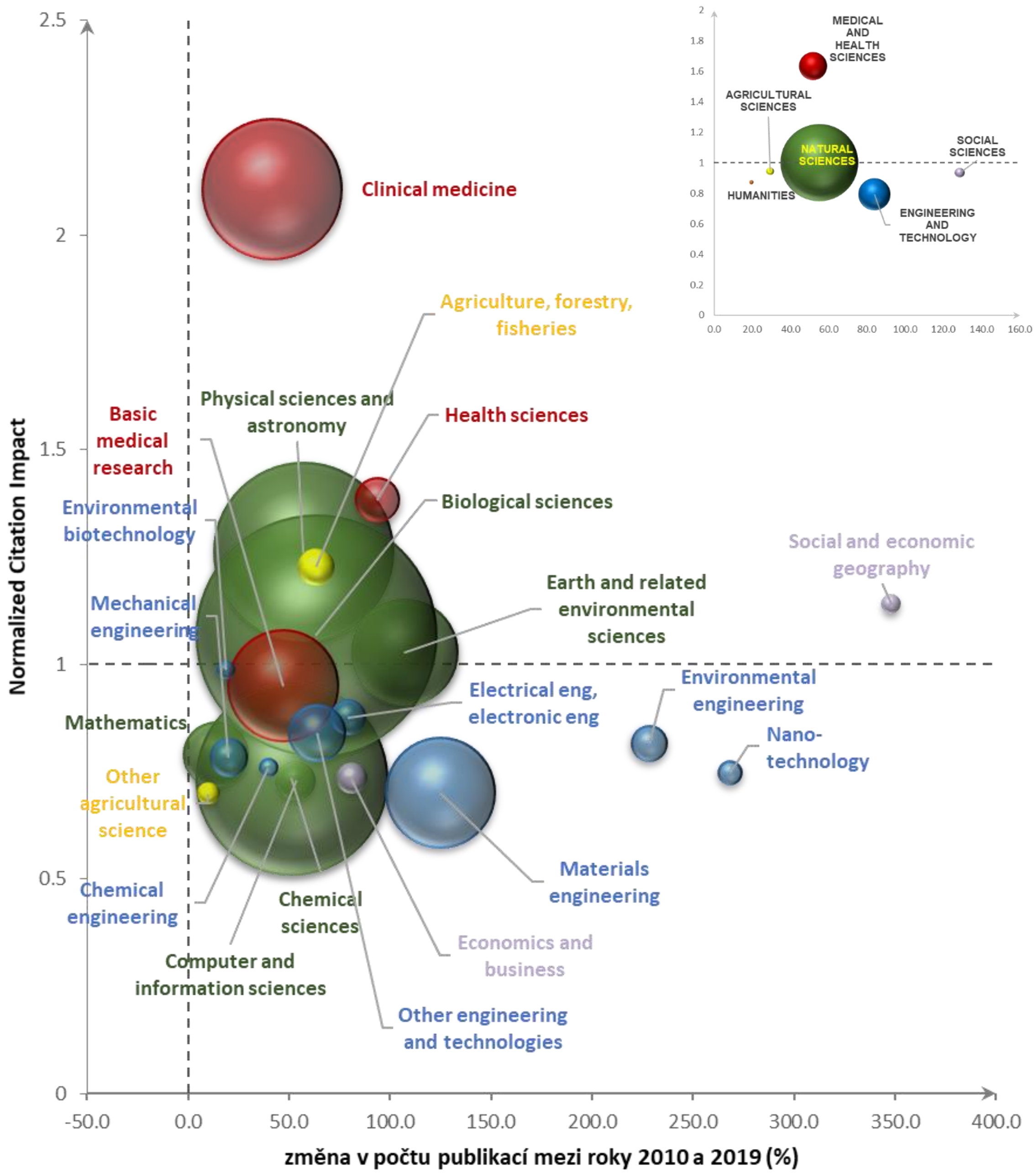
[87] The field bibliometric analysis drawn up by the Department of the Council for Research, Development and Innovation and commented on by Expert Panels is one of the supporting documents used for evaluating research organisations according to Methodology 2017+ under Module 2. The primary supporting 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+.

domestic journals indexed in the WoS database, which is why a new comparison was carried out on the evolution of the number of journals Czech authors were published in and their inclusion in quartiles with a detailed look at the evolution of the number of Czech journals (see Figure 7.9). The number of journals (ALL) in which Czech authors published their results grew in almost all fields other than Medical and Health Services; on the other hand, the greatest proportion of journals included in the first quartile (Q1) is recorded in Medical and Health Services. The number of Czech journals (CZE) has practically not changed: growth is recorded in single digits and, moreover, most journals are in the two bottom quartiles (Q3 and Q4). From this point of view, there is room for improving the level of the Czech RDI environment, as the quality of domestic journals is an indirect indicator of the level of RDI in the respective country.

Figure 7.6: 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 2010 and 2019 (%)

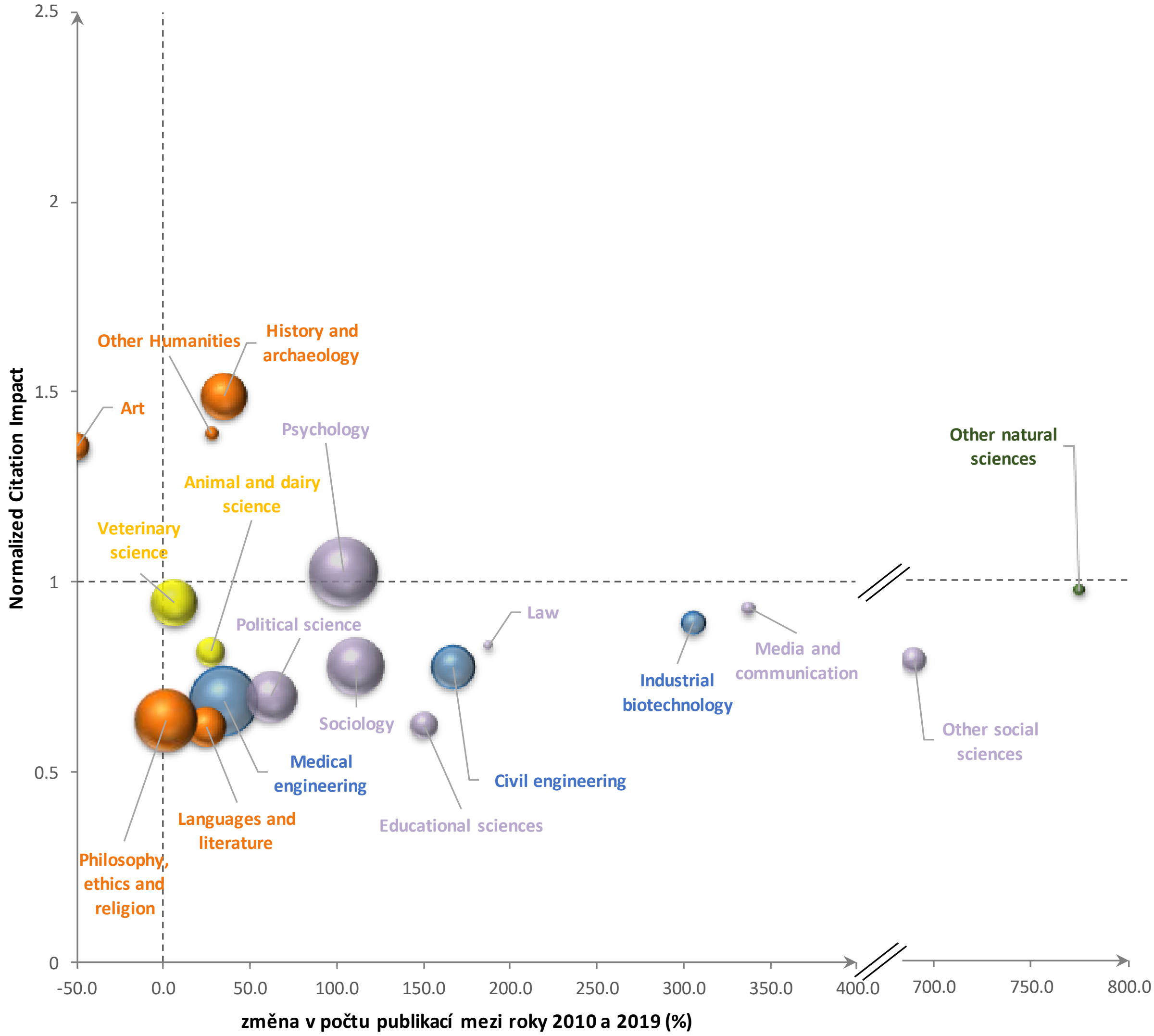
Source: WoS; classified are publications of the article and review type for the 2015–2019 period in WoS Core; field classification according to OECD (Frascati Manual)

Included are 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 2010 and 2019: (2019–2010)/2010 in %. | Vertical axis: Normalised Citation Impact as at 28 May 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 2015–2019 period.

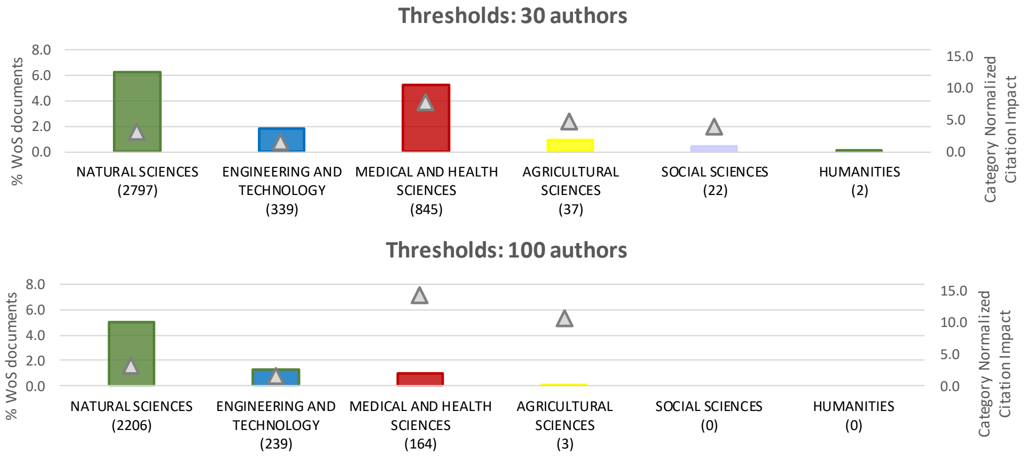
Figure 7.7: Number of publications by Czech authors in WoS by field and citation impact (fields with less than 1 000 publications)



Change in the number of publications between 2010 and 2019 (%)

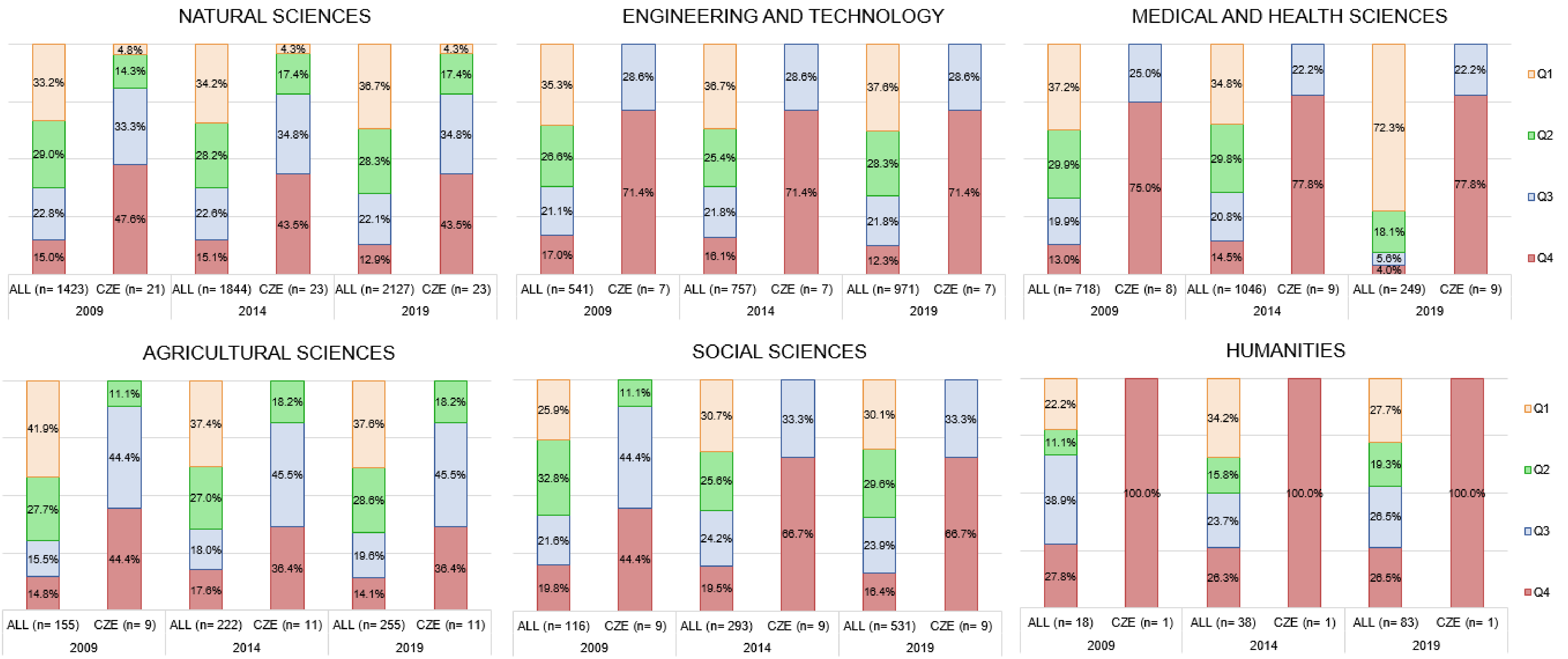
Source: WoS; included are publications of the article and review type for the 2015–2019 period in WoS Core Collection; field classification according to OECD (Frascati Manual) / Horizontal axis and vertical axis are expressed in the same way as in Figure 7.6.

Figure 7.8: Publications by Czech authors in WoS by field according to number of authors



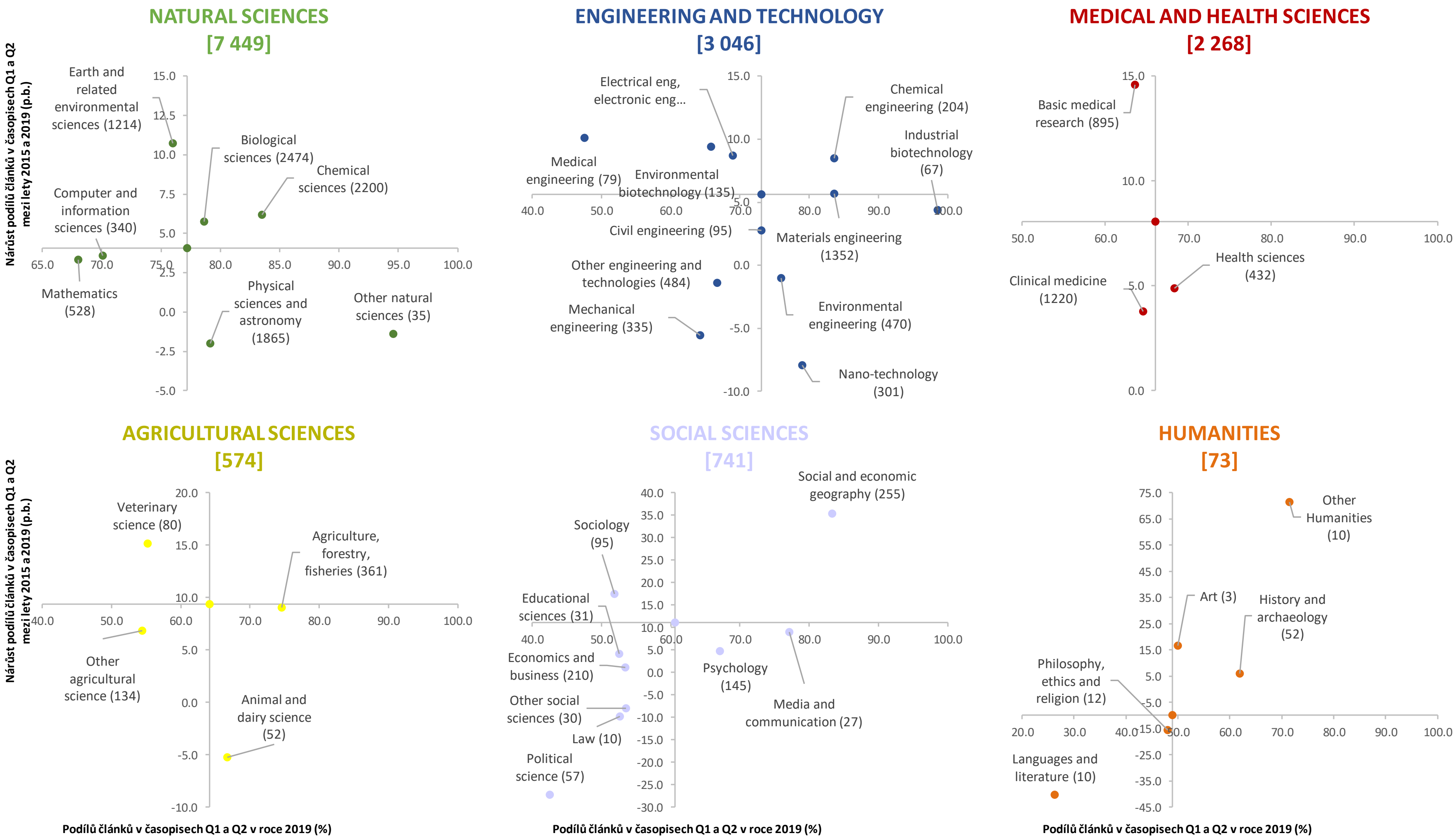
Source: WoS; included are publications of the article and review type for the 2015–2019 period in WoS Core Collection; field classification according to OECD (Frascati Manual).

Figure 7.9: Evolution of the number of journals in WoS with publications from Czech authors in 2009, 2014 and 2019



Source: WoS, included are article- and review-type publications for 2009,2014 and 2019 in WoS Core Collection periodicals, field classification according to OECD (Frascati Manual). Included are periodicals where at least one of the authors is listed as "Czech" in the address (co-authorship is not taken into account). ALL represents the total number of journals with at least one publication from a Czech author; CZE represents the total number of journals recorded in the Czech Republic.

Figure 7.10: Evolution of the proportion of articles in WoS published in Q1 and Q2 journals (2015–2019)



Proportion of articles in Q1 and Q2 journals in 2019 (%)

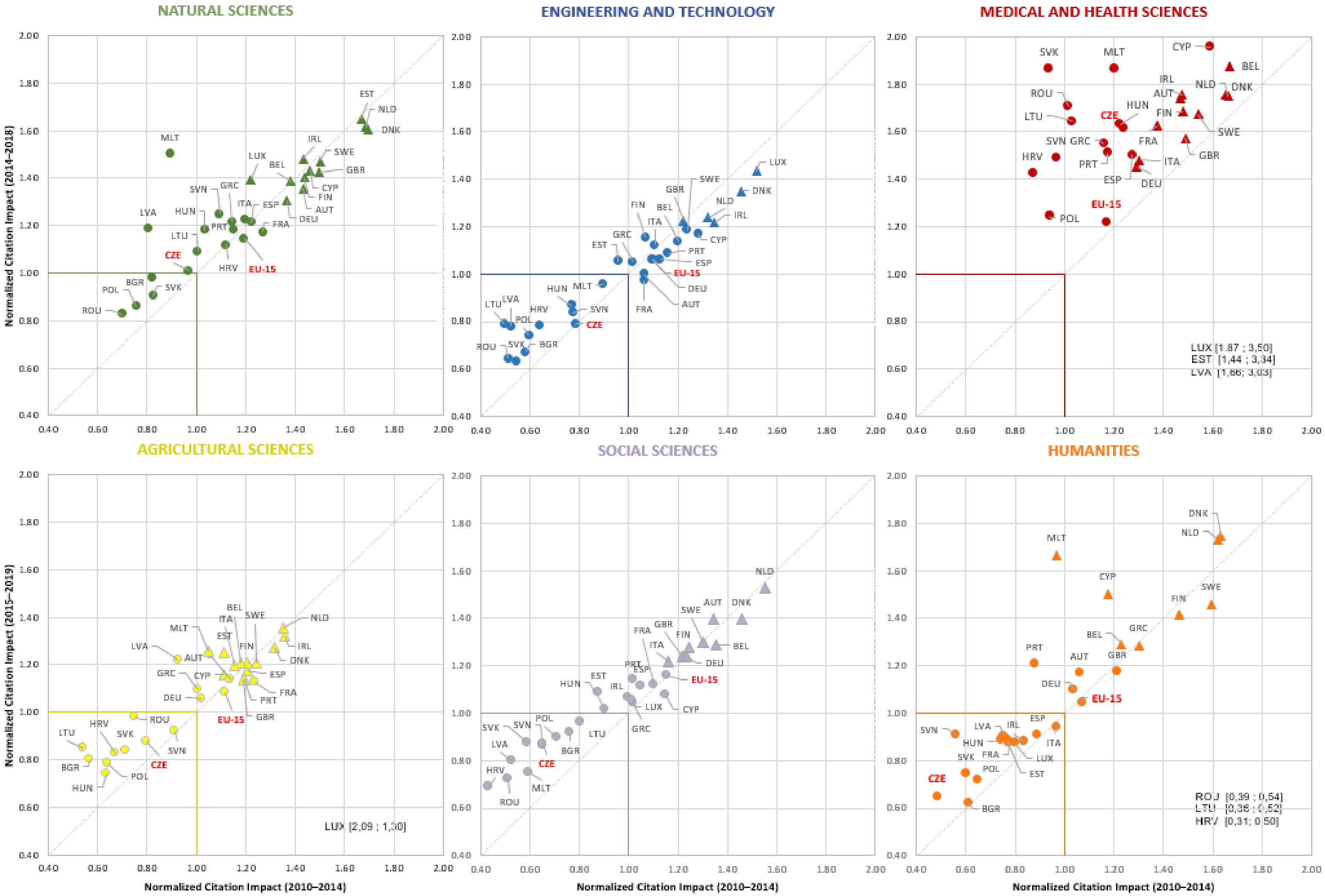
Source: included are article- and review-type publications for the 2015-2019 period in WoS Core Collection periodicals, field classification according to OECD (Frascati Manual) | The brackets contain the total number of articles in the respective field or sub-field published in journals with IF and categorised as Q1 and Q2.

Another possible way to measure the publication performance of each field is to track the evolution 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 7.10 shows the proportion of articles published by Czech authors in journals found in the top two quartiles 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.

Just like in Figures 7.6 and 7.7, it is possible to observe in Figure 7.10 the differences in the size of each field group (number of documents from 70 to 7 500). A differentiation between fields 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 field group. Most publications can be found in the first three FORD groups (see Figure 7.10, top row). On the field group level, it is possible to observe a positive trend in the growth of the proportion of articles in all groups of fields, other than Humanities. In the case of the Humanities group (bottom right graph), the disintegration into different fields is rather illustrative, because from the perspective of number of articles, it is a very small groups of fields; moreover, with regard to the specifics of Humanities fields, it is very difficult to set “traditional” bibliometric indicators for it (see, e.g., the lack of observation in the case of the Art field). As already mentioned, when comparing citation impact among various fields, it is necessary to take into account whether impacted journals (WoS indexed) are published in the specific field and whether the citations come from other Czech journals or from abroad. For example, three impacted journals (of which two are in English) in Economics and Business are published in the Czech Republic, and they have a high degree of mutual citation. The result is a low citation response to Czech publications in this field compared to the world average. Similarly, Chemical Sciences publishes an impacted journal with low citations in the Czech Republic. It is the journal most used by Czech authors to publish the results of chemical research, and this fact is probably the cause of a lower citation rate of publications relative to the world average (Figure 7.6).

In international comparisons in the evolution of NCI for each field group, it is evident from Figure 7.11 that the Czech Republic is one of the countries lagging behind the EU15 average; only in the case of Medical and Health Sciences has the Czech Republic exceeded the EU15 average. Furthermore, 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 = 0.65 in 2015–2019). Compared with other groups, this is a small group of fields that receives public support in the form of a targeted support 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+.

Image 7.11: Evolution of publications by Czech authors in WoS on the level of field groups compared with authors from EU countries



Source: WoS; included are article- and review-type publications for the 2010–2019 period in WoS Core Collection periodicals: field classification according to OECD (Frascati Manual) | Included are publications where at least one author has the respective country indicated in the address (co-authorship not taken into account). NCI is determined as at 28 May 2020 (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 publication quality, it is also necessary to monitor publication structure in terms of the journal citation impact and related publication strategy, which may differ from field to field. Figure 7.12 characterises this phenomenon on the example of field groups in the Czech Republic compared internationally. The figure clearly shows differences that, to a substantial extent, correspond to the international comparison of the actual publication citation impact (Figure 7.11) and to the breakdown of publications with 100 or more authors with a high NCI (Figure 7.8). 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, publication 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; this, however, is not enough for the citation impact of Czech authors, when compared internationally, to be at least on the EU15 level (Figure 7.11). It is thus apparent that there is intense international competition in this field, and if the Czech Republic wishes to increase 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%[88] of the most cited publications in this field group (see e.g. 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 at 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 is, compared with other countries, 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 mentioned groups are, in terms of the number of FORDs, one of the biggest; 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, Chemical Sciences, Biological Sciences and Materials Engineering – with publication numbers in the tens of thousands, and small to micro fields – such as Civil Engineering and Industrial Biotechnology – with publication numbers in the hundreds are represented in the Czech Republic. 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 even in international comparisons the citation impact is high (Figures 7.6 and 7.11), with the percentage of publications in the Top 1% of the most cited publications exceeding 3%. In **Agricultural Science**, the Czech Republic is ranked among the medium-sized

[88] 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.

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, however, has fewer publications cited in the upper quartile and in the top decile, which of course is reflected in NCI values (index AUT 1.14, CZE 0.87). Both **Social Sciences and Humanities** have a relatively low citation impact (measured by TOP 1%), as within these fields, a relatively large share of publications are ranked in the lower citation quartile.

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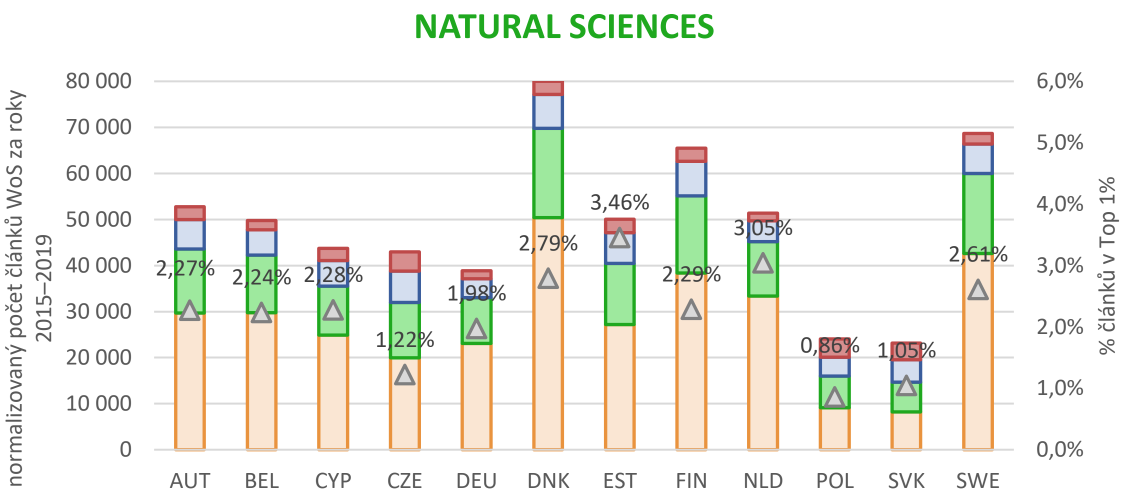
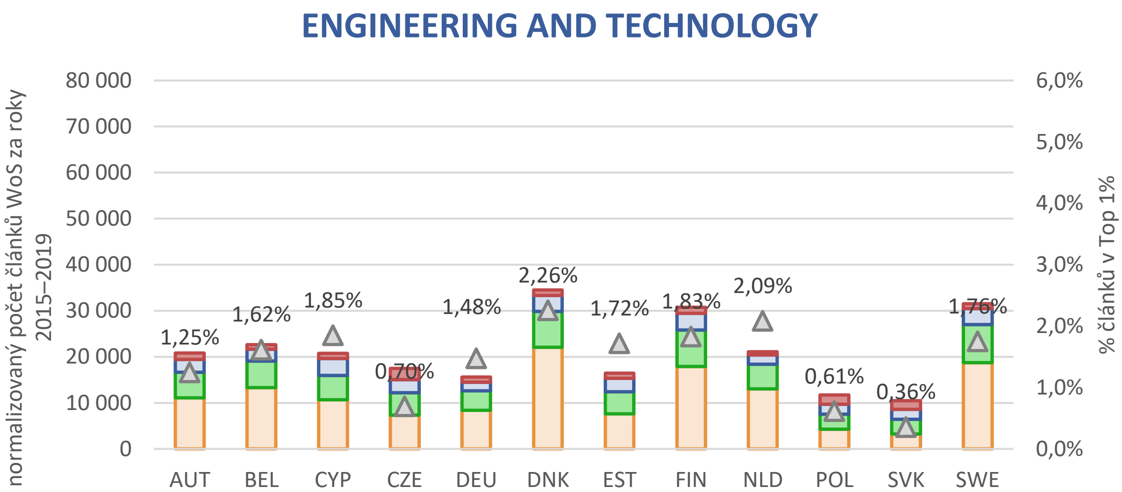
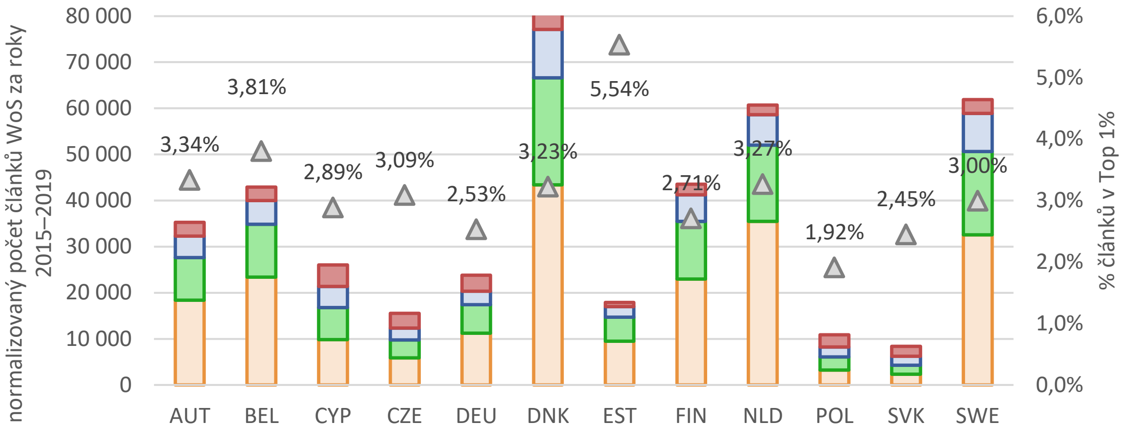
Image 7.12: International comparison of the quality of publications in field groups in the Czech Republic according to citation response of periodicals

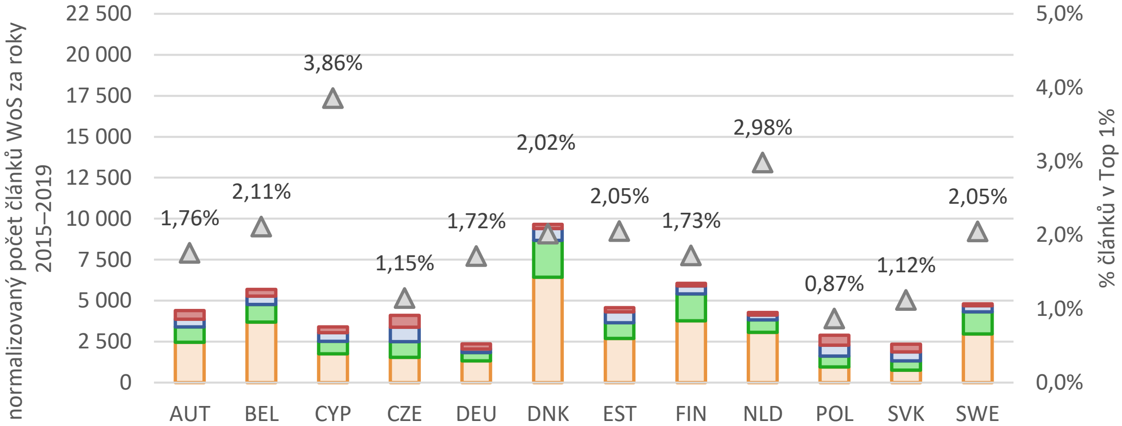


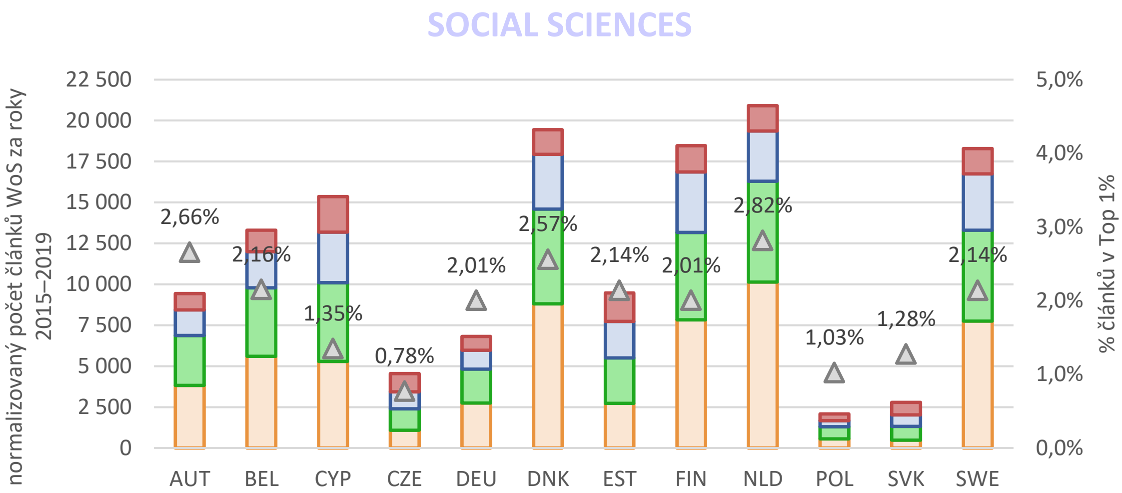


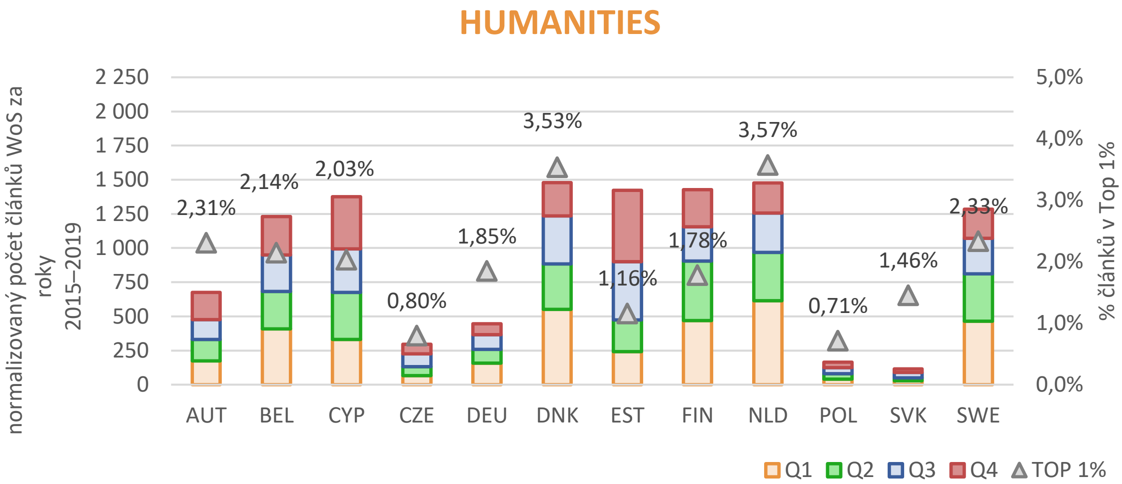
MEDICAL AND HEALTH SCIENCES



AGRICULTURAL SCIENCES







Normalised citation impact (WoS) for 2015-2019
% of Article in Top 1%

Source: WoS; included are article and review type publications for 2015–2019 in WoS Core Collection periodicals / These are publications with at least one author having "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 such field. For international comparisons, data from other medium-sized countries where the native language is not English (save New Zealand) was 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.

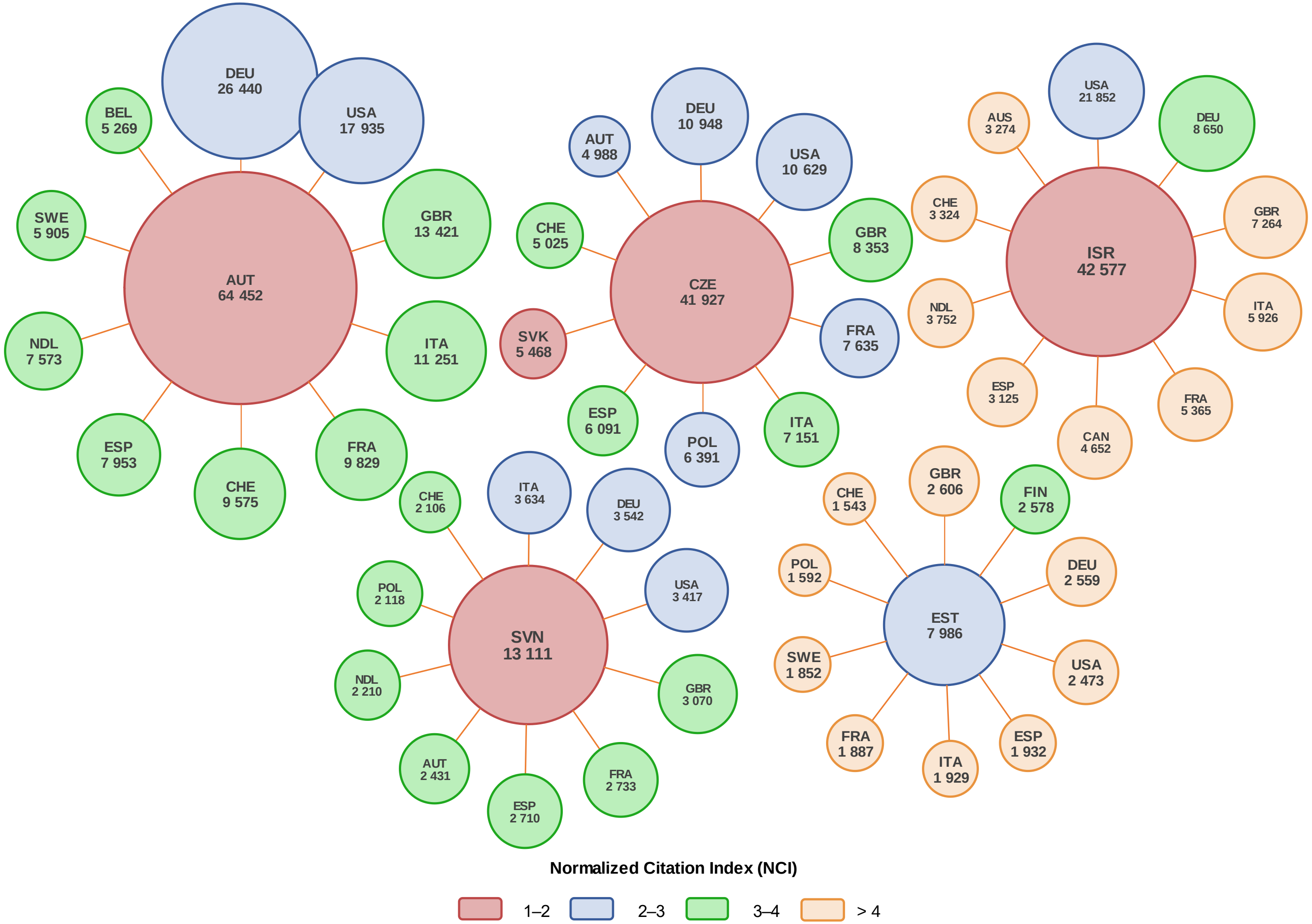
The mentioned facts about the size and quality of field groups according to publication results (Figures 7.6 to 7.11) partially correspond to the financial allocation of targeted support to field groups and individual fields (Figures 2.5 to 2.7 in Chapter 2 – Funding of RDI from the State Budget). The high support for projects[89] in the Biological Sciences, Medical Sciences, Physics and Chemistry manifested itself in the higher number of publication outputs and, in the case of the

[89] Due to the gradual transition to the FORD code list, project fields are reported according to the previous RDI IS code list.

Medical Sciences and Chemistry also by their high level of quality. It may appear in the case of the Social Sciences and Humanities and Industrial Sciences that financial allocations of targeted support do not 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 can be the result of activities funded institutionally, with there not being a sufficient amount of relevant data for a longer period of time to allow determination of financial allocation of institutional support by field.

Another important measure of quality of publications 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 2015, out of 13 500 publications recorded in the WoS database, only about 53% were international, in 2019 this number was almost 61% out of a total of 16 300 publications. As documented by Figure 7.13, the structure of countries with which Czech scientists cooperate on publications is favourable.

Figure 7.13: National authors' publications created in cooperation with foreign partners – comparison of the Czech Republic with selected countries (2015–2019)

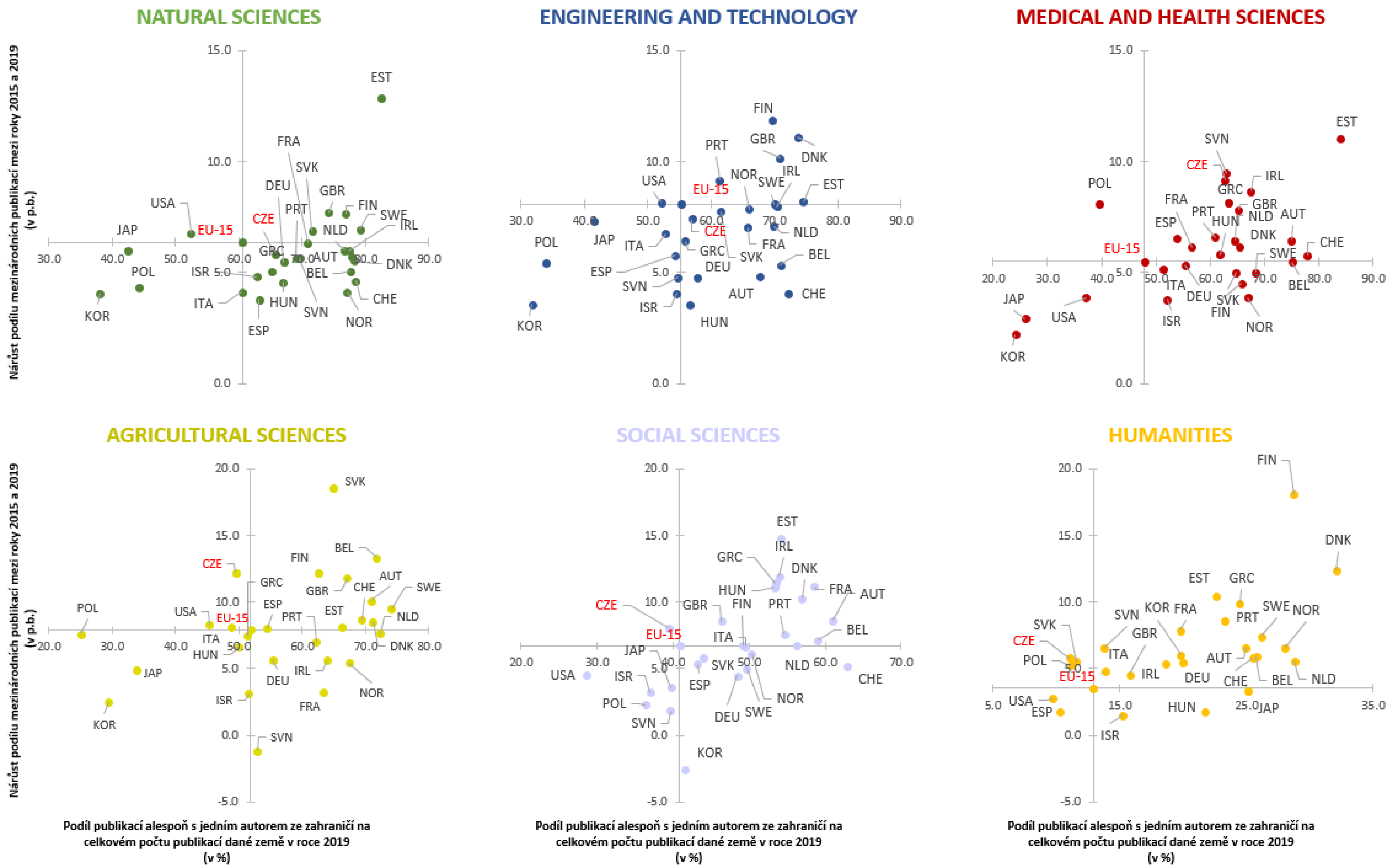


Source: WoS; included are article-, review- and letter-type publications for 2015–2019 in WoS Core Collection publications; field classification according to OECD (Frascati Manual) | The bubbles contain the number of publications created in 2015–2019 where authors from the home country worked with authors from the cooperating country.

In 2015-2019, the greatest number of international publications were created by Czech authors in cooperation with authors from Germany, followed by cooperation with colleagues from the USA and Great Britain. The publication of articles with a relatively high NCI (between 3–4) is occurring in the case of cooperation of Czech authors with colleagues from Great Britain, Italy, Spain and Switzerland; conversely, the least prestigious publications in terms of NCI are created in cooperation with colleagues from Slovakia. The composition of countries that colleagues from Austria work with is similar to that of the Czech Republic; however, the NCI of these publications is higher. The Czech Republic has, compared with the EU average, relatively good results in international cooperation; i.e., it attains good values in case of the "Cooperation on international scientific publications" indicator (SII, Chapter 8). 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 NCI). The Czech Republic should thus not focus only on increasing the number of publications created in international cooperation, but also on increasing the number of first-rate publications, as is the case of, e.g., Estonia, where the NCI exceeds the value of 4 in almost all the countries it works with.

As regards the extent of publication with foreign partners between the various countries (Figure 7.14), the Czech Republic was above the EU15 average in Natural Sciences, Engineering and Technology and Medical and Health Sciences in 2019. In the last three field groups, the percentage of publications created under international cooperation may be behind the EU15 average, but in the last five years, a substantial increase in the proportion in the respective field groups has occurred, which can be seen as positive. The greatest degree of cooperation by Czech authors was in Natural Sciences (approx. 65.7%); this field group has the greatest number of articles with the number of authors at 100 or more (see Figure 7.8). The second greatest degree of cooperation was recorded in Medical and Health Sciences (62.71%). Social Sciences and Humanities belong to fields with a very low proportion of publications created in cooperation with foreign partners (up to 40%). Countries with a high proportion of publications with foreign cooperation are, e.g., 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 7.14: Proportion of scientific publications created by international teams of authors in EU countries and selected OECD countries



Growth in proportion of international publications between 2015 and 2019

Proportion of publications with at least one author from abroad to total number of publications of the respective country in 2019 (%)

Source: WoS; included are article-, review- and letter-type publications for 2015–2019 in WoS Core Collection periodicals; field classification according to OECD (Frascati Manual)

7.3 Licences

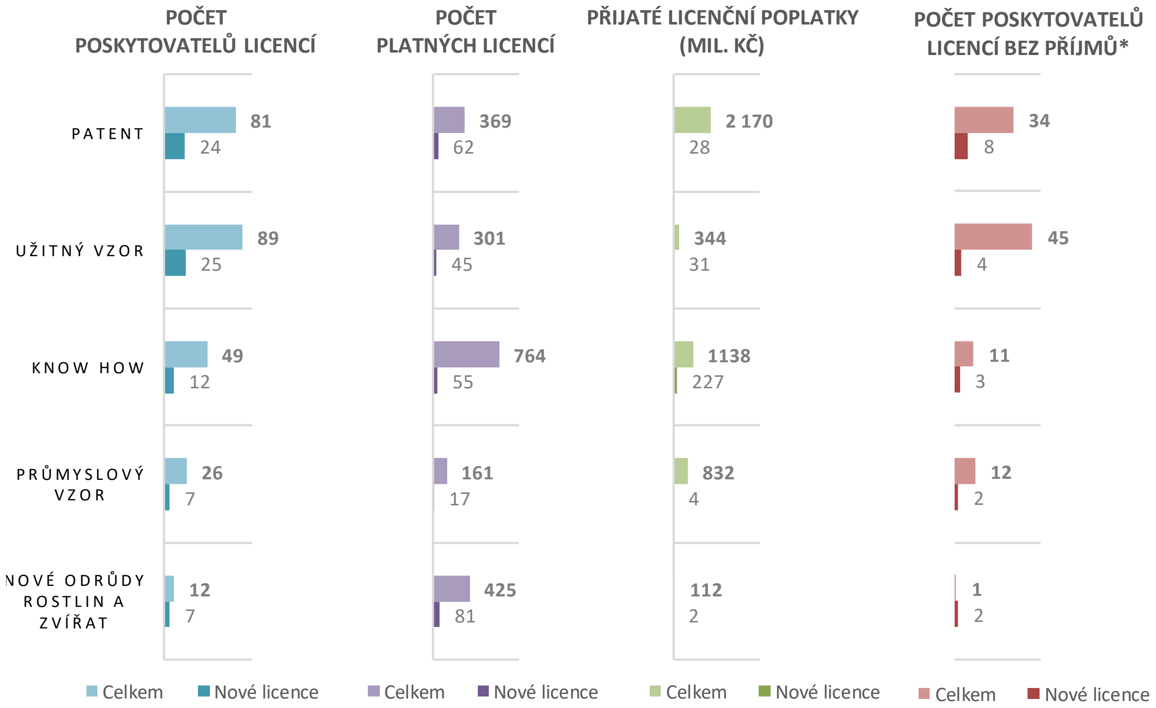
In the case of RDI results intended for application – the use of which can be expected to be interesting not only for their originator, but also for other groups of users – the originator of RDI results elects a suitable form of protection that then allows the regulation and stipulation of the conditions for the further use of these results. These results are not published to the extent of technical details, but repeatedly usable results become the subject of legal protection like patents, utility models or unpatented results 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 to be paid for enjoying the right to use the defined RDI results.

CZSO statistics ascertain the following: (i) Anticipated interest in RID result – number of licensors in the Czech Republic for selected industrial property items; (ii) Actual interest in RDI result – number of concluded licence agreements; and (iii) Market value of the protected RDI result – the royalty amount.

Figure 7.15 below shows granted licences by subject of licence agreement for 2019, including number of subjects providing licences and total revenue from royalties. According to summary results of the examination of licences for 2019, which was carried out by the CZSO, interest in licences resulting from research activity in the Czech Republic saw renewed growth. The total number of monitored licensors grew year-on-year by 7% (from 233 to 257). Among licensors, those with **patent licences** predominated (Table 7.1 shows the evolution of the number of patent licences granted and royalties received). In the case of royalties arising from patent licences, one institute of the Czech Academy of Sciences contributed substantially. About 20% more entities than in the previous year had been granted a licence to use technical solutions protected by a **utility model** (from 74 to 89), and even royalties grew by 20%. In the case of **industrial design,** the number of licensors increased by 8% (from 24 to 26), and the number of granted licences by 8% (from 151 to 161). Royalties from industrial designs fell by 20%. **The number of licences for unpatented inventions (know-how) granted between 2014 and 2018 grew.** Contributing substantially to this growth is the specific use of this type of protection. For example, a larger number of licences and know-how may be granted over a short period of time under large development projects. Although the number of licensors in 2019 indicated year-on-year growth compared to 2018 (from 41 to 49), the royalties received fell year-on-year by almost CZK 1 billion. The number of licensors of **new plant and animal breeds** was at a ten-year low in 2019 (12 in 2019, 11 in 2018). The total number of licences granted fell by more than 20%. The amount of royalties received grew by CZK 2.7 million compared to 2018.

Figure 7.15: Valid licences by subject of licence agreement in 2019



NUMBER OF LICENSORS
NUMBER OF VALID LICENCES
RECEIVED ROYALTIES
NUMBER OF LICENSORS WITHOUT REVENUE*

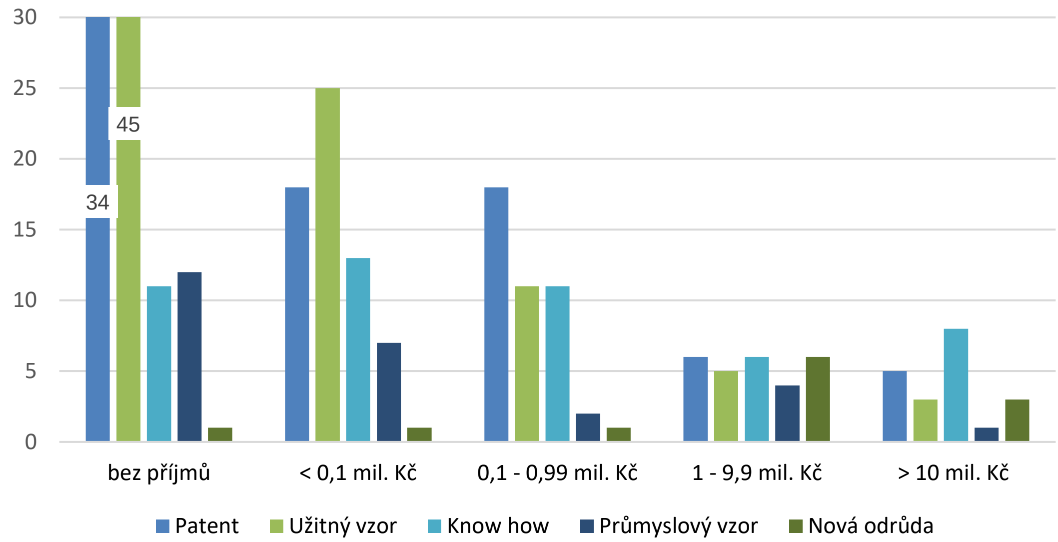
Without revenue
Patent
Utility model
Industrial design
Know-how
New breed

Total
New licences

Source: CZSO, own processing

* based on bulk royalties received from individual entities in connection with licences for the various kinds of subjects of the licence agreements

Figure 7.16: Number of licensors by subject of licence agreement and royalties received in 2019 (CZK millions)



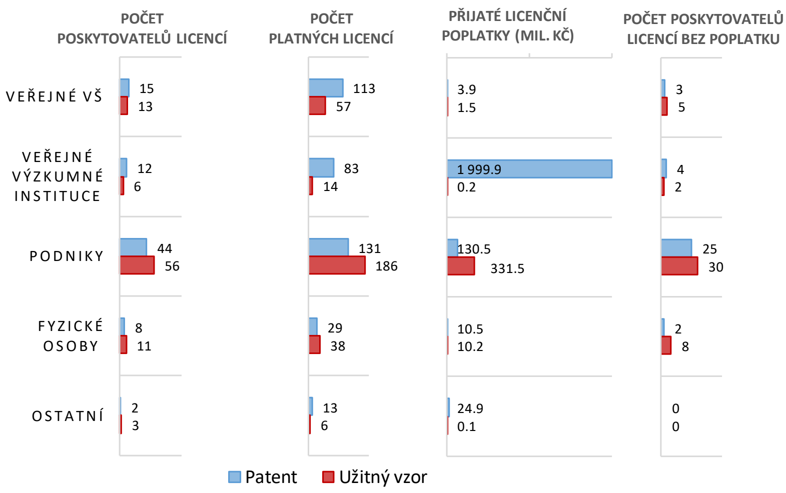
Without revenue
CZK […] million
Patent
Utility model
Industrial design
Know-how
New breed
Source: CZSO, own processing

It is becoming apparent that a significant number of licensors (103 out of 257, i.e., 40%) received no royalties (see Figure 7.16). This relatively high number of licensors without revenue could be due to the former principles of evaluation prior to Methodology 2017+ (now in place), when the number of results, such as patents and utility models, were accredited regardless of the amount of the royalties

The growing interest in licenced results of innovated activities can be seen as a positive trend that, ideally, should be accompanied by growing revenue from royalties. Figure 7.17 shows the licences provided in 2019 for patents and for utility models by licensor sector, including amount of received royalties.

Most of the royalties for patents and utility models (just under 75%) were received by public research institutions (CZK 1.4 billion). The remaining royalties were received by the business sector (CZK 44 million, i.e., 23%).

Figure 7.17: Patent and utility model licences by licensor sector in 2019



NUMBER OF LICENSORS
NUMBER OF VALID LICENCES
RECEIVED ROYALTIES
NUMBER OF LICENSORS WITHOUT ROYALTIES
PUBLIC UNIVERSITY
PUBLIC RESEARCH ORGANISATION
PRIVATE ENTERPRISES
INDIVIDUALS
OTHER
Patent
Utility model

Source: CZSO, own processing

Table 7.1 shows the evolution of the number of patent licensors, granted patented licences and received royalties over time, i.e., in 2010–2018. The number of patent licensors, just like the number of granted licences, grew compared to 2009: in the case of the number of patent licensors by more than 108% and in the case of the number of granted licences by more than 178%. The sudden drop in total received royalties per licence between 2016 and 2017 may thus seem surprising, but this drop is caused by one public research institution falling under the CSA (Institute of Organic Chemistry and Biochemistry), 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 90% of all royalties, from the point of view of royalty recipients (public research institutions), were allocated in the government sector. In 2010–2019, these revenues totalled CZK 19.5 billion.

Table 7.1: Evolution of the number of patents and royalties between 2010 and 2019

Indicator	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	diff 2019/2010 %
Patent licensors											
Total	51	56	69	71	66	75	72	81	83	81	59%
Of which with new licence	16	21	26	28	20	20	19	25	25	24	50%
Licensor's sector											
Private enterprise – total	33	22	28	34	36	42	40	41	43	44	33%
Public university	7	11	12	13	11	11	14	16	14	15	114%
Public research institution - total	11	11	11	11	11	12	10	12	15	12	9%
Of which workplaces of the Czech Academy of Sciences	8	6	7	6	6	7	6	8	10	8	0%
Entrepreneur	-	12	15	10	6	8	6	10	9	8	-
Other	-	-	3	3	2	2	2	2	2	2	-
Patent licences granted											
Total	142	166	224	270	255	271	307	370	372	369	160%
Of which with new licence	27	42	68	69	40	51	61	78	81	62	130%
Received royalties (CZK mil.)											
Total	1 427.1	1 519.2	1 865.0	2 292.5	2 726.0	3 319.4	3 356.3	1 930.4	1 602.4	1 602.4	12%
Of which for new licences	69.7	3.4	8.1	266.0	14.9	12.8	13.6	17.6	73.2	73.2	5%
Royalty recipient's sector											
Private enterprise – total	34.6	41.3	63.1	317.2	290.4	313.3	105.6	101.0	165.3	130.5	278%
Public university	52.6	3.6	2.1	6.5	21.5	5.9	6.7	5.6	10.5	3.9	-93%
Public research institute – total	1 339.9	1 472.3	1 781.2	1 953.6	2 406.5	2 992.5	3 235.7	1 814.0	1 412.1	1 999.9	49%
Of which workplaces of the Czech Academy of Sciences	1 339.7	1 471.7	1 780.8	1 952.7	2 406.2	2 992.1	3 235.3	1 812.7	1 410.8	1 999.1	49%
Entrepreneur	-	2.0	18.6	15.1	7.4	7.6	7.6	9.7	9.9	10.5	-
Other	-	-	-	0.2	0.1	0.1	0.7	0.1	4.7	24.9	-

Source: CZSO

Table 7.2 below shows the structure of granted licences by the contractual partner's country. As is apparent, most contractual partners who were provided a patent and utility model licence came from the Czech Republic. Most foreign royalties for patent licences in 2019 came from the USA (CZK 2 billion), followed far behind by China (CZK 56.3 million). As stated by the CZSO in its analysis, Czech licensors, since 2009, received up to 47 times higher amount of patent royalties from these two countries than from the Czech Republic itself, although 72% of all granted licences "stayed" in the country. In 2019, most utility model royalties came from Russia (CZK 67.8 million).

Table 7.2: Granted patent and utility model licences and royalties by contractual partner's country in 2019

Structure of granted licences by contractual partner's country

for patents

Country		number 2010	number 2019	2019 of which new
Czech Republic	CZE	68	284	54
EU28 (w/o CZE) total		20	39	5
France	FRA	3	2	-
Italy	ITA	4	-	-
Germany	DEU	8	24	4
Poland	POL	1	2	1
Austria	AUT	1	2	-
Slovakia	SVK	-	5	-
Great Britain	GBR	-	2	-
Other EU countries		3	2	-
China	CHN	8	9	-
Russia	RUS	1	-	-
United States	USA	37	21	2
Switzerland	CHE	6	2	1
Other world countries		2	14	

for utility models

Country		number 2010	number 2019	2019 of which new
Czech Republic	CZE	101	254	38
EU28 (w/o CZE) total		13	34	4
Bulgaria	BGR	2	3	1
Croatia	HRV	1	2	
Hungary	HUN	-	2	
Germany	DEU	-	5	
Netherlands	NDL	-	1	
Poland	POL	-	1	1
Austria	AUT	1	1	
Romania	ROU	-	2	
Slovakia	SVK	9	12	
Sweden	SWE	-	1	
Other EU countries		-	4	2
Belarus	BLR	1	1	
China	CHE	19	1	
Russia	RUS	1	3	
United States	USA	1	1	1
Serbia	SRB	1	2	
Switzerland	CHE	8	-	-
Ukraine	UKR	1	1	-
Other world countries		-	4	2

Structure of royalties received by recipient's country

for patents

Country		CZK millions 2010	CZK millions 2019	2019 of which new
Czech Republic	CZE	67.8	96.3	26.1
EU28 (w/o CZE) total		6.0	13.6	0.3
France	FRA	0.4	12.0	-
Italy	ITA	0.1	-	-
Germany	DEU	4.4	0.9	0.1
Austria	AUT	1.1	0.1	-
Slovakia	SVK	-	0.1	-
Great Britain	GBR	-	0.3	-
Other EU countries		-	0.1	-
China	CHN	13.3	56.3	-
Japan	JAP	-	-	-
Russia	RUS	-	-	-
United States	USA	1 337.5	1 998.4	1.2
Switzerland	CHE	2.5	0.1	0.1
Other world countries		-	5.0	-

for utility models

Country		CZK millions 2010	CZK millions 2019	2019 of which new
Czech Republic	CZE	23.2	44.8	2.8
EU28 (w/o CZE) total		12.9	166.5	0.6
Bulgaria	BGR	2.0	12.3	-
Croatia	HRV	2.3	21.2	-
Hungary	HUN	-	16.5	-
Netherlands	NDL	-	13.6	-
Austria	AUT	0.0	1.3	-
Romania	ROU	-	17.5	-
Slovakia	SVK	8.6	40.7	-
Sweden	SWE	-	1.5	-
Great Britain	GBR	-	41.3	-
Other EU countries		-	0.7	0.6
China	CHN	28.1	6.0	-
Russia	RUS	47.1	67.8	27.6
United States	USA	0.0	0.0	0.023
Serbia	SRB	2.1	8.4	
Switzerland	CHE	4.0	-	
Ukraine	UKR	41.3	39.7	-
Other world countries		-	10.3	0.4

Source: CZSO, processed by RDI Council

Czech patent statistics and the status of utilisation of intellectual property protection in the Czech Republic should also be observed through international comparisons (see Chapter 8 for more details). Patent statistics are usually part of "composite indicators" assessing the innovation performance of a country (e.g., SII, GII, IOI). It 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:[90]

- 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
- Insufficient use of intellectual property protection in science and research
- Existing public support for intellectual property protection without linked 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

[90] According to the Industrial Property Office: the evaluation 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 intellection property rights.

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

- For the resolution of intellectual property disputes, alternative methods (mediation) are not used sufficiently in the Czech Republic; there are not enough sufficiently trained mediators with knowledge of intellectual property issues; there is no specialised body that would focus on resolving intellectual property disputes through alternative methods
- Analysis of the European Innovation Scoreboard (EIS) Intellectual Assets Sub-Index shows that the Czech Republic lags behind in the frequency of intellection property protection; it is highly likely that the State does not invest as much in activities tied to intellectual property protection as it does in other sub-indexes; an analysis of the State's investments in correlation to the EIS sub-indexes is not available.

8 Innovative Performance of the Czech Economy and Its International Comparison

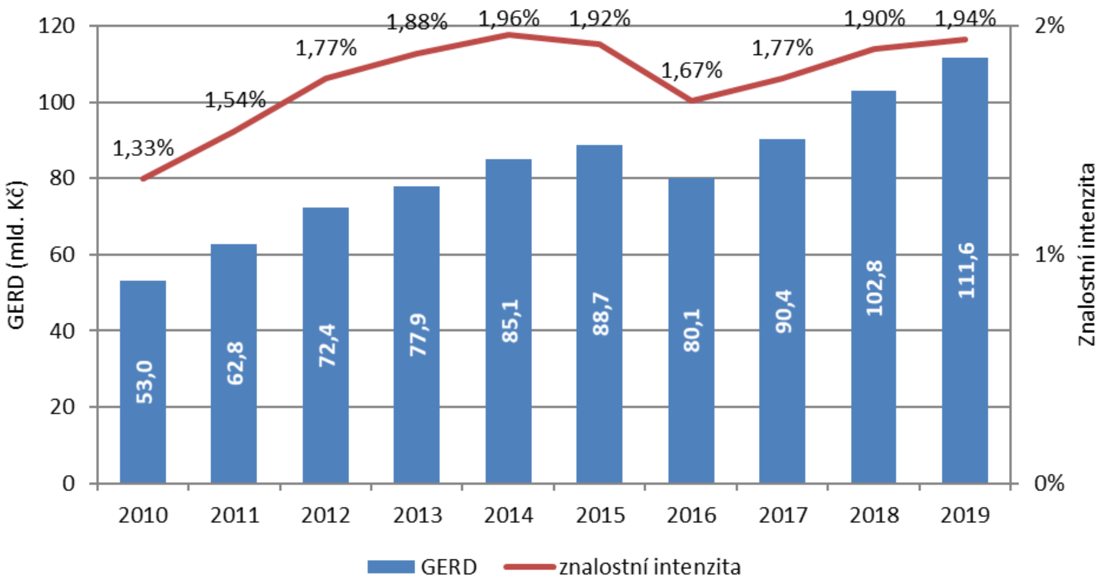
Long-term and sustainable economic growth and the competitiveness of any economy cannot do without effective innovation efforts. Innovation can also be seen as a tool to mitigate the effects of economic crises. Successful innovation requires a balanced system of support for innovation efforts backed by an optimal ratio of public and private investment, and all this works only if business and academia are connected effectively. The basis for successful innovations is a top-notch research base and maximum utilisation of the results of basic research.

The aim of this chapter is to provide a general analysis of the innovation performance of the Czech economy and compare it internationally, especially with selected EU countries. Innovation performance in this chapter is measured by two types of indicators: simple (knowledge intensity) and composite (Summary Innovation Index, Global Innovation Index, Innovation Output Indicator). Furthermore, the chapter also includes the CZSO's survey on innovation activities of enterprises. The advantage of simple indicators is relatively easy calculation, simple interpretation and easy comparison of the results of these indicators across economies. However, the contribution of individual factors or components to the achieved innovation performance cannot be read from simple indicators. These indicators can therefore be considered as basic indicators of innovation performance, but for a comprehensive analysis of innovation performance, it is necessary to supplement simple indicators with composite indicators. The greater sophistication of composite indicators lies in the fact that they are composed of up to several dozen sub-indicators and therefore enable an analysis of innovative performance.

8.1 Innovative Performance of the Czech Republic Based on Simple Indicators

Figure 8.1 shows the development of GERD CR and knowledge intensity in 2010–2019. In the reference period, GERD decreased only in 2016. Knowledge intensity decreased year-on-year only in 2015 and 2016. Compared to the base year 2010, GERD more than doubled. In 2018, the value of GERD exceeded CZK 100 billion for the first time (specifically CZK 102.8 billion); in 2019, the value of GERD reached CZK 111.6 billion. In 2019, GERD increased by 8.6% year-on-year (between 2017 and 2018, the increase was 13.7%). After the aforementioned decline from 2015 and 2016, the knowledge intensity returns to a level approaching 2% (the knowledge intensity in 2019 reached 1.94%).

Figure 8.1: GERD and knowledge intensity of the Czech Republic in 2010–2019



GERD (CZK billions), Knowledge intensity
Source: CZSO, Research and Development

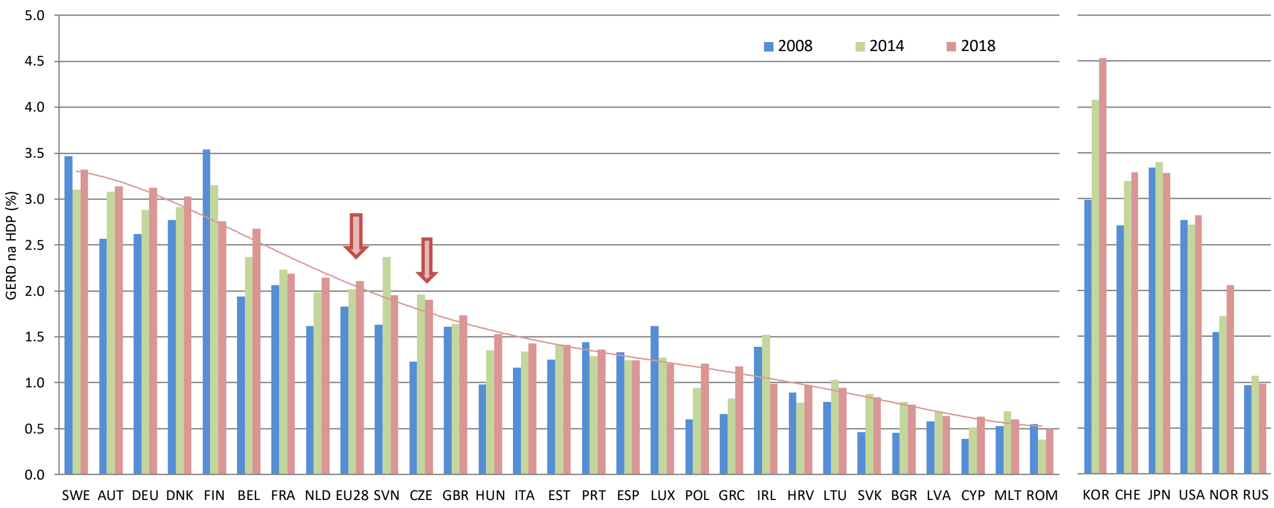
Figure 8.2 shows the knowledge intensity of selected countries in 2008, 2014 and 2018 (sorted according to 2018). EU28 countries are shown on the left side of the figure; third countries are show on the right for comparison. In 2014, the Czech Republic was ranked just behind the EU28 average; in 2018 Slovenia was between the Czech Republic and the EU28. The Czech Republic thus does not reach the value of the EU28 average in the area of knowledge intensity, but there are many other countries behind the Czech Republic in the imaginary ranking, and so it is ranked 10th. South Korea attains he highest knowledge intensity of all the countries shown in Figure 8.2 (4.5%); within the EU28, it is Sweden (3.32 %).

A comparison between 2014 and 2018 shows that South Korea, Greece, Norway, Belgium and Poland enjoyed the highest absolute increase in knowledge intensity value; in relative terms, it is Greece, Romania, Poland, Croatia and Cyprus. In 2018, the Czech Republic's knowledge intensity value decreased by 3% compared to 2014. When comparing knowledge intensity values between 2018 and 2008, the differences are, of course, even more obvious. The highest absolute increase in value is reported by South Korea, Belgium, the Czech Republic and Poland, and in relative terms by Poland, Slovakia and Greece. The decline in the knowledge intensity value between 2018 and 2008 is evident only in Portugal, Japan and Romania.

In 2018, GERD for the EU28 was EUR 336.5 billion. The largest contributors to this amount were Germany (EUR 104.7 billion, or 31.1%), France (EUR 51.8 billion, or 15.4%) and the United Kingdom (EUR 41.9 billion, or 12.5%). The Czech Republic's contribution to GERD EU28 is 1.2% (EUR 4.0 billion). In 2017, the contribution was 1.1% (EUR 3.4 billion) and in 2016 it was 1% (EUR 3.0 billion). The contribution of other selected EU countries are as follows: Sweden 4.6% (EUR

15.6 billion). Austria 3.6% (EUR 12.1 billion), Slovenia 0.3 % (EUR 0.9 billion), and Estonia 0.1% (EUR 0.4 billion).

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



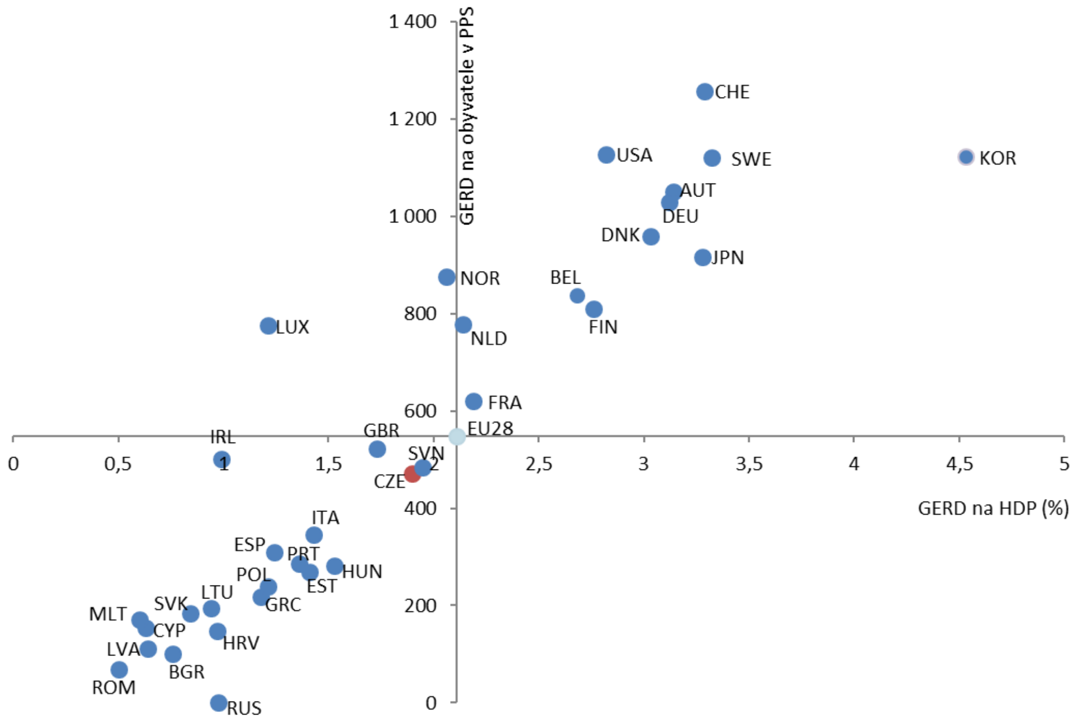
Source: Eurostat; OECD – MSTI database | For CHE, the data for 2018 are from 2017 and the data for 2014 are given for 2012.

In order to increase the informative value of knowledge intensity, it is usually compared to the amount of R&D expenditure per capita in purchasing power standards (PPS). Figure 8.3 compares selected countries according to knowledge intensity and according to R&D expenditure per capita for 2018. PPS is expressed per capita in 2005 prices.

In 2018, the Czech Republic reached 85.6 % of the EU28 average in R&D expenditure per capita in PPS (in 2017 this share was 80.9%). In absolute terms, the Czech Republic reports R&D expenditure per capita in PPS at the level of 469.8 (425.1 in 2017 and 382.6 in 2016). For comparison: the value of Sweden is 1119.9; Austria 1050.2; Slovenia 482.7 and Estonia 269.5. Within the EU28, aforementioned Sweden reaches the highest value (2.4 times higher than the Czech Republic).

Figure 8.3 also shows that while South Korea attains the highest knowledge intensity value of the selected countries, Switzerland attains the highest value after conversation of R&D expenditure per capita into PPS. The leading countries in terms of knowledge intensity and, at the same time, GERD per capita in PPS are South Korea, Switzerland, the USA, Sweden, Austria, Germany, Denmark and Japan. At the other end of the scale are Russia, Romania, Bulgaria and Latvia. The Czech Republic, along with Great Britain and Slovenia, is found slightly below the EU28 average.

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



Source: own processing according to Eurostat and OECD – MSTI Database

Y- axis - GERD per capita in PPS (CHE data from 2017; JPN, KOR and USA data from 2016)

Axis X - GERD to GDP in % (CHE data from 2017)

8.2 Innovative Performance Based on Composite Indicators

Each year, the European Commission publishes the European Innovation Scoreboard (EIS). The EIS provides a comparison and analysis of the innovation performance of selected EU countries and third countries and compares the strengths and weaknesses of the research and innovation environment. The current EIS 2020 is based mainly on data from 2019. EIS 2020 is the first edition that does not include the United Kingdom. The EIS measures and analyses innovation performance based on the composite Summary Innovation Index (SII) indicator. The main parts thereof are the framework conditions, innovation activities, investments and impacts. These parts are further divided into other innovation groups and further into individual indicators (27 in total) with different weights. According to the SII value, the analysed country is classified into one of four groups: Innovation Leaders, Strong Innovators, Moderate Innovators and Modest Innovators.

The innovation performance of the EU27 as well as the innovation performance of most EU countries can be described as steadily increasing. The innovation performance of the EU27 in 2019 surpassed that of Russia, China, Brazil and the USA and is close to the innovation performance of Japan. For now, Australia, Canada and South Korea are more distant countries for the EU27. The growth rate of China's innovation performance in 2012 and 2019 was five times higher than that of the EU, so the assumption of China moving ahead of the US and balancing the

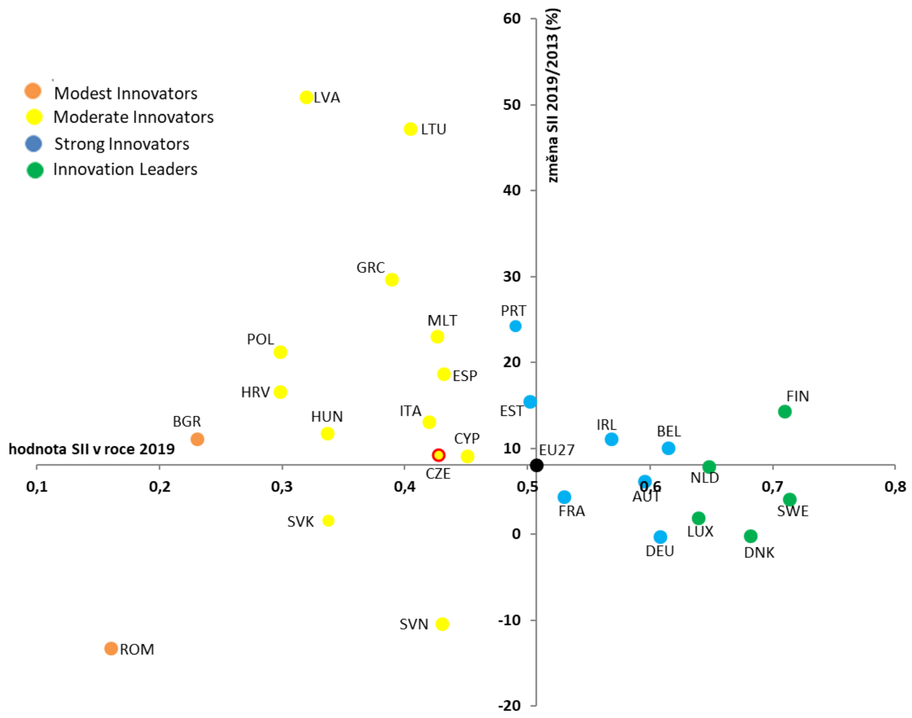
EU's innovation performance is correct. Between 2018 and 2019, the innovation performance of Australia and Japan decreased, while the performance of Canada and the USA increased.

Figure 8.4 shows the value of SII according to 2019 data on the horizontal axis and the relative change of SII according to 2013 and 2019 data on the vertical axis. The EU27 countries are brought out into the space, and their colour differentiation corresponds to the above-mentioned groups with regard to the SII value achieved.

Among the most innovative countries (Innovation Leaders) in 2019 were Sweden, Finland, Denmark, the Netherlands and Luxembourg, which in the previous year was in the lower group (Strong Innovators). At the opposite end of the scale (Modest Innovators) are Romania and Bulgaria. The Czech Republic is included in the Moderate Innovators category.

Compared to the previous evaluation, there have only been two changes in the classification of the countries into the four innovator categories: the aforementioned Luxembourg has moved to the highest group (Innovation Leaders) and Portugal has also moved to a higher group (Strong Innovators).

Figure 8.4: SII of EU Member States for 2019 and its change in 2013 and 2019

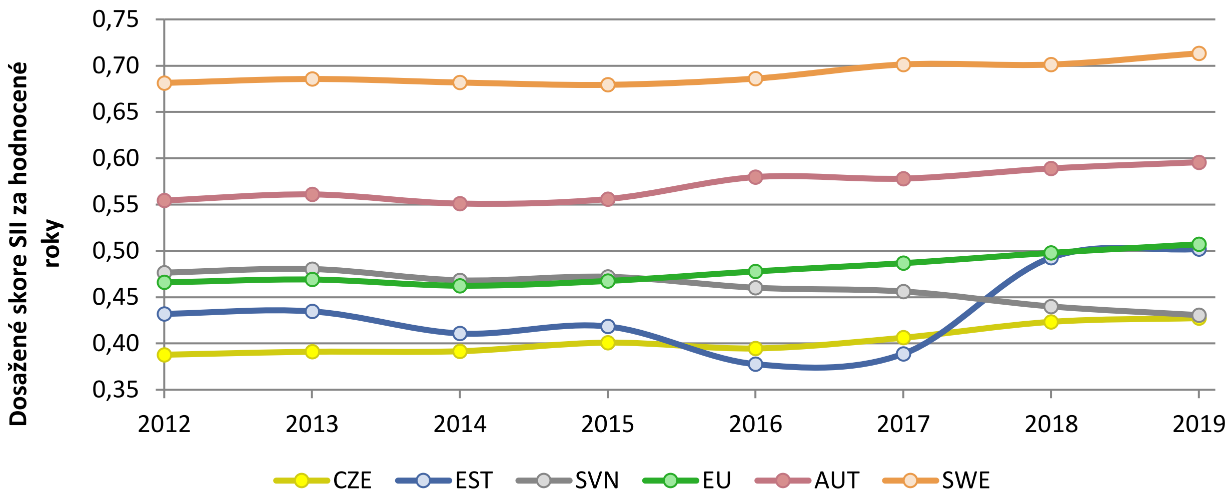


Source: own processing according to EIS 2020 | The colours of the countries correspond to the division according to SII.

Figure 8.5 shows the development of the SII value from 2012 to 2019 in the case of the Czech Republic, EU 27 and other selected countries. Sweden has long attained the highest SII values. Of the selected countries, Austria still reaches above-average values compared to the EU27 as a whole. The other monitored countries (Estonia, Slovenia), including the Czech Republic, have been see themselves below the EU27 in recent years. Estonia has seen a sharp rise in its SII value in 2018, which is close to the EU average and is following the same trend as the

EU average in 2019. Behind this sharp increase is an improvement in the performance of indicators that come from the Community Innovation Survey (CIS). The trend in recent years also indicates how the next period will develop, with the CR's SII value possibly surpassing Slovenia's.

Figure 8.5: Evolution of SII in 2012–2019 in the Czech Republic and other selected countries



SII score for the evaluated period
Source: own processing according to EIS 2020

Figure 8.6 below shows the values of SII for 2019 and the SII sub-areas for the Czech Republic and selected countries. In most areas, Sweden achieves significantly higher values than the other selected countries. Sweden shows lower values only in the Innovators, Linkages, Intellectual Assets areas (in all of the above, Austria has the highest value out of the monitored countries) and Sales Impacts (the EU 27 and the Czech Republic have the highest value). Sweden is superior to the other selected countries in Innovation-Friendly Environment and Human Resources areas.

Out of the selected countries, the Czech Republic achieves the lowest values in these areas: Human Resources, Attractive Research Systems, Innovation-Friendly Environment, Firm Investments, Linkages and Intellectual Assets. A more detailed breakdown is shown in Figure 8.7 below.

Figure 8.7 shows the individual SII indicators for 2019 and their values for the Czech Republic and selected countries. The Framework Conditions category includes three indicator areas, of which there are eight in total. Of the monitored countries, the Czech Republic, as in the previous year's evaluation, attains the lowest values in five Framework Condition indicators ('Population having completed tertiary education', 'Life-long learning', 'International scientific co-publications', 'Top 10% most-cited publications' and 'Broadband penetration'). Conversely, Sweden reaches the highest values in all Framework Conditions indicators.

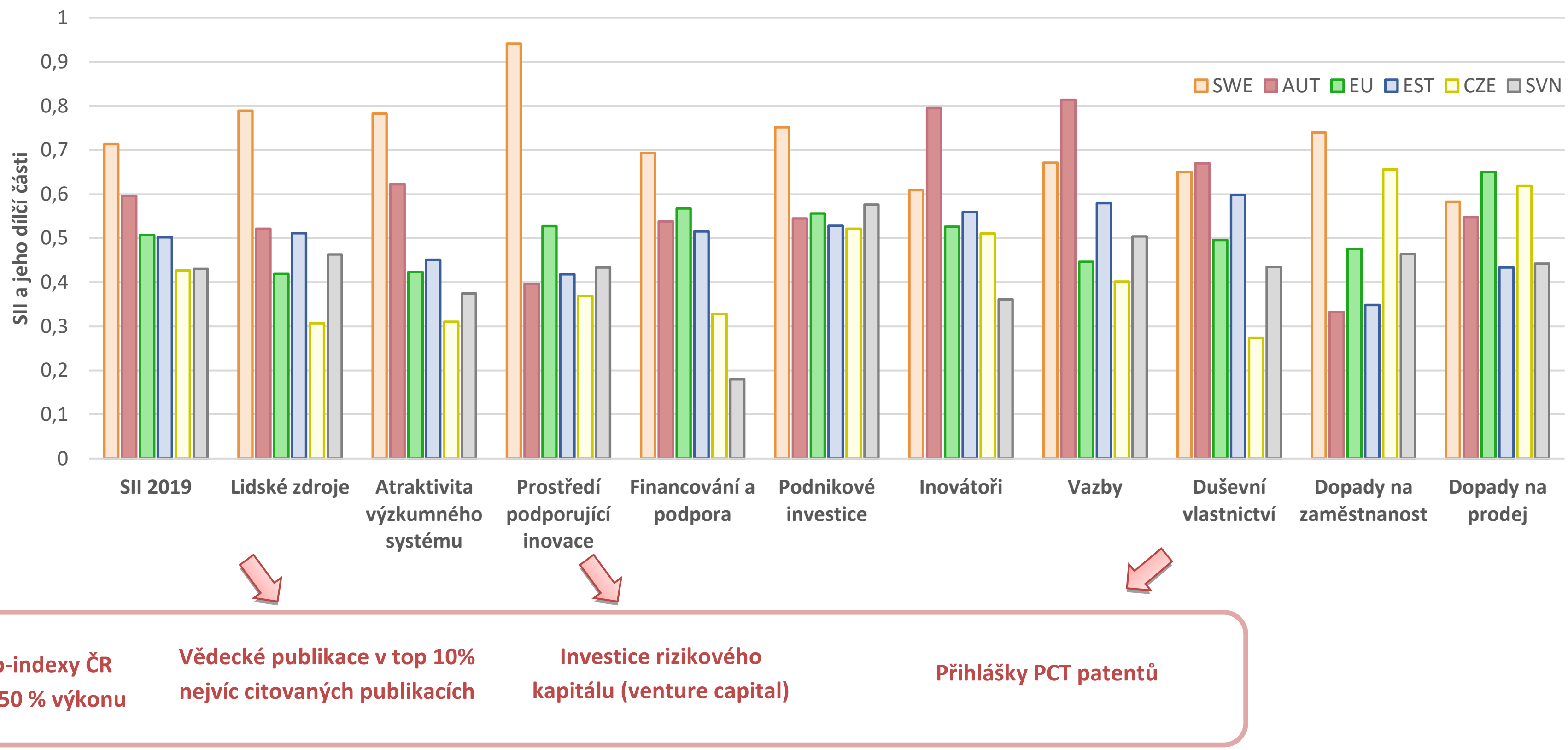
The second category is 'Investments', in which there are two areas of indicators out of a total of five. In most of these indicators, the Czech Republic achieves average values. Compared to the EU27 average, the Czech Republic lags more significantly in the 'Venture capital investment' category.

The third category is 'Innovation activities', where there are nine indicators classified into three groups. In the 'Intellectual assets' group, the Czech Republic attained the lowest values of all countries in the 'PCT patent applications' and 'Trademark applications' indicators. In the last indicator group for 'Intellectual assets' ('Designs applications'), the Czech Republic attains the same value as Slovenia. Among other areas, it is worth mentioning 'Public-private co-publications' indicator, where the Czech Republic attains the lowest value of the selected countries.

The last category is 'Impacts', which has five indicators divided into two groups. In three of these indicators, the Czech Republic reaches the highest values of the monitored countries. In the 'Employment impacts' group, the Czech Republic is the best of the monitored countries in the indicator 'Employment in fast-growing enterprises of innovative sectors' (Austria reached approximately 30% of the value of the Czech Republic). Conversely, the Czech Republic achieved the worst result of the monitored countries in 'Employment in knowledge-intensive activities'. In the 'Sales impacts' group, the Czech Republic shows the highest value of the monitored countries in the 'Medium and high-tech product exports" indicator (Estonia reaches only 59% of the value of the Czech Republic) and in the 'Sales of new-to-market and new-to-firm product innovations' indicator.

According to SII, the following dimensions can be considered the Czech Republic's strengths for 2019: 'Employment impacts', 'Innovators', and 'Sales impacts'. The Czech Republic achieves a high score for the 'Employment in fast-growing enterprises of innovative sectors', 'Innovative SMEs collaborating with others', 'Medium and high- tech product exports' and 'Enterprises providing training to develop or upgrade ICT skills of their personnel'. Conversely, the following dimensions can be considered weaknesses: 'Intellectual assets', 'Finance and support' and 'Innovation-friendly environment'. The CR attains a low score in the following indicators: 'Venture capital expenditures (Venture capital)' 'Top 10% most cited publications', 'PCT patent applications' and 'Knowledge-intensive services exports'.

Figure 8.6: 2019 SII and its sub-areas comparing the Czech Republic and selected countries



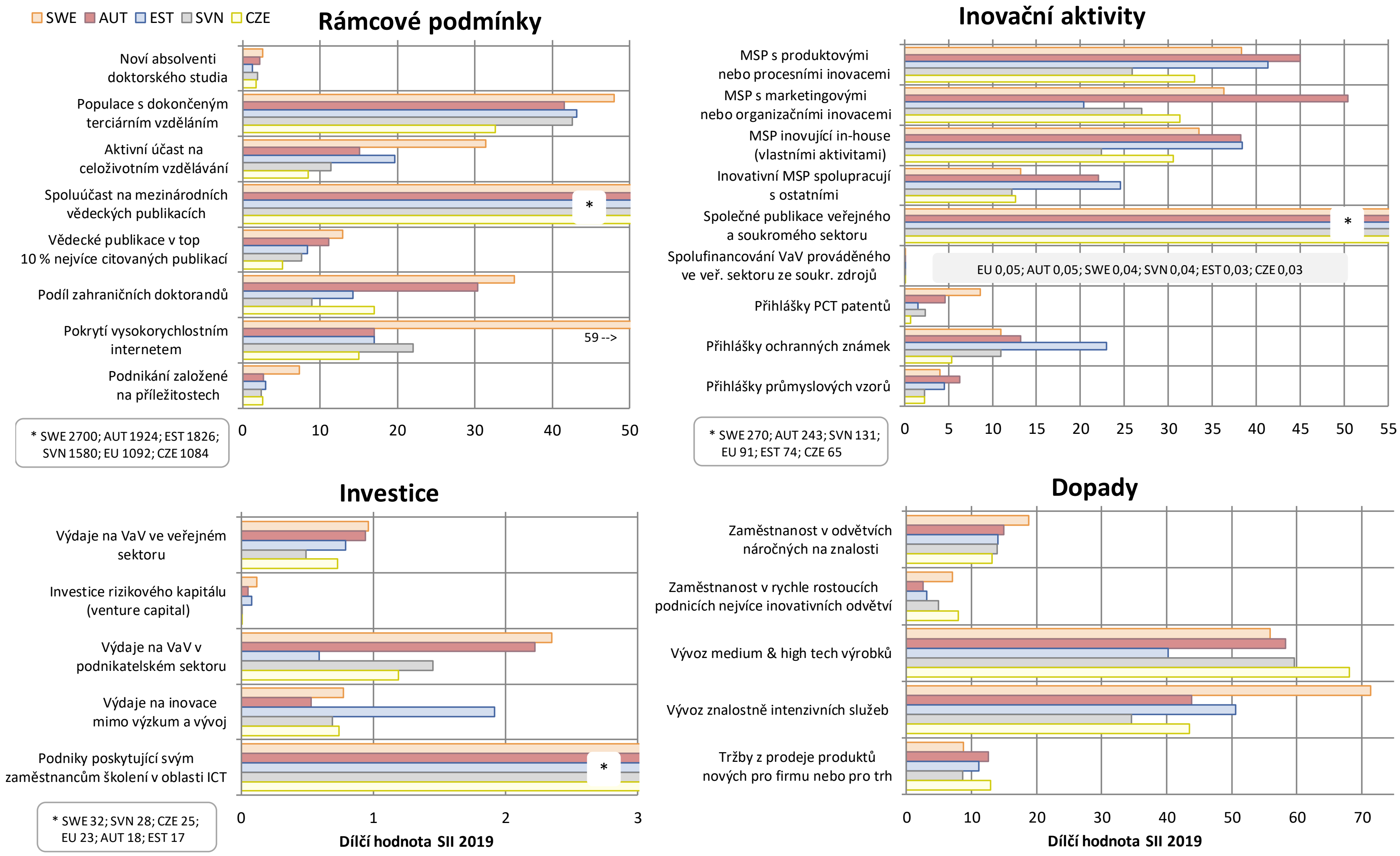
SII and its sub-areas

SII 2019 | Human resources | Attractive research systems | Innovation-friendly environment | Finance and support | Firm investments | Innovators | Linkages | Intellectual assets | Employment impacts | Sales impacts

Sub-indexes where CR's performance is below 50%
Top 10% most cited publications
Venture capital expenditures
PCT patent applications

Source: own processing according to EIS 2020

Figure 8.7: Breakdown of SII for 2019 and comparison of values of the Czech Republic and selected countries



Framework Conditions
New doctorate graduates
Population with tertiary education
Lifelong learning
International scientific co-publications
Top 10% most cited publications
Foreign doctorate 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 expenditures
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 fast-growing enterprises of innovative sectors
Medium and high tech product exports
Knowledge-intensive services exports
Sales of new-to-market and new-to-firm product innovations

2019 SII sub-value

Source: own processing according to EIS 2020

Even though the innovation performance of the Czech Republic is growing, Table 8.1 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 the performance of the EU28 in 2019 is much higher only in the indicators ‘Employment in fast growing enterprises of innovative sectors’ and ‘Medium and high tech product exports’ and in general in ‘Employment impacts’. Conversely, the Czech Republic achieved the worst values in the indicator ‘Venture capital expenditures’, where it achieves only 7.5% of EU28 values. The Czech Republic also achieves an unsatisfactory result in the ‘Top 10% of the most cited publications’ and ‘PCT patent application’ indicators. Generally speaking, ‘Intellectual assets’ can be considered one of the Czech Republic’s weaknesses.

The second part of Table 8.1 captures the positions of selected countries according to the SII evaluation for 2019 only within the EU28 and the evolution of performance in 2013 and 2019. From the red arrows, which depict a negative change of more than 5 percentage points in 2013 and 2019, it is clear that of the selected countries, the Czech Republic (along with Austria) has deteriorated in the fewest number of indicators (7). Conversely, the position of the Czech Republic in each of the indicators places it in the bottom half of the EU28 ranking. The Czech Republic achieved its best placement (3rd place) in the ‘Medium and high tech product export’ indicator (previously 4th place in the EU28 evaluation). It achieved 5th place in the ‘Employment in fast-growing enterprises of innovative sectors, 7th in ‘Sales impacts’, 7th in ‘Employment impacts’, 8th in ‘R&D expenditure in the public sector’ and 9th in ‘Sales of new-to-market and new-to-firm product innovations’. The Czech Republic achieved its worst position (27th among the EU28) in ‘Venture capital expenditure’ (26th the previous year).

Table 8. 1 : Relative performance of the Czech Republic and selected countries according to SII

	Relativní výkonnost ČR k EU 2019	Relativní výkonnost ČR k EU 2012		Pořadí v EU 28 dle SII za rok 2019 a změna mezi roky 2013 a 2019									
				ČR		Švédsko		Rakousko		Slovinsko		Estonsko	
	2019	2012	2019	Δ	pozice	Δ	pozice	Δ	pozice	Δ	pozice	Δ	pozice
SOUHRNNÝ INOVAČNÍ INDEX	81,9	82,1	90,5	↑	17	↑	1	↑	9	↓	16	↑	12
Lidské zdroje	67,7	71,5	76,6	↑	21	↘	1	↑	10	↓	13	↑	11
Noví absolventi doktorského studia	78,1	86,5	95,0	↑	14	↓	5	↑	9	↓	12	↗	21
Populace s dokončeným terciárním vzděláním	52,7	50,4	72,7	↑	25	↗	7	↑	17	↑	14	↑	13
Aktivní účast na celoživotním vzdělávání	74,5	101,1	84,4	↓	15	↗	1	↑	8	↓	11	↑	4
Atraktivita výzkumného systému	65,8	50,2	75,3	↑	19	↑	4	↑	9	↑	17	↑	13
Spoluúčast na mezinárodních vědeckých publikacích	92,1	80,5	145,7	↑	14	↑	3	↑	8	↑	12	↑	10
Vědecké publikace v top 10 % nejvíce citovaných publikacích	41,7	39,1	45,4	↑	22	↘	4	↗	10	↑	18	↑	17
Podíl zahraničních doktorandů	79,2	69,1	109,9	↑	13	↑	7	↑	8	↓	22	↑	18
Prostředí podporující inovace	71,3	81,5	125,8	↑	22	↑	3	↗	21	↓	17	↑	20
Pokrytí vysokorychlostním internetem	68,2	80,0	150,0	↑	22	↑	1	↑	18	↑	13	↑	18
Podnikání založené na příležitostech	74,6	78,0	102,4	↑	16	↓	3	↓	15	↓	19	↑	12
Financování a podpora	57,9	73,3	65,5	↓	19	↗	4	↑	11	↓	26	↓	13
Výdaje na VaV ve veřejném sektoru	107,9	92,7	100,0	↓	8	↓	3	↑	4	↓	18	↓	7
Investice rizikového kapitálu (venture capital)	7,2	44,6	11,0	↘	27	↑	13	↑	21	↓	28	↓	18
Podnikové investice	92,9	100,6	120,0	↑	11	↑	2	↓	8	↓	6	↑	10
Výdaje na VaV v podnikatelském sektoru	84,0	66,8	93,5	↑	10	↑	1	↑	2	↓	7	↓	19
Výdaje na inovace mimo výzkum a vývoj	89,0	116,9	124,7	↑	13	↑	10	↑	19	↑	15	↑	1
Podniky poskytující svým zaměstnancům školení v oblasti ICT	105,3	130,8	153,8	↑	14	↑	3	↓	19	↑	9	↑	22
Inovátoři	96,4	91,7	87,6	↘	16	↓	12	↑	3	↓	20	↓	14
MSP s produktovými nebo procesními inovacemi	94,9	87,4	96,4	↑	17	↓	11	↑	5	↓	20	↗	7
MSP s marketingovými nebo organizačními inovacemi	82,4	103,1	69,4	↓	17	↓	14	↑	2	↓	20	↓	23
MSP inovující in-house (vlastními aktivitami)	112,6	81,1	95,4	↑	15	↓	13	↑	7	↓	20	↑	6
Vazby	84,1	75,9	95,3	↑	14	↓	5	↑	1	↓	11	↑	9
Inovativní MSP spolupracují s ostatními	107,1	110,7	139,5	↑	12	↓	10	↑	5	↓	13	↑	1
Společné publikace veřejného a soukromého sektoru	68,8	76,7	80,9	↑	17	↑	2	↑	3	↓	10	↑	15
Spolufinancování VaV prováděného ve veřejném sektoru ze soukromých zdrojů	73,8	51,2	70,5	↑	14	↘	9	↑	4	↓	6	↑	11
Duševní vlastnictví	56,8	63,5	53,0	↓	23	↓	5	↓	4	↘	12	↑	8
Přihlášky PCT patentů	46,0	41,9	42,2	↘	20	↗	1	↓	6	↓	10	↘	14
Přihlášky ochranných známek	70,2	74,6	73,1	↘	21	↑	9	↘	5	↑	8	↑	4
Přihlášky průmyslových vzorů	59,9	79,3	47,8	↓	19	↓	11	↓	3	↓	20	↘	9
Dopady na zaměstnanost	128,0	114,7	138,1	↑	7	↑	4	↘	25	↑	15	↑	23
Zaměstnanost v odvětvích náročných na znalosti	86,2	89,2	101,4	↑	17	↗	3	↑	11	↘	16	↑	14
Zaměstnanost v rychle rostoucích podnicích nejvíce inovativních odvětví	162,4	151,3	187,0	↑	5	↑	7	↓	26	↑	17	↗	25
Dopady na prodej	94,2	95,9	97,3	↗	7	↗	10	↗	15	↘	18	↘	20
Vývoz medium & high tech výrobků	130,0	126,7	143,0	↑	3	↑	10	↗	7	↑	5	↓	24
Vývoz znalostně intenzivních služeb	50,7	45,1	52,4	↑	19	↓	7	↘	18	↗	24	↑	14
Tržby z prodeje produktů nových pro firmu nebo pro trh	100,0	108,0	87,5	↓	9	↗	18	↑	10	↓	19	↓	14

Relative Performance of CR to EU 2019 Relative Performance of CR to EU 2012 Rank to EU28 for 2019 and change between 2013 and 2019

CR Sweden Austria Slovenia Estonia

SUMMARY INNOVATION INDEX
Human resources
New doctorate graduates
Population with tertiary education
Lifelong learning
Attractive research systems
International scientific co-publications
Most cited publications
Foreign doctorate students
Innovation-friendly environment
Broadband penetration
Opportunity-driven entrepreneurship
Finance and support
R&D expenditure in the public sector
Venture capital expenditures

Firm investments
R&D expenditure in the business sector
Non-R&D innovation expenditures
Enterprises providing ICT training
Innovators
SMEs product/process innovations
SMEs marketing/organisational innovations
SMEs innovating in-house
Linkages
Innovative SMEs collaborating with others
Public-private co-publications
Private co-funding of public R&D exp.
Intellectual assets
PCT patent applications
Trademark applications
Design applications
Employment impacts
Employment in knowledge-intensive activities
Employment fast-growing enterprises
Sales impacts
Medium and high tech product exports
Knowledge-intensive services exports
Sales of new-to-market/firm innovations

Source: own processing according to EIS2020

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 percentage points labelled with a green arrow, a change of less than 5 percentage points labelled with a yellow arrow; a negative of more than 5 percentage points labelled with a red arrow.

GLOBAL INNOVATION INDEX (GII)

The Global Innovation Index 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. In monitored areas in innovations outputs are: knowledge, technology and creativity. The resulting GII value is calculated as the average o the innovation inputs and innovation outputs. The ratio of innovation inputs and innovation outputs is called the Innovation Efficiency Indicator. This Indictor show how much of an innovation output is produced by one innovation input.

The latest GII 2020 is based on data from 2019. A total of 131 economies were evaluated. As in previous years, Switzerland ranked best, followed by Sweden, the USA, the United Kingdom, the Netherlands, Denmark, Finland, Singapore and Germany. The Czech Republic is ranked 24th according to GII 2020 (it ranked 26th according to GII 219, 27th according to GII 2018 and 24th according to CII 2017). The Czech Republic’s absolute value under GII 2020 is 48.3 (Switzerland is first at 66.1; Yemen last 13.6). Other selected countries reached the following rankings: Sweden 2nd (score 62.5), Austria 23rd (score 50.1), Estonia 25th (score 48.3), Slovenia 32nd (score 42.9).

Within the Innovation Input Sub-Index, Singapore ranked 1st, followed by Switzerland, Sweden and the USA. The Czech Republic ranked 28th (Sweden 3rd, Austria 18th, Estonia 25th, Slovenia 29th).

According to the Innovation Output Sub-Index, Switzerland ranks first, followed by Sweden, the United Kingdom and the Netherlands. The Czech Republic ranked 17th (Sweden 2nd, Estonia 20th, Austria 23rd and Slovenia 39th).

Table 8.2 shows the rankings for selected countries within the EU28 as well as the relative change between GII 2020 and GII 2013. The green arrow depicts a positive change of more than 10% and the red arrow depicts a negative change of more than 10%. For some indicators, it was not possible to calculate the change between years, because the composition of GII 2013 and GII 2020 differs slightly.

In the G11 2020 evaluation, the Czech Republic ranked 1st among the EU28 in just a few indicators: GERD financed by abroad, High-tech Imports, Utility model by origin, High-tech net exports, Creative goods and services and Creative goods exports. Under the GII 2020 evaluation, the Czech Republic also achieves the best result among the EU28 in two indicators: GERD financed by abroad and Creative goods exports. The Czech Republic is ranked last among the EU28 evaluation in Ease of starting a business, Information and communication technologies (ICTs), Government's online service and E-participation.

Table 8.2: Ranking of the Czech Republic and selected countries according to GII 2020 within the EU28

		Pořadí v EU28 dle GII 2020 a změna GII 2013 a 2020									
		ČR		Švédsko		Rakousko		Slovinsko		Estonsko	
	Indicator	Δ	pozice	Δ	pozice	Δ	pozice	Δ	pozice	Δ	pozice
	Global Innovation Index	↘	12	↗	1	↘	10	↘	19	↘	13
	Innovation Efficiency Ratio	↘	7	↘	3	↓	22	↓	27	↓	14
	Innovation Input Sub-index	↗	14	↗	1	↗	8	↗	15	↗	12
	Innovation Output Sub-index	↘	10	↗	1	↘	13	↓	23	↓	11
	Index										
1.	Institutions	↗	18	↘	3	↘	5	↗	10	↗	12
1.1.	Political environment	↘	18	↘	5	↘	7	↗	14	↘	11
1.1.1.	Political and operational stability	↓	10	↘	3	↓	6	↘	14	↗	10
1.1.2.	Government effectiveness	↗	19	↘	4	↘	8	↑	14	↗	12
1.2.	Regulatory environment	↘	22	↘	4	↘	2	↘	14	↘	8
1.2.1.	Regulatory quality	↘	12	↘	2	↘	10	↘	22	↘	9
1.2.2.	Rule of law	↘	16	↘	2	↘	3	↘	14	↗	12
1.2.3.	Cost of redundancy dismissal	↗	26	↗	16	↗	1	↘	9	↗	10
1.3.	Business environment	↑	15	↗	9	↗	16	↑	4	↑	18
1.3.1.	Ease of starting a business	↗	28	↗	10	↗	26	↘	11	↗	2
1.3.2.	Ease of resolving insolvency	↑	9	↗	10	↓	14	↑	5	↑	19
2.	Human capital and research	↘	16	↘	2	↗	5	↘	13	↓	17
2.1.	Education	↘	12	↘	3	↓	7	↓	11	↓	17
2.1.1.	Expenditure on education	↑	6	↑	1	↘	7	↓	14	↘	12
2.1.2.	Government funding per secondary student	-	16	-	8	-	4	-	12	-	21
2.1.3.	School life expectancy	↗	12	↑	2	↗	17	↗	9	↗	20
2.1.4.	PISA scales in reading, maths, and science	↗	12	↗	7	↗	15	↗	5	↗	1
2.1.5.	Pupil-teacher ratio, secondary	↗	19	↑	25	↘	12	↑	14	↗	11
2.2.	Tertiary education	↗	12	↘	13	↑	2	↗	14	↑	6
2.2.1.	Tertiary enrolment	↗	20	↘	18	↑	5	↓	9	↗	15
2.2.2.	Graduates in science and engineering	↗	15	↗	7	↗	2	↑	10	↑	5
2.2.3.	Tertiary inbound mobility	↑	5	↘	18	↓	4	↑	25	↑	14
2.3.	Research and development (R&D)	↓	19	↗	1	↗	9	↑	13	↓	20
2.3.1.	Researchers	↓	14	↘	2	↓	4	↓	10	↓	15
2.3.2.	Gross expenditure on R&D (GERD)	↗	10	↘	1	↑	2	↓	9	↓	13
2.3.3.	Global R&D companies, average expenditure top 3	-	19	-	5	-	13	-	14	-	19
2.3.4.	QS university ranking, average score top 3	↗	14	↓	5	↘	12	↑	22	↑	16
3.	Infrastructure	↑	13	↗	1	↑	12	↑	19	↑	3
3.1.	Information and communication technologies (ICTs)	↑	28	↑	6	↑	15	↑	19	↑	11
3.1.1.	ICT access	↑	25	↘	10	↗	7	↑	11	↑	13
3.1.2.	ICT use	↑	18	↑	3	↑	17	↑	24	↑	8
3.1.3.	Government's online service	↑	28	↑	6	↑	14	↑	18	↗	13
3.1.4.	E-participation	↑	28	↑	8	↑	18	↑	20	↑	12
3.2.	General infrastructure	↗	7	↘	1	↘	3	↓	15	↘	10
3.2.1.	Electricity output	↘	5	↘	1	↘	8	↗	6	↘	3
3.2.2.	Logistics performance	↑	12	↑	2	↑	4	↗	18	↑	19
3.2.3.	Gross capital formation	↗	3	↑	4	↑	5	↑	16	↗	2
3.3.	Ecological sustainability	↘	3	↘	13	↗	23	↘	17	↗	1
3.3.1.	GDP per unit of energy use	↑	25	↑	22	↑	12	↑	23	↑	26
3.3.2.	Environmental performance	↗	14	↑	7	↑	5	↑	13	↑	20
3.3.3.	ISO 14001 environmental certificates	↓	3	↓	9	↓	22	↓	15	↘	1
4.	Market sophistication	↗	15	↓	3	↓	16	↓	24	↑	5
4.1.	Credit	↘	15	↓	4	↓	14	↓	28	↓	9
4.1.1.	Ease of getting credit	↗	6	↓	15	↓	19	↘	22	↘	6
4.1.2.	Domestic credit to private sector	↘	21	↘	4	↓	12	↓	23	↓	17
4.1.3.	Microfinance gross loan	-	-	-	-	-	-	-	-	-	-
4.2.	Investment	↑	19	↓	5	↑	20	↑	14	↑	3
4.2.1.	Ease of protecting minority investors	↑	19	↑	6	↑	9	↗	3	↗	24
4.2.2.	Market capitalization	-	-	-	-	↑	11	↗	16	-	-
4.2.3.	Venture capital deals	-	18	↗	7	↗	14	-	-	-	2
4.3.	Trade, competition, & market scale	↓	10	↓	11	↓	9	↓	22	↓	19
4.3.1.	Applied tariff rate	↗	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 2020 a změna GII 2013 a 2020									
		ČR		Švédsko		Rakousko		Slovinsko		Estonsko	
	Indicator	Δ	pozice	Δ	pozice	Δ	pozice	Δ	pozice	Δ	pozice
5.	Business sophistication	↘	13	↑	1	↑	10	↗	14	↓	16
5.1.	Knowledge workers	↓	15	↑	1	↗	6	↗	11	↓	14
5.1.1.	Knowledge-intensive employment	↑	18	↑	2	↑	15	↑	13	↑	8
5.1.2.	Firms offering formal training	↓	2	-	1	-	-	↘	5	↓	8
5.1.3.	GERD performed by business	↗	10	↗	1	↑	2	↓	8	↓	19
5.1.4.	GERD financed by business	↓	26	↗	4	↑	9	↗	3	↓	21
5.1.5.	Females employed with advanced degrees	-	27	-	5	-	20	-	15	-	3
5.2.	Innovation linkages	↑	13	↑	1	↑	7	↗	16	↓	17
5.2.1.	University/industry research collaboration	↓	14	↘	3	↘	10	↗	17	↓	18
5.2.2.	State of cluster development	↘	20	↘	9	↗	7	↗	23	↘	24
5.2.3.	GERD financed by abroad	↓	1	↓	4	↓	2	↓	10	↓	14
5.2.4.	JV-strategic alliance deals	-	24	↑	2	-	20	↓	17	↗	9
5.2.5.	Patent families 2+ offices	↑	16	↑	1	↑	8	↑	15	↑	19
5.3.	Knowledge absorption	↗	6	↑	5	↑	13	↘	17	↓	22
5.3.1.	Intellectual property payments	-	19	-	7	-	20	-	23	-	26
5.3.2.	High-tech imports	↑	1	↓	13	↓	17	↘	23	↓	10
5.3.3.	ICT services imports	-	21	-	4	-	7	-	19	-	6
5.3.4.	Foreign direct investment, net inflows	↑	7	↑	15	↓	27	↑	16	↑	8
5.3.5.	Research talent in business enterprise	-	12	-	1	-	4	-	6	-	21
6.	Knowledge and technology outputs	↑	8	↑	1	↑	12	↓	22	↑	15
6.1.	Knowledge creation	↑	12	↗	1	↑	8	↑	13	↘	17
6.1.1.	Patent applications by origin	-	16	-	4	-	7	-	13	-	24
6.1.2.	PCT patents by origin	-	21	-	1	-	7	-	15	-	16
6.1.3.	Utility models by origin	-	1	-	-	-	7	-	16	-	11
6.1.4.	Scientific and technical articles	↓	8	↓	5	↓	12	↓	2	↓	6
6.1.5.	Citable documents H index	↓	16	↓	7	↓	10	↓	18	↓	22
6.2.	Knowledge impact	↑	3	↓	14	↓	16	↓	23	↓	9
6.2.1.	Growth rate of PPP$ GDP	↑	9	↓	18	↓	15	↓	12	↑	5
6.2.2.	New businesses	↑	17	↗	10	↗	28	↓	22	↑	1
6.2.3.	Computer software spending	↓	16	↓	7	↓	12	-	26	-	24
6.2.4.	ISO 9001 quality certificates	↓	3	↓	22	↓	25	↓	5	↓	4
6.2.5.	High- and medium-high-tech manufacturing	↑	3	↑	7	↑	8	↓	19	↘	23
6.3.	Knowledge diffusion	↑	10	↑	3	↑	16	↗	25	↑	14
6.3.1.	Intellectual property receipts	-	16	-	3	-	14	-	19	-	25
6.3.2.	High-tech net exports	↑	1	↓	12	↓	14	↘	20	↓	6
6.3.3.	ICT services exports	↓	19	↓	4	↓	13	↓	27	↓	7
6.3.4.	Foreign direct investment, net outflows	↑	12	↓	7	↓	26	↑	18	↓	19
7.	Creative outputs	↓	11	↘	5	↓	13	↓	23	↓	9
7.1.	Intangible assets	↓	20	↗	4	↓	16	↓	22	↓	14
7.1.1.	Trademarks by origin	-	11	-	19	-	13	-	9	-	3
7.1.2.	Global brand value	-	16	-	1	-	13	-	19	-	23
7.1.3.	Industrial designs by origin	-	18	-	17	-	8	-	22	-	13
7.1.4.	ICTs and organizational model creation	↑	13	↑	1	↑	15	↑	20	↑	4
7.2.	Creative goods and services	↓	1	↓	11	↓	16	↓	19	↓	9
7.2.1.	Cultural and creative services exports	-	24	-	14	-	12	-	19	-	4
7.2.2.	National feature films	↑	14	↑	10	↓	15	↑	5	↑	2
7.2.3.	Entertainment and media market	-	14	-	2	-	4	-	-	-	-
7.2.4.	Printing and other media	↓	21	↓	18	↓	13	↓	7	↓	5
7.2.5.	Creative goods exports	↗	1	↓	10	↓	20	↓	22	↓	18
7.3.	Online creativity	↓	15	↘	4	↓	10	↓	17	↓	9
7.3.1.	Generic top-level domains	↑	19	↓	9	↓	11	↓	17	↓	24
7.3.2.	Country-code top-level domains	↓	9	↘	5	↓	7	↓	17	↓	11
7.3.3.	Wikipedia edits	-	8	-	2	-	9	-	13	-	1
7.3.4.	Mobile app creation	-	14	-	5	-	13	-	10	-	3

Source: own processing according to GII report 2020

Positions - positions 1-14 are highlighted in green, positions 15–28 are highlighted in red.
Change - a positive change greater than 10% is indicated by a green arrow, yellow arrows indicate a change less than 10%, a negative change greater than 10% is indicated by a red arrow..

Of the monitored indicators and sub-pillars in the Czech Republic, 13 are marked as strengths and 11 as weaknesses – see Table 8.3.

Table 8.3 : Strengths and weaknesses of the Czech Republic according to GII 2020

GII 2020	
Strength of the Czech Republic	**Weaknesses of the Czech Republic**
Ecological sustainability sub-pillar	Investment sub-pillar
Knowledge impact sub-pillar	Cost of redundancy dismissal indicator
Creative goods and services sub-pillar	Ease of starting a business indicator
ISO 14001 environmental certificates indicator	Global R&D companies indicator
Firms offering formal training indicator	Government´s online service indicator
GERD financed by abroad indicator	E-participation indicator
High-tech imports indicator	GDP indicator
Utility models by origin indicator	Ease of protecting minority investors indicator
ISO 9001 quality certificates indicator	State of cluster development indicator
High- and medium-high-tech manufacturing indicator	JV-strategic alliance deals indicator
High-tech net exports indicator	Printing and other media indicator
Creative goods exports indicator	
Wikipedia edits indicator	

Source: own processing according to GII report 2020

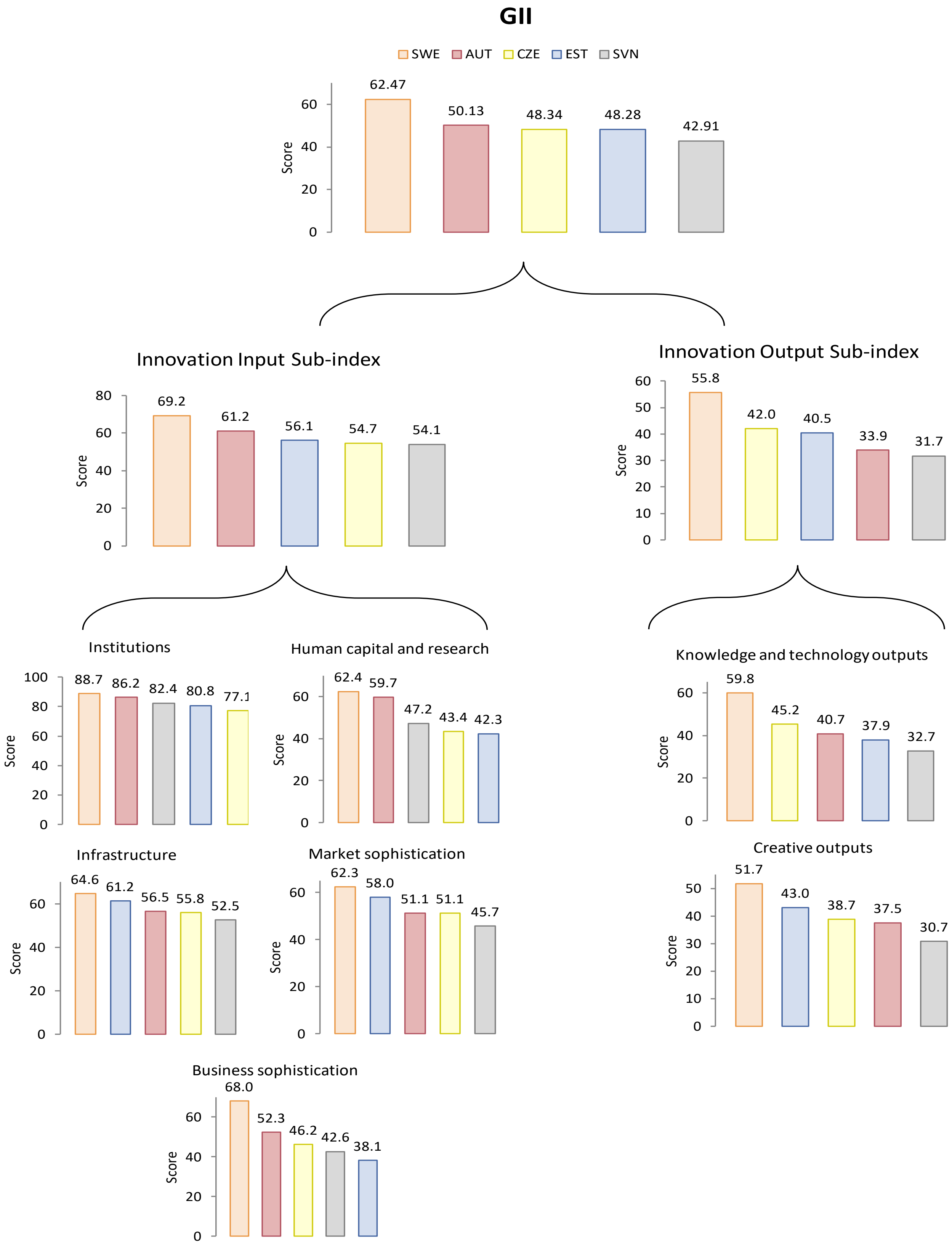
Figure 8.8 shows the breakdown of GII 2020 according to pillar and achieved values of the Czech Republic and selected countries.

In GII 2020, the Czech Republic achieved a rating value of 48.34, which puts it in 24th position. Compared to previous years, the Czech Republic, in comparison with the selected countries, has moved ahead of Estonia and is approaching the score of Austria. Sweden ranked 2nd in all evaluated economies, Austria 19th, Estonia 25th and Slovenia 32nd.

Within the Innovation Input 2020 sub-index, the Czech Republic received a rating of 54.74 (28th position) and in the Innovation Output Index 2020 sub-index a value of 41.95 (17th position). The value of the Innovation Output Index of the Czech Republic is the second highest among the selected countries (Sweden is ranked 1st).

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.

Figure 8.8: GII 2020 breakdown for the Czech Republic and selected countries



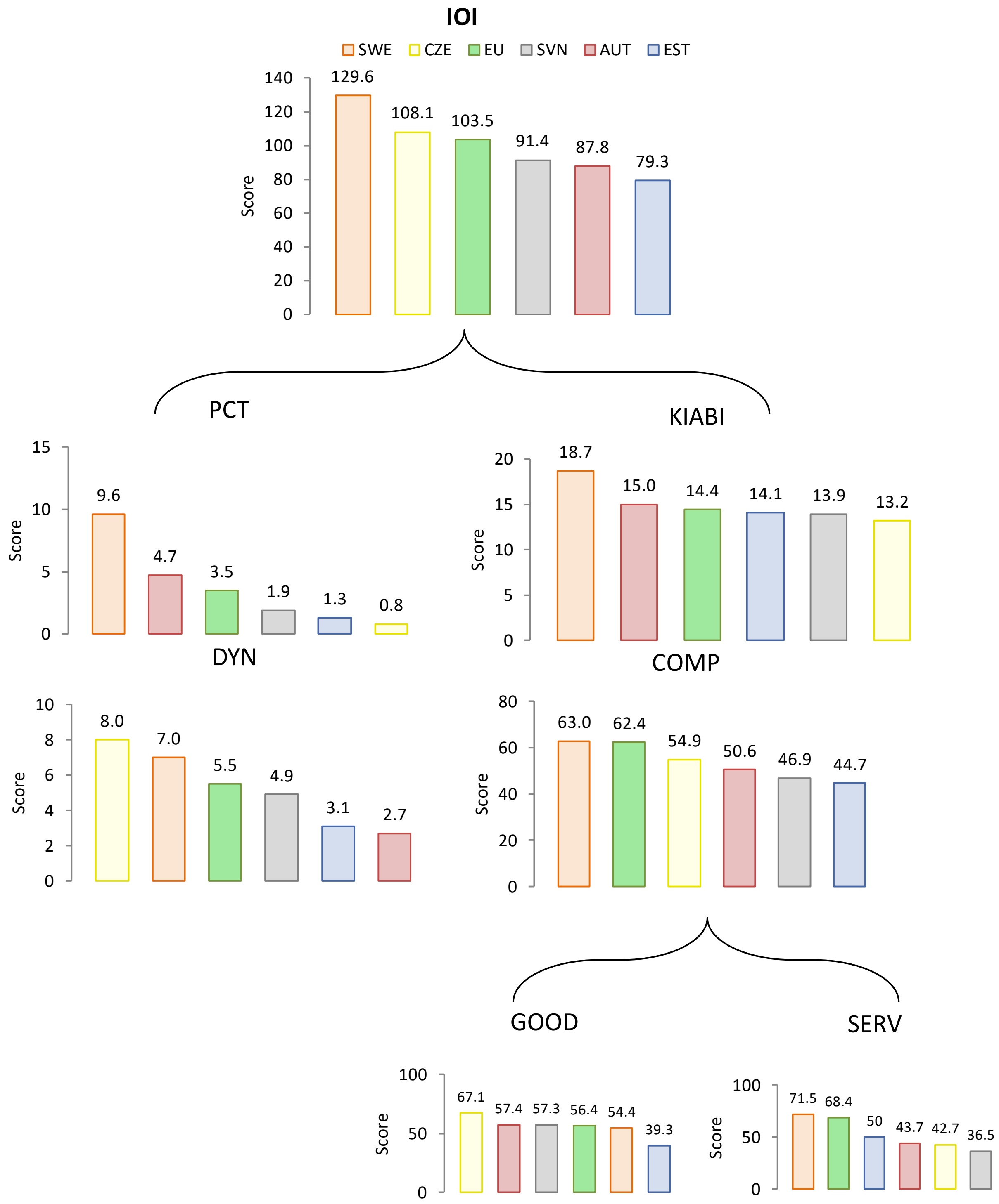
Source: own processing according to GII Report 2020

INNOVATION OUTPUT INDICATOR (IOI)

The Innovation Output Indicator (IOI) is based on the degree of ability of ideas from innovative industries to reach the market, thus creating more qualified jobs and increasing the competitiveness of the economy. The IOI consists of four sub-indicators: first, degree of technical innovation (PCT), which is quantified in connection with patents; second, employment in knowledge-intensive fields (KIABI); third, competitiveness of goods (GOOD) and services (SERV), which requires a high level of knowledge; and fourth, the employment rate in fast-growing enterprises within the innovation sector (DYN).

Figure 8.9 shows the IOI 2019 breakdown for the Czech Republic and selected countries. The input data are for 2016, 2017 and 2018 (for more details, see the legend to Figure 8.9). Israel, Ireland, Sweden and Japan attained the highest IOI score of the analysed countries. The CR is at the EU average and, compared to the EU28 basis in 2011 = 100, attained 108.1. In the PCT sub-indicator, the CR lags significantly behind the other selected countries. There are only 0.8 patents per billion GDP in PPS. In Sweden, this number is 9.6; in Austria, 4.7. Of all the countries evaluated, Japan ranked the highest (12.2), followed by Sweden (9.6) and Israel (9.4). The Czech Republic does not even reach the EU28 average in the second sub-indicator. Israel, Luxembourg and New Zealand perform best in terms of the proportion of employment in knowledge-intensive industries (KIABI). In terms of the proportion of medium-tech and hi-tech products in total exports, the Czech Republic ranks among the highest of the selected countries. Of the countries evaluated, only Japan, Germany, Hungary and Slovakia rank higher. The Czech Republic is thus ranked 5th. The situation is different for the proportion of exports of knowledge-intensive services in total exports of services. In this area, Sweden is ranked the highest out of the selected countries, with the Czech Republic attaining below-average values. In the context of all evaluated countries, Ireland and Luxembourg show the highest values. Of the selected countries, the Czech Republic is again at the forefront in terms of the proportion of employment in fast-growing companies in innovative sectors. Of all the evaluated countries, Ireland, Hungary, Slovakia and Malta have the highest scores, and the Czech Republic ranked 5th.

Figure 8.9: IOI 2019 breakdown for the Czech Republic and selected countries



Source: own processing according to The Innovation Output Indicator 2019, Dániel Vértesy, Giacomo Damioli, JRC Technical Reports
The IOI value is expressed relative to the EU28 based from 2011 (EU28 2011 = 100).
PCT = Number of patents per billion GDP (PPS); data for 2016
KIABI = Proportion of employment in knowledge-intensive sectors; data for 2018
DYN = Proportion of employment in fast-growing enterprises in innovative sectors; data for 2017
COMP = Component
GOOD = Proportion of medium-tech and hi- tech products in total exports; data for 2018
SERV = Proportion *of exports of knowledge-intensive services in total exports of services; data for 2017*

8.3 Innovative Performance in Czech Enterprises

The origin of the word innovation is in the Latin "innovare", i.e., to renew. The current perception of the word innovation goes beyond mere renewal. Innovation is based on novelty, whether it is a completely new form or a significant improvement of the current form. Innovation must, however, also actually be implemented (it can be the introduction to the market or the practical use of the innovation within the organisation).

Since 2002, the Czech Statistical Office has been conducting statistical surveys on innovative activities of enterprises on a regular, biennial basis. The last such survey is the Statistical Survey on Innovation Activities of TI 2018 Enterprises, which is aimed at the 2016–2018 period. To allow for international comparison, the CZSO observes the OECD methodological principles set out in the Oslo Manual (OECD, 2018) and the Commission Implementing Regulation (EU) No. 995/2012 of 26 October 2012.

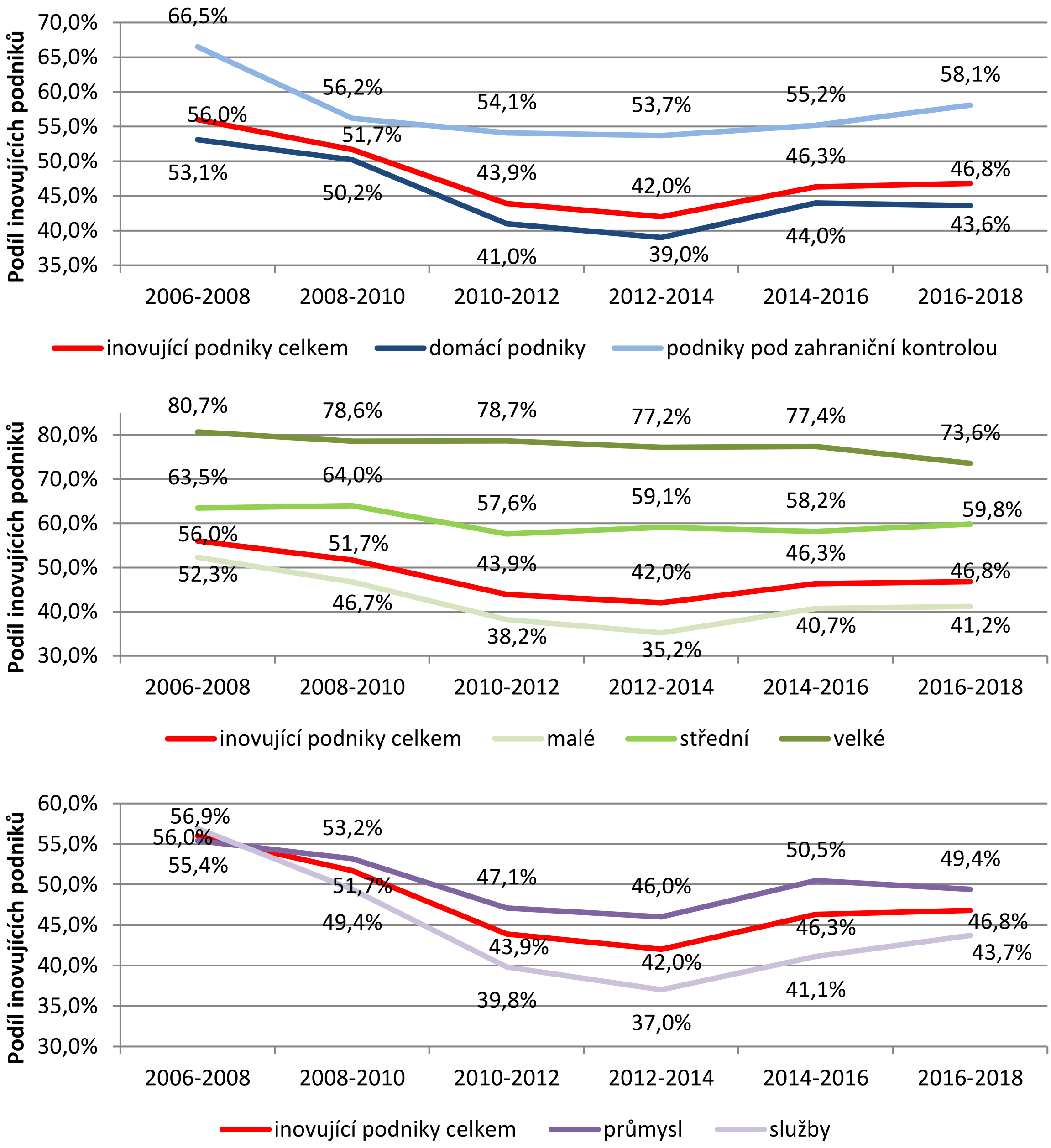
In previous surveys, innovations had been divided into technical and non-technical innovations, but this division was no longer used. Instead, classification according to the Oslo Manual 2018 – which divides innovation activities into product innovations, business process innovations (internal process innovations, marketing innovations, organisational innovations) and unfinished or cancelled innovation activities – has been used since 2018.

Figure 8.10 shows the basic information from the TI 2018 survey. The first part of the figure shows the proportion of innovative companies according to enterprise ownership. The figure shows that the proportion of innovative enterprises in the last monitored period (2016–2018) increased slightly compared to the previous period (by 0.5 percentage points). The proportion of innovative companies therefore reached 46.8%. The trend concerning the proportion of innovative companies is the same as the evolution of the proportion of innovative domestic enterprises. In 2016–2018, 43.6% of domestic enterprises innovated. The proportion of innovative foreign-controlled enterprises grew more significantly between the two periods, with a positive increase of 3 percentage points (the proportion of innovative foreign-controlled enterprises is 58.1 %).

The middle part of the figure pertains to the proportion of innovative enterprises by enterprise size. It is clear that the small enterprise category falls under the proportion of innovative enterprises. The evolution of innovative small enterprises copies the evolution of innovative companies in the Czech Republic. The proportion of innovative small enterprises in the last reporting period (i.e., 2016-2018) was 41.2%. It increased between the periods just by about 0.5 percentage points. The growing proportion of innovative enterprises is also visible in the category of medium-sized enterprises (59.8%). Conversely, in the category of large enterprises, the proportion of innovative enterprises has recently decreased significantly, by almost 4 percentage points to 73.6%.

The drop in the proportion of innovative large companies can also be seen in the last part of the figure showing the evolution of enterprises in years, divided according to their basic field of activity. A lower proportion of innovative companies is recorded in the Industry category. While the proportion of innovative enterprises in the Service category increased by 2.5 percentage points (43.7%), in the Industrial Enterprises category, there was a decrease of 1 percentage point (49.4%).

Figure 8.10: Basic information on innovations in the Czech Republic by enterprise category



Proportion of innovative enterprises
Total innovative enterprises
Domestic enterprises
Enterprise under foreign control

Total innovative enterprises
Small
Medium
Large

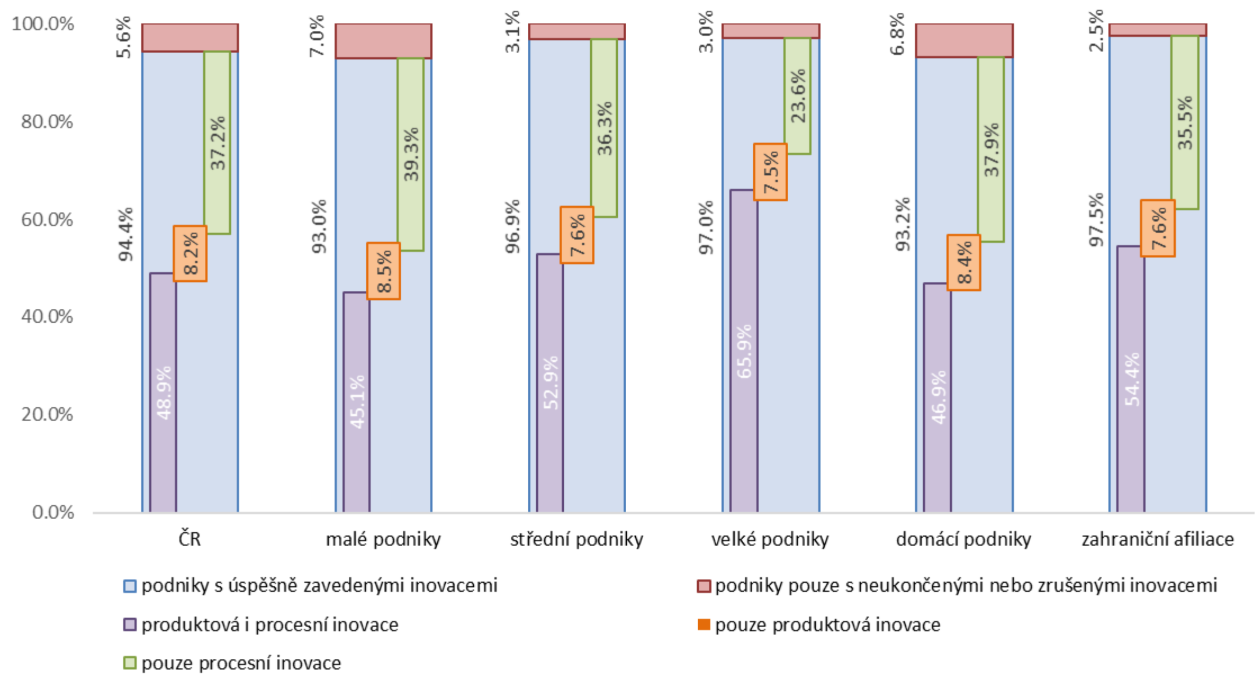
Total innovative enterprises
Industry
Services

Source: own processing according to the CZSO, Innovative activities of enterprises in 2016–2018

Figure 8.11 shows only innovating enterprises broken down by type of innovation and by enterprise size or ownership. In the Czech Republic, 94.4% of innovative enterprises had successfully implemented innovations. The remaining 5.6% did not complete the innovations or cancelled them. In terms of successfully completed innovations, the smallest proportion is of enterprises with only product innovations (8.2%), followed by enterprises with process innovation only (37.2%). The largest proportion of businesses (48.9%) implemented both process and product innovation. The same composition (i.e., the largest proportion of enterprises introduced product and process innovation and the smallest proportion introduced product innovation only) applies across all enterprise categories. In the case of categorisation of enterprises by size, it is evident that the proportion of enterprises with product and process innovation increases as the size of the enterprise grows, and, conversely, the proportion of enterprises introducing only process innovation decreases as the size of the enterprise grows. Equally noticeable is that the proportion of enterprises with ongoing or abandoned innovations declines as the size of the enterprise grows (although the difference between medium and large enterprises are not so marked in this area). There is a significant difference in this area between domestic enterprises (6.8%) and foreign affiliates (only 2.5 %).

It is therefore clear that large enterprises are significantly more successful in completing and introducing innovations than small enterprises. The same is true between domestic enterprises and foreign affiliates, the latter of which are more successful.

Figure 8.11: Innovative enterprises by type of innovation and enterprise category



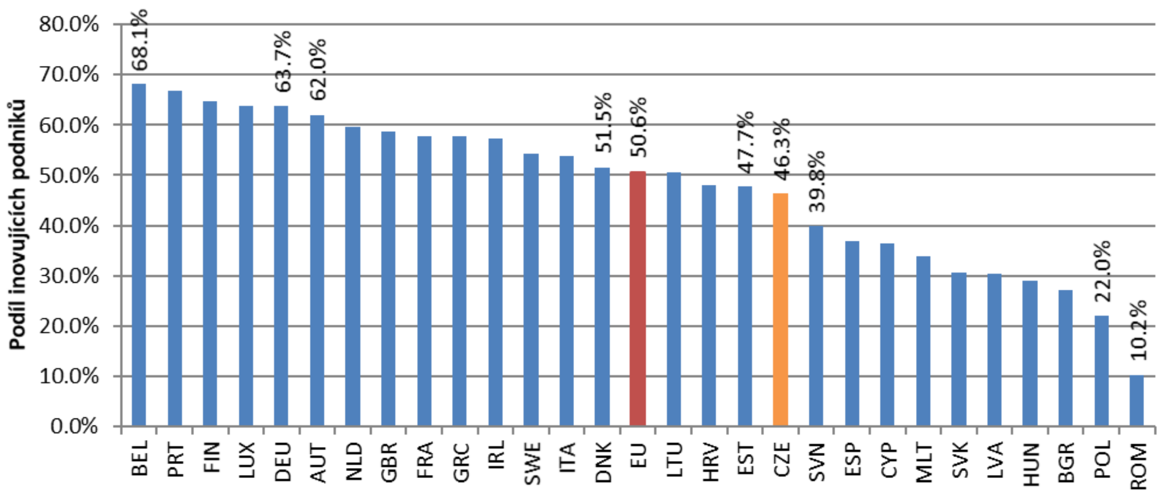
Enterprises with successfully implemented innovations
Product and process innovation

Process innovations only
Enterprises with only unfinished or cancelled innovations
Product innovations only

Source: own processing according to the CZSO, Innovative activities of enterprises in 2016–2018

Figure 8.12 shows the proportion of innovative enterprises in individual EU countries for the 2014–2016 period. The Czech Republic (46.3%) is below the EU28 average (50.6%) in terms of the proportion of innovative enterprises. The EU countries with the largest proportion of innovative enterprises are Belgium (68.1%), Portugal (66.9%), Finland (64.8%), Luxembourg (63.8%), Germany (63.7%) and Austria. (62%). Compared to the previous period (2012–2014), the largest increase in the proportion of innovative enterprises was in Estonia (+ 21.2 pp) and Portugal (+ 12.9 pp), while the largest decrease was in Malta (-7.3 pp) and Slovenia (-6.1 pp). Looking at the evolution in the proportion of innovative enterprises of the various countries, no general trend can be seen. For example, Germany has shown a lower proportion of innovative companies in each subsequent period since 2006.

Figure 8.12: Proportion of innovative companies in EU countries (2014–2016)



Source: own processing according to Eurostat

9 International Cooperation in Research, Development and Innovation

Research, development and innovation (RDI) are increasingly international in nature, with researchers from different countries working on international RDI projects in international teams. This cooperation enables the efficient sharing of expertise and resources, as well as finding solutions to global challenges in areas such as health, environment, energy and the like. A broad spectrum of Czech government bodies and establishments contribute to public support for international cooperation in R&D in the Czech Republic. At the forefront is the Ministry of Education, Youth and Sports (MEYS), which is the central government authority responsible for research and development, including international cooperation in this area. International cooperation in RDI is supported through targeted and institutional support. These different forms of support are defined in Act No. 130/2002 Coll., on Support of Research, Experimental Development and Innovation.

Table 9.1 shows the spectrum of support for international cooperation in research, development and innovation in the Czech Republic. The key tools for targeted support of international cooperation include the INTER-EXCELLENCE programme (MEYS), groups of grant projects and support for ERC applicants (CSF) and TA CR international cooperation programmes (especially Delta 2 and Kappa). Projects implemented within large research infrastructures also have a significant international dimension.[91] Institutional support for international cooperation according to Section 3(3)(b) of Act No. 130/2002 Coll., on the support of research, experimental development and innovation, includes payments for the Czech Republic's membership in international research, development and innovation organisations and contributions to the European Research Infrastructure Consortia (ERIC).[92] This also includes international cooperation programmes of the Ministry of Defence, specifically in connection with the payment of membership fees to the European Defence Agency (EDA). Institutional support also includes monetary shares from the Czech Republic's funds to support international cooperation projects in research, development and innovation, which include, among others, mobility implemented by MEYS and the Academy of Sciences of the Czech Republic.

[91] A specific type of large research infrastructure project in the Czech Republic is capacities that are operated in order to ensure the Czech Republic's participation in the international research infrastructure located abroad. The Roadmap of Large Research Infrastructures of the Czech Republic from 2019 divides large research infrastructures into six scientific fields: physical sciences and engineering; energy; environmental sciences; health and food/biological and medical sciences; social and human sciences / social and cultural innovations; and e -infrastructure.

[92] The involvement of the Czech Republic in the ERIC is discussed in more detail in the "Large Research Infrastructures" chapter.

Table 9.1: Spectrum of support for international cooperation in research, development and innovation in the Czech Republic and expenditures from the state budget in 2019

	Programme/activity by provider	Expenditures from SB under Act No. 336/2018 on SB (CZK millions)
Targeted support	**MEYS**	
	INTER-EXCELLENCE (LT) Programme	**760**
	Large infrastructure projects for research and development (LM Programmes)	**1 720**
	CSF	
	Grant project groups	
	- International bilateral projects	**89**
	- International Lead Agency projects	**73**
	Support for ERC applicants	**10**
	TA CR	
	Delta 2 Programme (2020–2025)	**-**
	Kappa Programme (2019–2024)	**18**
Institutional support	**MEYS**	
	International cooperation of CR in R&D - *CR's membership in international organisations, research, development and innovation* and ERIC* - *International bilateral projects* - *Mobility* - *EUROSTARS-2* - *EIG CONCERT Japan*	**1 261**
	Ministry of Defence **	
	International cooperation	**9**
	CAS	
	Mobility	**6**

Source: Act No. 336/2018 Coll., 2019 Annual Report of AV CR

** CR's membership in the European Space Agency (ESA) is in the purview of the Ministry of Transport; CR's membership in the European Defence Agency is in the purview of the Ministry of Defence.*

9.1 Targeted Support for International Cooperation

INTER-EXCELLENCE PROGRAMME (MEYS)

The INTER-EXCELLENCE programme, whose implementation period is 2016-2024, is an instrument used by MEYS to promote international cooperation in R&D. The programme has six sub-programs (see Table 9.2), which are targeted at the development of international bilateral and multilateral cooperation in research and development as well as at the involvement of the Czech Republic in European and world research structures. The programme is implemented through public tenders announced by MEYS[93] for projects with a maximum duration of five years.

[93] Outside the INTER-EUREKA sub-programme, targeted support in this case is provided on the basis of project selection at the international level.

Table 9.2: INTER-EXCELLENCE: summary by support sub-programmes (2017-2020)

Name	Brief description	Overall budget	Number of projects delivered	Proportion of supported projects
INTER-ACTION	*Bilateral Cooperation*	CZK 1.9 billion	905	21 %
INTER-COST	*Cooperation in the intergovernmental framework for European cooperation in science and technology (COST)*	CZK 890 million	322	54 %
INTER-TRANSFER	*Participation of Czech scientists in international teams*	CZK 800 million	76	53 %
INTER-INFORM	*Support and information services*	CZK 540 million	70	47 %
INTER-VECTOR	*Representation of CR in the governing bodies of international research organisations*	CZK 50 million	86	40 %
INTER-EUREKA	*Applied research*	CZK 800 million	122	40 %
	Total	**CZK 4.9 billion**	**1 459**	

Source: RDI IS / VES, CEP (2020)

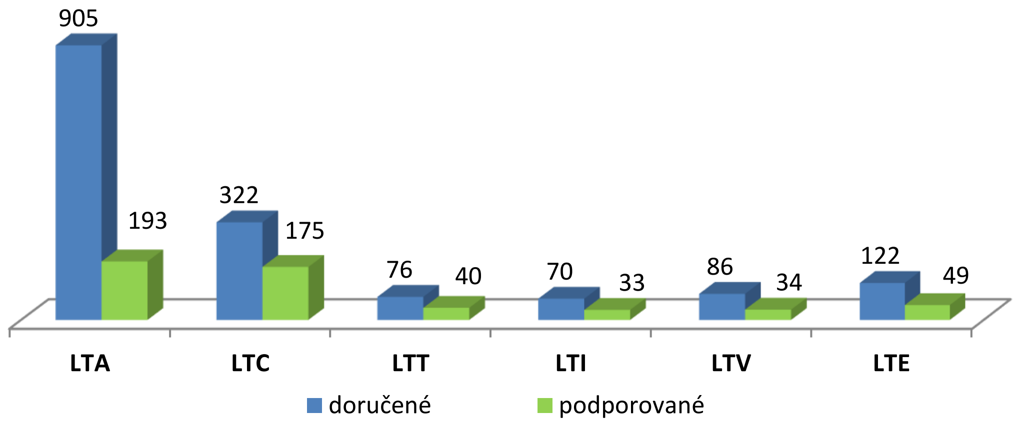
INTER-ACTION

The aim of this sub-programme is to develop bilateral cooperation with countries to which a valid bilateral, intergovernmental or inter-ministerial agreement for RDI activities is linked. Without direct financial support, this bilateral cooperation would only remain declared. INTER-ACTION mainly covers countries outside the EU that cannot be supported from European funds. Projects are currently underway in bilateral relations with the USA, India, Russia, China, Israel and Bavaria. Between 2017-2020, total expenditure on projects in the INTER-ACTION sub-programme amount to **CZK 1.1 billion.** The proportion of supported projects in this period reaches 21% (RDI IS, 2020).

INTER-COST

The aim of the sub-programme is to involve Czech scientists in the international programme for European cooperation in science, research and technology (COST). The international COST platform enables scientists to meet, exchange information and create professional networks ("networking"). INTER-COST should support projects in basic and applied research. This sub-programme has the result of facilitating the participation of Czech researchers in the EU framework programmes such as Horizon 2020. Between 2017 and 2020 the total expenditure on projects in the INTER COST sub-programme amounted to **CZK 620 million.** The proportion of supported projects in this period reaches 54% (RDI IS, 2020).

Figure 9.1: INTER-EXCELLENCE: Number of submitted and supported project proposals between 2017–2020 according to individual sub-programmes



Submitted *Supported*

Source: RDI IS / VES, CEP (2020)
NB.: LTA (INTER-ACTION), LTC (INTER-COST), LTT (INTER-TRANSFER), LTI (INTER-INFORM), LTV (INTER-VECTOR), LTE (INTER-EUREKA)

INTER-TRANSFER

The INTER-TRANSFER sub-programme supports the involvement of Czech researchers in international research teams operating in research centres or international organisations abroad. The aim of the sub-programme is to enable further development of Czech scientific capacities and increase of quality scientific knowledge. Between 2017 and 2020, total expenditure on projects in the INTER-TRANSFER sub-programme amounted to **CZK 564 million.** The proportion of supported projects in this period reaches 53%. The most successful applicants in terms of the number of approved projects in this period include the Czech Technical University, the Institute of Physics of the CAS, the Faculty of Mathematics and Physics of Charles University and the Institute of Nuclear Physics of the CAS (RDI IS, 2020).

INTER-INFORM

The INTER-INFORM sub-programme focuses on disseminating information on available international support programmes through advisory and consulting services for Czech entities. Between 2017 and 2020, total expenditure on projects in the INTER- INFORM sub-programme amounted to **CZK 464 million.** The share of supported projects in this period reaches 47% (RDI IS, 2020).

INTER-VECTOR

The INTER VECTOR sub-programme provides funding to strengthen the representation of Czech scientists in the governing bodies of international research organisations. The representation of the Czech scientific community in these governing bodies makes it possible to influence future directions in the development of science and research at the supranational level. The expected benefit is an increase in the proportion of Czech scientists in these bodies and an increase in the level of prestige of Czech science abroad. Between 2017 and 2020, total expenditure on projects in the INTER VECTOR sub-programme amounted to **CZK 22 million.** The proportion of supported projects in this period reaches 40% (RDI IS, 2020).

INTER-EUREKA

The last sub-programme is INTER- EUREKA, which focuses on applied research and supports international cooperation between industry, research institutes and universities. The INTER-EUREKA sub-programme enables international cooperation with partners associated in the EUREKA network, which connects industry and research organisations. The objective of INTER-EUREKA is to support the growth of applied research results. Between 2017 and 2020, total expenditure on projects in the INTER- EUREKA sub-programme amounted to **CZK 801 million.** The proportion of supported projects in this period reaches 40% (RDI IS, 2020).

International Cooperation of the Czech Science Foundation

The Czech Science Foundation is a government establishment that provides targeted support from public funds for basic research projects. At the global level, the CSF implements projects in the framework of membership in the Global Research Council (GRC), which brings together national agencies from Europe, Asia, Africa, Latin America and the USA that support basic research. At the European level, cooperation takes place mainly on the basis of membership in the Science Europe (SE) organisation, which brings together 27 European countries, mainly EU members.

Table 9.3: Groups of grant projects in the field of international cooperation of the CSF

Kind of cooperation	Foreign partner organisation	Project duration	Approved support from SB (2019)
Bilateral cooperation (International projects 2007-)	Germany, Austria, Taiwan, South Korea, São Paulo (Brazil)	2–3 years	CZK 89 million
Lead Agency projects (LA grants – int. grants on principle of Lead Agency 2015- evaluation)	Austria, Switzerland, Poland, Slovenia	3 years	CZK 73 million
Support for ERC applicants (Support for international cooperation for obtaining ERC grants 2017-)	-	3–6 months	CZK 10 million

Source: CSF (2020), RDI IS (2020), Act No. 336/2018 Coll.

Table 9.3 shows groups of grant projects in the field of international cooperation of the CSF. Based on **bilateral cooperation,** the CSF works closely with partner organisations in Germany, Austria, Taiwan, South Korea, Russia and the Brazilian state of Sao Paulo. Specifically, the following partners are: Deutsche Forschungsgemeinschaft (DFG), Ministry of Science and Technology (MOST), Taiwan, National Research Foundation of Korea (NRF), Russian Foundation for Basic Research (RFBR) and Sao Paulo Research Foundation (FAPESP). Each national provider funds activities within its territory. The condition for the provision of support to an international project by the CSF is its approval by both national providers. According to the Report on the Activities of the CSF in 2019, the CSF, in cooperation with the Taiwanese partner MOST, finances six international projects with a solution start date in 2019. In cooperation with the Korean organisation NRF, the CSF finances a total of three international projects with a solution start date in 2019. A total of thirteen projects succeeded in the public competition of international projects with the German organisation DFG. Furthermore, within the framework of public tenders announced in 2019, the CSF received a total of 231 international (bilateral) projects. Based on the recommendations of the advisory bodies and by general consensus, the presidium decided in November 2019 to finance a total of 38 international projects in cooperation with partners in the six above-mentioned countries.

The second type of grant projects are **Lead Agency projects.** These are projects based on agreements between agencies, where project proposals are assessed by only one of the national agencies, with the other accepting the results of the evaluation process. The topic of the project is chosen by the Czech promoter in cooperation with the foreign promoter. As with bilateral agreements, each national provider funds activities within its territory. In 2019, 66 proposals were submitted under the joint call for proposals for Austrian-Czech project proposals based on the Lead Agency principle, with the expected solution start date to be 1 January 2020, with one proposal being rejected on the Austrian side for formal reasons. In December 2019, the CSF Board approved support for 12 international grant projects, which were recommended for funding by the Austrian agency FWF (Fonds zur Förderung der wissenschaftlichen Forschung).

CSF also implements **projects to support ERC applicants.** The purpose of which is to help researchers gain experience and increase success in obtaining funding from European Union structures and strengthen excellence in basic research in the Czech Republic. By obtaining a grant from the European Research Council (ERC), the international scientific reputation of the researcher, his team and his workplace is significantly strengthened. According to data from RDI IS, support from the ERC has not yet been drawn.

International Cooperation of the Technology Agency of the Czech Republic

The Technology Agency of the Czech Republic is an organisational unit of the state that centralises state support for applied research. TA CR ensures the development of international cooperation in applied research and innovation and cooperation with similar agencies abroad. TA CR's activities in the international field mainly include the Delta 2 and Kappa programmes (see Table 9.4). TA CR also participates in the European Framework Programme for Research and Innovation (Horizon 2020) via ERA-NET co-funding calls and other activities in connection with the European framework programme.

Table 9.4: Programmes in the field of international cooperation of TA CR (CZK millions)

Type of cooperation	Partners	Project duration	Approved support from SB (CZK millions)	
			2019	2020
Delta 2	Countries outside EU	3–5 years	0	100
Kappa	Norway, Iceland, Lichtenstein	2–5 years	18	24

Source: TA CR (2020), RDI IS (2020), Act No. 336/2018 Coll., Act No. 355/2019 Coll..

The Delta 2 programme builds on the Delta programme, which is now winding up. Implementation will take place between 2020 and 2025 and will focus on bilateral international cooperation between research teams in the Czech Republic and partners especially from countries outside the EU (Asia, South America and North America). The aim is to support the results in applied research and experimental development, which will be successfully implemented in practice and thus strengthen the competitiveness of the Czech Republic. To obtain a grant, projects must be supported by both the Czech (TA CR) and foreign parties (foreign organisations in the given locality). The expected duration of individual projects is three years, but the duration of the project must not exceed five years. The total expenditures of the Delta 2 programme amount to CZK 1.2 billion; for 2020, CZK 100 million was allocated to this programme from the state budget (Act No. 355/2019 Coll.).

The **Kappa programme** runs between 2019 and 2024 and is financed by the European Economic Area (EEA) and Norway. This is the first programme of the TA CR that is not fully financed from national sources. The programme is focused on financing the bilateral and multilateral cooperation between entities from the Czech Republic and partners from Norway, Iceland and Liechtenstein. The programme focuses on connecting research organisations with customers of applied research outputs. Approximately 30% of total expenditure is dedicated to carbon capture and storage projects. The minimum duration of the project is two years, but the project must not exceed five years. The total expenditures of the Kappa programme amount to approximately CZK 781 million, of which targeted expenditures from the EEA and Norway Financial Mechanisms amount to approximately CZK 663 million and targeted expenditures from the state budget (TA CR chapters) amount to approximately CZK 117 million. In 2019, support from the state budget in the amount of CZK 18 million was approved for this programme (Act No. 336/2018 Coll.).

9.2 Institutional Support for International Cooperation

Membership of the Czech Republic in International Research and Development Organisations

International research and development organisations are a specific type of research infrastructure in which the Czech Republic is in the position of member state. These organisations are established under public international law and differ from other international research infrastructures in the legal framework of their establishment.[94] The membership of the Czech Republic in these organisations is conditional upon observance of the proper legislative process associated with the negotiation of international treaties. Prior to ratification by the President, the consent of the Chamber of Deputies and the Senate is required. Membership in international research and development organisations means a commitment to pay annual contributions, which may be mandatory or optional in nature. Membership subsequently brings a number of significant benefits to the research and industrial communities of the member countries. The following section provides an overview of international research organisations established under public international law and that the Czech Republic is a member of. Table 9.5 provides an overview of the Czech Republic's membership fees paid to these organisations in 2019.

Table 9.5: Membership fees paid by the Czech Republic to international research and development organisations from the MEYS budget heading in 2019

Abbreviation	Name	Czech membership fee paid by MEYS (2019)
CERN	European Organisation for Nuclear Research	CZK 232.0 mil.
JINR	Joint Institute for Nuclear Research	CZK 132.0 mil.
ESA	European Space Agency*	CZK 314.0 mil.
ESO	European Southern Observatory	CZK 50.0 mil.
EMBC	European Molecular Biology Conference	CZK 4.7 mil.
EMBO	European Molecular Biology Organisation	CZK 7.2 mil.
EMBL	European Molecular Biology Laboratory	CZK 26.0 mil.
ITER	International Thermonuclear Experimental Reactor	CZK 1.4 mil.
VKIFD	Von Karman Institute of Fluid Dynamics	CZK 0.9 mil.

Source: RDI IS (2020), MEYS (2020)
** Only fees for ESA's R&D activities included*

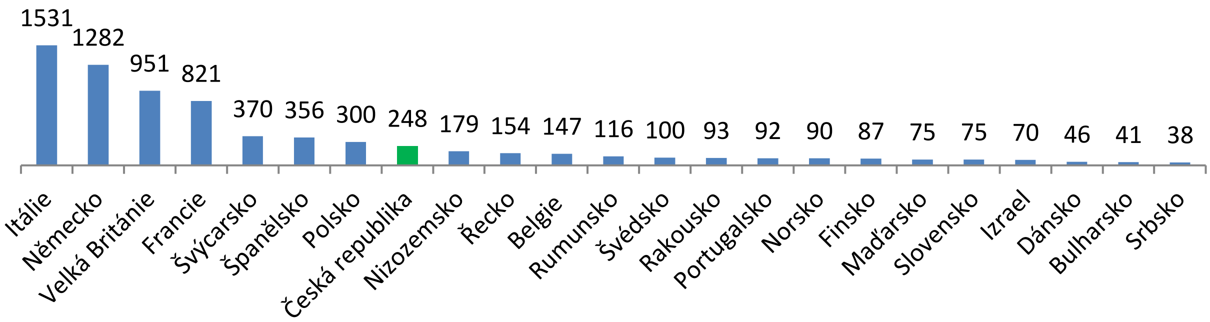
European Organisation for Nuclear Research (CERN)

The European Organisation for Nuclear Research, based in Geneva, Switzerland, is the largest research centre for particle physics in the world. CERN currently has 23 member states. CERN's annual budget is CHF 1.2 billion (approximately CZK 29 billion). The Czech Republic's contribution to CERN in 2019 amounted to **CZK 232 million** (RDI IS, 2020), and the MEYS pays membership contributions to CERN from its budget. The goal of research at CERN is to understand what components matter is composed of and how these components interact with one another. The most important experiments are performed here in a particle accelerator, which consists of a tube with a circumference of almost 27 km (Large Hadron Collider, abbreviated "LHC"). The particles orbit each other and their collisions are recorded by detectors. Scientific teams from around the world evaluate these experiments.

[94] The Von Karaman Institute is not established under public international law, but has the legal form of AISBL (a non-profit organisation under Belgian law), see below.

In 2019, CERN's research infrastructure was used by almost 12,400 scientists from 110 different countries. As regards CERN Member States, the Czech Republic ranks 8th in terms of the number of researchers involved in CERN projects (see Figure 9.2). The participation of the Czech scientific community in CERN is realised on the basis of the project "Research infrastructure of CERN-CZ". The goal of CERN-CZ is to support the development and operation of research facilities for experiments at CERN with the participation of the Czech Republic. Delivered orders and successful operation of many facilities built in the Czech Republic represent important knowledge-intensive orders for industrial companies stimulating their innovative capabilities.

Figure 9.2: Number of CERN scientific infrastructure users by CERN Member State



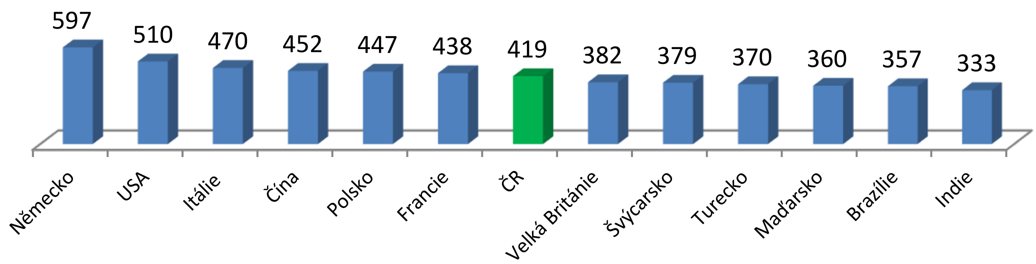
Italy, Germany, Great Britain, France, Switzerland, Poland, Czech Republic, Netherlands, Greece, Belgium, Romania, Sweden, Austria, Portugal, Norway, Finland, Hungary, Slovakia, Israel, Denmark, Bulgaria, Serbia
Source: CERN Annual Report (2019)

Joint Institute for Nuclear Research (JINR)

The Joint Institute for Nuclear Research, based in Dubna, Russia, focuses on the fields of particle and nuclear physics, solid state physics and radiobiology. Currently, JINR brings together 17 member states, especially the former countries of the East Bloc. Czechoslovakia was also among the founding members of JINR in 1956. Associate members of JINR include Egypt, Germany, Hungary, Italy and South Africa. The annual budget of JINR is USD 210 million (approximately CZK 4.6 billion). The Czech Republic's contribution to the JINR in 2019 amounted to approximately CZK 132 million (MEYS, 2020). JINR research infrastructure includes seven laboratories. Experimental flagship devices include the Nuclotron, Phasotron, Cyclotrons and Pulse Reactor.

JINR employs about 4 500 employees, of which more than 1 200 are scientists. In 2019, JINR employed 45 workers from the Czech Republic with an employment contract longer than three months. The highest-ranking Czech workers are Dr. Richard Lednický, who holds the position of Vice-Director of the JINR, and Dr. Alojz Kovalík, who works as the Deputy Director of the Laboratory of Nuclear Problems. Membership in JINR significantly contributed to the fact that particle and nuclear physics are two of the most important Czech fields in terms of the weight of quality scientific publications on a global level. According to the annual reports of JINR of 2019, scientists from the Czech Republic published 419 scientific articles, placing the country at the top of rankings according to the number of JINR publications (see Figure 9.3).

Figure 9.3: Number of JINR publications by nationality of authors in 2019



Germany, USA, Italy, China, Poland, France, Czech Republic, Great Britain, Switzerland, Turkey, Hungary, Brazil, India

Source: JINR 2019 Annual Report

European Space Agency (ESA)

The aim of the European Space Agency is to design and implement the European Space Programme and to support space research and the use of space technologies. ESA is headquartered in Paris, France, with a number of research institutes and laboratories located in other EU Member States. ESA's infrastructure also includes a spaceport in French Guiana and a network of ground surveillance stations around the world. Currently, ESA brings together 22 member states. The Czech Republic has been a member since 2008. ESA's annual budget is approximately EUR 57 billion. The Czech Republic's cooperation with ESA is coordinated by the Ministry of Transport, which also finances ESA's activities in the field of industry in the amount of approximately EUR 46 million per year (approximately CZK 1.2 billion). ESA programmes in the field of research and development are financed by the MEYS. In 2019, this contribution amounted to **CZK 314 million** (MEYS, 2020).

Membership in ESA enables Czech companies to work on top technological projects that, due to their complexity, difficulty and total costs, exceed the possibilities of the Czech Republic itself. Currently, 50 Czech companies and 23 scientific institutes and universities cooperate with ESA.[95] Among other things, the Czech Republic participates in the Programme for the Development of Scientific Experiments (PRODEX), intended for the development of scientific instruments for space research. Under the auspices of ESA, there are two space incubators in the Czech Republic (based in Prague and Brno) that help selected start-up companies to find use for space technologies in everyday life.

[95] Czech Space Portal (2020)

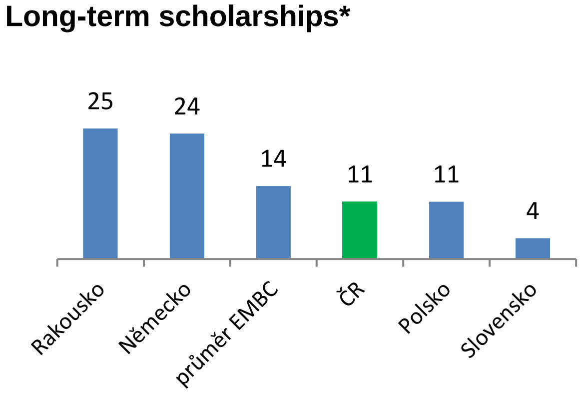
European Southern Observatory (ESO)

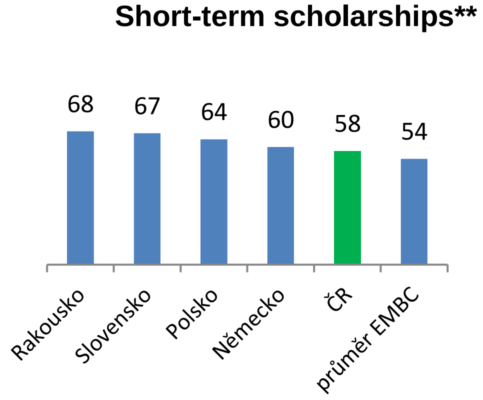
The European Organisation for Astronomical Research in the Southern Hemisphere (or the European Southern Observatory) is an intergovernmental organisation of 16 member states. The Czech Republic has been a member of ESO since 2007. The goal of ESO is to enable European scientists to observe space from the southern hemisphere in the best possible climatic conditions. ESO operates three observatories in the Atacama Desert in Chile. In 2025, the world's largest *Extremely Large Telescope (*ELT) is to be commissioned. The Czech Republic's contribution to ESO in 2019 amounted to **CZK 50 million** (MEYS, 2020), which corresponds to approximately 1% of ESO's budget. Membership in ESO allows the Czech Republic to use the most advanced astronomical infrastructure in the world. At present, the share of Czech scientists using ESO infrastructures, according to the length of observations over time, is around 1.6%. Time is given to the scientifically best projects based on a competition. In 2019, a total of 21 requests for observation time were submitted from Czech entities, and 6 of these requests succeeded in international competition. Based on observations and analyses in ESO, a total of 28 articles with a Czech (co-)author were published in 2019. Czech entities received EUR 17,688 (approximately CZK 474,000) from ESO public contracts in 2019.

European Molecular Biology Conference (EMBC)

The European Molecular Biology Conference provides a framework for European cooperation in the field of molecular biology. The EMBC brings together 30 countries, mostly from the EU and neighbouring countries. The EMBC funds basic research through short-term and long-term scholarships. Participation in the installation grant programme, which motivates young talented scientists to return to their countries of origin, is also important for the Czech Republic. The EMBC programme is implemented by the ***European Organisation for Molecular Biology (EMBO),*** which administers scholarship programmes. The Czech Republic's contribution to EMBC and EMBO is financed from the MEYS budget. In 2019, the Czech Republic's contribution to EMBC amounted to **CZK 4.7 million.** The Czech Republic's contribution to EMBO (the installation grant programme to support the creation of scientific teams in home countries) amounted to **CZK 7.2 million** in the same year (RDI IS, 2020). The success rate of Czech applicants for long-term and short-term EMBO scholarships is solid. While the success rate of Czech applicants for long-term scholarships between 2015–2019 was 11%, the success rate of Czech applicants for short-term scholarships was 58% in the same period. Figure 9.4 compares the success rate of Czech applicants with selected Member States. The amount of the EMBO scholarship varies according to the country where the research is carried out.

Figure 9.4: Success rate of Czech applicants for short-term and long-term EMBO scholarships in comparison with selected Member States in 2015–2019 (in percent)





Austria, Germany, EMBC average, Czech Republic, Poland, Slovenia
Austria Slovenia, Poland, Germany, Czech Republic, EMBC average

Source: EMBO facts & figures 2019
** postdoctoral research up to two years; ** postdoctoral research up to three months*

In 2019, ten Czech scientists applied for an installation grant (programme co-financed and approved by the MEYS). Two new grants were awarded and a total of six projects supported by the installation grant were in progress in 2019. Furthermore, seven long-term scholarship applications for research in Czech laboratories were submitted (none successful), and ten researchers from the Czech Republic applied for a scholarship for a long-term stay abroad (one successful application). In the category of short-term scholarships (up to three months), a total of 19 applications were submitted, of which 12 were successful. In 2019, 134 participants from the Czech Republic participated in courses and workshops organised by EMBO (110 students and 24 lecturers), and 23 participants were reimbursed for travel expenses.

European Molecular Biology Laboratory (EMBL)

The European Molecular Biology Laboratory, based in Heidelberg, Germany, is an international organisation of 27 member states. Through a network of six European laboratories, EMBL offers a technologically important research infrastructure in the field of molecular biology and genetics. Apart from European countries, Israel is also a member state, with Australia and Argentina being associate members. The Czech Republic has been a member since 2014. In 2019, the Czech Republic's contribution to the EMBL was **CZK 26 million** (RDI IS, 2020), which corresponds to 0.9% of the EMBL budget. In 2019, EMBL was visited by 18 Czech researchers and students for short-term (up to three months) and medium-term (up to one year) internships, and two researchers received a so-called *Boulin Fellowship* (scholarship covering travel and accommodation for medium-term stays). A total of 29 users from the Czech Republic used the EMBL facilities in Heidelberg and 16 Czech users the facilities in Hamburg. The EMBL-EBI database in Hinxton recorded 106.2 thousand accesses from the Czech Republic using bioinformatic data and services. In 2019, a total of 16 research and internationally granted projects with involvement from the EMBL and entities from the Czech Republic took place. Two twinning projects between EMBL and partners from the Czech Republic were successfully submitted in the EU Horizon 2020 programme. Courses and conferences organised by the EMBL in 2019 were attended by 96 participants from the Czech Republic. In 2019, EMBL employed 12.8 Czech workers (calculated according to the full-time equivalent).

International Thermonuclear Experimental Reactor (ITER)

A special category of the Czech Republic's involvement in international research and development organisations is the International Thermonuclear Experimental Reactor. The aim of this scientific experiment, which is the largest in the world to date, is the construction of a tokamak, which aims to demonstrate the possibility of producing electricity from a thermonuclear fusion reaction. Thermonuclear fusion is a potential source of clean and almost inexhaustible energy. The Tokamak is being built in Cadarache, France, by the ITER member states (EU, Switzerland, USA, Japan, China, Russia, India and South Korea). The tokamak is due to be commissioned in 2025, with a total cost of EUR 25 billion. Member States are involved in ITER through their national agencies. The agency for the EU is the Barcelona-based "European Joint Undertaking for ITER and the Development of Fusion Energy" (i.e., Fusion for Energy - “F4E"). F4E was established under Article 45 of the Treaty establishing the European Atomic Energy Community by a decision of the Council of the EU of 27 March 2007 for a period of 35 years. One of the two Vice-Chairmen of the F4E Board in 2020 was RNDr. Radomír Pánek, Ph.D., **Director of the Institute of Plasma Physics of the Academy of Sciences of the Czech Republic.** The Institute of Plasma Physics of the CAS participates in the development of several diagnostic systems for ITER and also operates its own experimental equipment for thermonuclear fusion research, the COMPASS tokamak

In 2019, the fee paid by the Czech Republic to F4E amounted to **CZK 1.4 million** (RDI IS, 2020). For the duration of the project, Czech research institutions and companies concluded contracts with F4E for research, development and technological supplies totalling approx. CZK 224 million, of which CZK 201.4 million was paid in 2019. The most financially significant contract concerns the testing of the components of the first wall of the ITER fusion reactor. The above amount does not, however, include the value of subcontracting of Czech companies for F4E realised through suppliers from other Member States. Membership in F4E also makes it easier for Czech research institutions to apply for direct supplies to the ITER Organisation and to participate in the international cooperation on the preparation of the scientific programme of the ITER and DEMO reactors through the European consortium EUROfusion.

Von Karman Institute of Fluid Dynamics (VKIFD)

The Von Karman Institute for Fluid Dynamics is an international non-profit educational and research organisation based in Belgium that focuses on fluid dynamics. VKIFD was founded in

1956 as an institute to train experts in the field of fluid dynamics for the needs of the North Atlantic Treaty Organisation (NATO) and continues to do so to this day. Since 2011, it has also been the reference laboratory of the European Space Agency (ESA) and conducts contract research for a number of private companies operating mainly in the fields of aviation, renewable energy and engine manufacturing. The VKIFD brings together 15 member states that are also members of NATO. The total VKIFD budget in 2019 amounted to EUR 12.21 million (about CZK 2.3 billion). The Czech Republic's VKIFD contribution in 2019 amounted to approximately **CZK 857 000** (MEYS, 2020). VKIFD has approximately 100 employees, and up to 200 students participate in VKIFD’s activities every year. In the 2018–2019 academic year, 4 students from the Czech Republic made use of the VKIFD study programmes. From the Czech research institutions, the Řež Research Centre is cooperating with VKIFD on the SESAME EU project.

MEYS Mobility

Institutional support for international cooperation in R&D is also provided by the MEYS through Activity Mobility. This is another possibility of cooperation resulting from agreements on scientific and technical cooperation with a foreign partner. These agreements serve to establish contacts and develop cooperation between scientific institutions by supporting the mobility of researchers collaborating on international research projects. Supported projects are usually two years in duration. Through Aktivity Mobility, the Ministry of Education is currently developing cooperation with France, Germany, Austria, Ukraine, Poland and China.

CAS Mobility

The Academy of Sciences of the Czech Republic also provides institutional support for international cooperation in R&D through mobility projects. These are bilateral agreements between the CAS and foreign partner organisations in more than 40 countries. This cooperation takes the form of bilateral mobility projects and Mobility Plus projects lasting 2-3 years. The CAS also implements 2-year ERA-NET multilateral mobility projects, the aim of which is to support research within the Horizon 2020 programme. ERA-NET projects bring together at least three research organisations from the three participating countries.

According to the Annual Report on the Activities of the CAS, in 2019, contractual documents with existing partner organisations continued to be updated and several new contractual partnerships were established, for example with a major US partner, the United States Department of Energy. Bilateral international cooperation programmes were implemented by the CAS in 2019 with 27 partner organisations from 23 countries. Under these programmes, there were 115 projects in place to promote the mobility of researchers (80 projects continued to be realised and 35 new ones commenced). The total financial support for mobility of the CAS in 2019 exceeded CZK 6 million.

EUROSTARS-2 PROGRAMME

The ongoing EUROSTARS-2 programme, the implementation of which in the Czech Republic is in the purview of the MEYS, builds on the previous EUROSTARS programme. It is a European research, development and innovation programme that offers the possibility of co-financing from the European Community budget. Project support is based on the principles of the EUREKA programme and the Horizon 2021 framework programme for the 2014 to 2025 programming period. The EUROSTARS-2 programme aims to support small and medium-sized enterprises (as defined in the Community Framework for State Aid for Research, Development and Innovation) which, in addition to their production or service activities, perform their own research and development activities to the extent of at least 10% of annual turnover or report at least 10% of their employees involved in these activities. The EU contribution to these projects is about 25% of expended public aid. Under this programme, there were a total of 22 projects supported in 2019 (12 existing projects and 10 new ones). Public financial support for EUROSTARS-2 projects exceeded CZK 34 million in 2019.

EUROPEAN INTEREST GROUP FOR COOPERATION WITH JAPAN (EIG CONCERT JAPAN)

On the basis of the "Memorandum on cooperation in planning and implementing joint calls - EIG CONCERT Japan", which is signed on the Czech side by the CAS and the MEYS, Czech researchers from universities, research organisations and small and medium enterprises active in basic and industrial research have the possibility of receiving funding for their joint multilateral scientific projects with European and Japanese partners. The aim of the Memorandum is to strengthen cooperation between European countries and Japan in scientific, technical and innovative research addressing current societal challenges and needs. Each year, five or six of the highest quality projects are selected for funding under a joint call from this platform. In 2019, one project with Czech participation was supported. Every year, EUR 600 000 are earmarked by the MEYS as support for the successful Czech entities of this platform.

CONCLUSION

Based on the breakdowns and analyses carried out, the RDI Council formulated the "strengths" and "weaknesses" of the RDI system. Minimising or even eliminating weaknesses and consolidating strengths by taking advantage of opportunities should contribute to the stabilisation of the components of the RDI system and thus help the RDI system to function effectively as a whole in the future.

The 2019 Analysis of the Existing State of Research, Development and Innovation, just like in the ones for previous years, was one of the main starting points for the creation of the new 2021+ National Policy for Research, Development and Innovation. Annex 1 discusses the results monitoring of quantitative indicators of fulfilment of the objectives of the National Policy for Research, Development and Innovation 2016–2020.

It is clear that in some areas it is necessary to carry out more detailed analyses, which are often limited, unfortunately, by missing or insufficient data. and by a shortage of staffing at RDI Council Department. For this reason, some of the recommendations are directed towards developing and evidence base (see Technical Recommendations). A possible partial solution is the use of so-called shared activity projects, which would allow the provision of partial analytical inputs and data processing on the basis of assignments by the RDI Council or RDI Council Department.

STRENGTHS VS. WEAKNESSES AND OPPORTUNITIES:

+ *Economic potential of the Czech Republic (see international comparison of innovation performance of the Czech economy) together with growing expenditures on RDI and built infrastructure*

- When preparing the draft budget, further stabilise research organisations by strengthening the share of the institutional component of the state budget for RDI (indicator of long-term conceptual development of research organisations) vis-à-vis targeted support in connection with the evaluation of research organisations.
- When supporting research, development and innovation from the state budget, place greater emphasis on research and development in important/ground-breaking areas of each scientific field where the results thereof should be protected internationally.
- Use public foreign resources for the development of the RDI system, thereby making using of the potential of R&D centres built from EU SF funds as a basis for long-term cooperation in applied research.
- 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 method of evaluation of research organisations and of targeted support for research, development and innovation, which will lead to the elimination of the negative

impacts on the research and development system caused by previously used evaluation methods.

- Emphasise the component of institutional support for the long-term conceptual development of research organisations in the planning of funds for the operation and further development of research infrastructures.

– *Private expenditures of the RDI system are spent mainly in the private sector, which may mean low efficiency of cooperation between the private and public sectors in the RDI system.*

- In analyses, focus in more detail on the relationships between business entities and public research entities (universities, institutes of the Czech Academy of Sciences, government research facilities), with special regard for social and economic growth (including employment in technologically advanced fields with corresponding growth in real wages).
- Encourage the involvement of public sector research organisations in private sector research activities through various incentives and increased tax deductions.

– *Unsatisfactory participation of Czech research organisations and teams in the Horizon 2020 framework programme*

- Carry out such 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).
- Create conditions that encourage Czech organisations to be more interested in participating in international RDI programmes, from which significant benefits can be obtained for the Czech RDI system due to the high participation success of the Czech Republic in the Horizon 2020 framework programme.

+ *Qualified human resources and traditionally strong academic background*

- Motivate Czech researchers to participate in foreign projects through new or existing tools for establishing, maintaining and developing foreign cooperation (e.g., PROPED).

– *Insufficient development of professional abilities and skills of researchers and maximum use of their potential*

- Focus on eliminating shortcomings in the field of personnel management in research and development, support the sustainability of scientific careers by improving the conditions for combining family and professional life (work-life balance), create conditions that encourage women to remain in the research environment, motivate graduates to continue being active in their research activities.

– *Low representation of women in the research environment of the Czech Republic*

- Set conditions that encourage and motivate women to participate in research activities:
  - Formulate recommendations resulting from the evaluation of completed programmes towards providers of aid
  - Direct the requirements for research organisations to support a work-life balance (e.g., motivation and support for women already during doctoral studies, thus leading to a higher proportion of women embarking on scientific careers).

+ *Strong culture of publishing activity and gradually developing internationalisation leading to excellence of some scientific disciplines*

- Implement measures supporting improvements in the quality of publication outputs and internationalisation, especially in basic research.
- As part of the evaluation of research organisations as well as the evaluation of programmes, 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.
- Support the building of relationships with foreign partner and create long-term links to leading research facilities.

– *Conditions for effective functioning and development of innovation activities*

- Continue to remove the main barriers to innovation progress in the Czech Republic – which include low venture capital investments, low use of intellectual property protection in the form of international patents and shortcomings in human resources – and subsequently support the use of other forms of financial instruments, including guarantees, soft loans, etc. for development of innovation activities.
- 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.

TECHNICAL RECOMMENDATIONS:

- Within RDI IS, further build a robust, up-to-date and accessible database. The starting point for the development of the database used for RDI analyses is the data repository created and managed by the RDI Council. Such a solution will enable the connection of RDI IS data with data from various databases and registers relevant for RDI analyses (e.g., PATSTAT, E-Corda, Web of Science, CZSO-RTD, CZSO-RES, ETER, OECD MSTI, providers database, CSSA registers and GFR - see also Annex 2).
- 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).
- Arrange for institution 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 on the 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 state budget part (co-financing from SB)..
- Keep an accounting record of support for research, development and innovation provided on the national level divided up according to direct costs (payroll, materials and services) and indirect costs for each category of support, especially institutional support.
- Implement regular monitoring of the application of research infrastructures in applied research for the needs of important sectors of the Czech national economy; related to this is the implementation of a record of the results created using research infrastructure.
- Arrange for a record to be kept of information about the use of research and development results on the national level.
- Arrange for a record of researchers and their participation in individual projects, including a record of the workload.

LIST OF ABBREVIATIONS

A.C.	H2020 programme associated countries
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.
BBMRI ERIC	Bio-banking and Bio-molecular Resources Research Infrastructure
BERD	Business Enterprise Expenditure on R&D
CAS	Academy of Sciences of the Czech Republic
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
COFIN	Co-financing of Operational Programmes from the State Budget
CR	Czech Republic
CSF	Czech Science Foundation
CZ-CPA	Classification of production
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
EU13	Countries that joined the EU in 2004 or later
EU15	Countries that joint the EU prior to 2004
EU28	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
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
•	INTERNAT	International cooperation of the Czech Republic in Research and Development executed under international contracts
•	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, share of knowledge-intensive fields on total employed workforce
•	Lic 5-01	CZSO survey/Annual Licence Report
•	LP	Legal and natural persons outside universities
•	LRI	Large research infrastructures
•	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
•	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
•	MoLSA	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 Impact
•	NE	National economy
•	NIP	National Innovation Platform
•	NP RDI 2016-2020	Czech Republic National Policy for Research, Development and Innovation, 2016-2020
•	NP RDI 2021+	Czech Republic National Policy for Research, Development and Innovation, 2021+
•	NSP	National Sustainability Programmes I and II
•	OECD	Organisation 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 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 intelligent 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
• SALSC	State Administration of Land Surveying and Cadastre
• SB	State budgetary organisations, state organisational units and public research institutions except for the departments of CAS
• SERV	Export of knowledge-intensive services as % of total services export
• SF EU	Structural Funds of the European Union
• SME	Small and Medium-sized enterprise
• SO	Specific objective of an operational programme
• SSH	Social Sciences and the Humanities
• SII	Summary Innovation Index
• SP ČR	Confederation of Industry of the Czech Republic
• SPO	State budgetary organisation
• 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, Director*

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

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
Jana Kubecová, Jana Frantíkova (ERC section)

Implementation of the National Strategy for Intelligent Specialisations
MIT RIS3: Jan Bilík

Human Resources in Research and Development
Jana Kubecová

Research Infrastructures and Research and Development Centres
Jana Frantíková, Lucie Kureková (RDI IS – LM section)

Results of Research and Development
Lucie Kureková, Otakar Dobiáš (Licence section)

Innovation Performance of the Czech Economy and International Comparison
Jana Kubecová

International Cooperation in Research, Development and Innovation
Kateřina Hradilová

Annexes:

P1. 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 CAS

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
Mgr. Jana Kolaříková, Mgr. Luďek Kos, RNDr. Marek Vyšinka, Ph.D.	Chapter: International Cooperation in Research, Development and Innovation

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, 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 2016-2020 should also be the regular monitoring of indicators and their analysis.

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 such quantitative and qualitative indicators that were relevant at the time of their creation. Table P 1 shows the values of these indicators for 2019 (if the values for that specific year were not available, the data for the year when data was last available are used). The table provides **more specific details in the case of some indictors** to give them more relevance. 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 in some cases also retroactively adjusted. 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 2019
1	Number of Doctorate students aged 25–34 per million inhabitants of the same age category	1 114 (2013)	1 134 (2016)	1 185 (2018)
2	Proportion of women to total number of researchers (%)	25% (2013)	23.1% (2016)	23.2% (2018)
3	Proportion of scientific publications with co-authorship between domestic and foreign researchers (%) [1]	36.7% (2012)	40.8% (2016)	49.1% (2018) 54.7% (2019)
4	Proportion of foreign researchers to total number of researchers in the government and UNI sector (%) [2]	6% (2011)	9.5% (2015)	11.7% (2018)

	Name	Starting value when creating NP RDI (year)	Starting value for monitoring the fulfilment of objectives (year)	Indicator value for 2019
5	Number of participants in the Horizon 2020 project per thousand researchers (FTE)	-	18.4 (2016)	32.5 [3] (2020)
6	Acquired financial contribution in the Horizon 2020 programme per EUR GDP billion	-	-	1.87 [4] (2020)
7	Total number of publications registered in the WoS database per million inhabitants [1]	1 879 * (2014)	2 213 * (2016)	2 091 (2018) 2 078 (2019)
8	Number of PCT applications per million inhabitants	16.7 * (2012)	18.1 * (2014)	13.6 (2017)
9	Revenues from the sale of patent licences (incl. national) in CZ millions	2 726 (2014)	3 356 (2016)	1 602 (2018)
10	Share of highly cited publication (proportion of publication in 10% of the most cited publications in total)[1]	9.7% * (2012)	9.4% (2015)	9.7% (2018) 9.1% (2019)
11	Total number of ERC grants per thousand researchers in the government in UNI sector	0.17 (2013)	0.33 (2016)	1.44 [5] (2019)
12	Proportion of publication co-authored by the public and private sector in total number of publications (%)[2]	1.7% * (2013)	2.4% * (2016)	2.6% (2018) 2.5% (2019)
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)	11.5% (2019)
15	Proportion of jobs in knowledge intensive services (%)	32.6% (2013)	32.9% (2016)	33.5% (2019)
16	Proportion of public sector resources in GERD (%)	48.6% * (2013)	60.2% (2016)	58.3% (2018)
17	Early-stage venture capital (% GDP) [6]	0.002% (2013)	0.003% (2016)	0.009% (2019)
18	Proportion of domestic added value in total exports (%)	61.3% * (2011)	60.3% (2014)	62.3% (2016)

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

Notes to indicators:

1. 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 2019 are incomplete, data for 2018 is used.
2. Name of the indicator was revised to correspond to the definition set out in NP RDI.
3. The value was determined as the number of participants in the previous course of H2020 from data in the eCORDA database from May 2020. 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 EU28 in September 2020 was 54.2).

4 The value was determined as an EC contribution obtain by teams from the CR in the previous course of H2020 from data in the eCORDA database from May 2020. 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 EU28 in September 2020 was 3.09).

5 The value was set as the number of ERC grants obtained in the previous course of H2020 from data in the eCORDA database from May 2020. 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 EU28 in September 2020 was 5.71).

6 Data was updated according to the Invest in Europe and EVCA reports. “Seed” and “start-up” investments are considered early-stage investments.

Table P.2: Selected Data Resources in RDI

		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 (TI2018) pertains to the 2016–2018 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 t 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 provided special-purposes subsidies 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

	Data		Note
	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 services 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 on the 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
	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 (databases of grant agreement and databases of project proposals and applications)
	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 on the national level, with each financial instrument accounted for according to direct and indirect costs. It would be suitable 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 on the level of RDI IS (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 results
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 ERC: Additional Information

Successful ERC Grants

ERC grants can be entered through a Europe-wide peer-review competition by a top researcher of any age from anywhere in the world, as long as they are based in Europe or moving to Europe. Several Czech scientists have already joined the ranks of top researchers. The European Research Council has collected 16 ERC grants that it considers to be great ideas and has decided to "revitalise" them. The name of a Czech scientist also appeared among these important grants.

František Štěpánek, who works at the University of Chemical Technology in Prague, succeeded in the "**Robotics**" project in the "Starting Grant" category. The aim of this project is to design and manufacture microscopic chemical robots that do not currently exist. Their development will therefore be unique and very demanding. Many potential applications are expected, such as the targeted delivery of active ingredients to the human body (e.g. drugs) or distributed chemical processing (e.g. neutralisation of toxic leaks in difficult to access environments).[1]

Internationally, the following individuals succeeded:

- **Alberto Broggi (Advanced Grants) from Italy with the grant "Open Intelligent Systems - Driverless cars".** The aim of the project was to explore the use of "smart

[1] HORIZON 2020 [online]. Technology Centre of the ASCR [cit. 1.9.2020]. Available from: https://www.h2020.cz/en/storage/1d65fe8bb1f8f4e9d4d3c9bc0d67bbcc16e896db?uid=1d65fe8bb1f8f4e9d4d3c9bc0d67bbcc16e896db

cars" that move without a driver and with a sophisticated system of sensors. As part of this project, a unique intercontinental 13,000 km test drive from Italy to Shanghai took place with a driverless car powered by green energy.

- **- Irene May Leich (Advanced Grant) from the UK, with the "Health - Skin cancer" grant.** The aim is to develop preclinical models that can be used to identify therapeutic targets for the treatment of skin cancer and to explore new approaches to gene and cell therapy. The effects of the new small molecules will also be tested.
- **- Giulio Di Toro (Starting Grant) from Italy with the grant "Natural disasters - Earthquakes".** This project aims to better understand one of the "hottest" topics of earthquakes today: fault mechanics as they occur during earthquakes. As part of the research, one of the strongest earthquake imitators "SHIVA", which simulates the extreme deformation conditions typical of earthquakes, high pressure and fast-moving rocks, just like in nature was successfully installed in Rome.
- **Dorthe Dahl-Jensen (Advanced Grant) from Denmark with the grant "Climate change - Towards improved analysis of the ice sheet".** This project seeks to map the extent of dissolved water under the Greenland ice sheet for better predictions of the ice sheet's response to climate change. This research should bring a new direction in our understanding of future sea level rise and provide an opportunity to seek life under the ice.
- **Ann-Christine Albertsson (Advanced Grant) from Sweden with the "Environment - Biodegradable materials" grant.** This project aims to create a new generation of materials that mimic the structural organisation of nature and that biodegrade in a controlled manner without leaving any long-term fragments.
- **Fergal O'Brien (Starting Grant) of Ireland with the grant "Royal Irish College of Surgeons".** The project combines gene therapy, stem cell technology and bioreactor technology for the development of biomaterials replacing bone grafts. Applications are wide: from replacement of damaged or diseased bone for patients with trauma, through congenital and degenerative diseases, cancer or reconstructive surgery.
- **Nathalie Balaban (Starting Grant) from Israel with the grant "Biology - Antibiotic resistance".** This project aims to analyse how bacteria develop to resist antibiotics at the single cell level and at the population level. The researcher will use microfluidic devices to monitor these phenomena and help understand the development of drug resistance. The results could make a significant contribution to evolutionary biology by pointing to new therapeutic targets and helping to minimise the spread of drug resistance.
- **Christian Oliver Paschereit (Advanced Grant) from Germany. with the grant "Energy - Cleaner power generation".** The challenge is to achieve better energy

conversion efficiency and greater use of sustainable resources at low cost. The project examines the foundations needed to develop a prototype combustion plant technology that is capable of burning natural gas, hydrogen and coal or biowaste combustion products with low NOx emissions. Research will include the combustion process, aerodynamic design, acoustics and control.

- **David Milstein (Advanced Grant) from Israel with the grant "Energy - Responding to the Energy Grand Challenge".** The ERC project has demonstrated a mechanism for generating hydrogen and oxygen from water, without sacrificing chemicals, through individual steps using light. The aim of the project is to improve the understanding of the basic steps involved in this process. Research is expected to lead to the creation of an efficient catalytic system.
- **Cédric Blanpain (Starting Grant) from Belgium with the grant "Health - understanding the origin of cancer".** This blue-sky research was based on the original goal and yielded results that could eventually be used to treat patients suffering from cardiovascular disease. The team was able to isolate the nearest cardiovascular ancestors, the primitive cells from which the heart cells came, and certain blood vessels.
- **Armin Falk (Starting Grant) from Germany with the grant "Economy and neurobiology". Many people consider the growth of their income to be a good thing, even though the growth is again completely negated by inflation. This effect is called the "illusion of money."** Economists and brain researchers have discovered the neural cause of the "money illusion" phenomenon. This project approaches the topic of the "illusion of money" from a new angle: a look at the neural processes that underlie economic decisions. The results may help explain why nominal wages rarely fall, while real wages fall in times of inflation or speculative bubbles, for example in real estate or stock markets.
- **Franck Selsis (Starting Grant) from France with the grant "Astrobiology - Exoplanets".** The E3ARTHS project studies the key domain of astrobiology: the origin, evolution and identification of habitable worlds in space and the search for biomarkers on Earth-like planets. Franck Selsis and his team also return to early Earth models to better understand the context of the beginnings of life, in light of existing work on Earth formation, the history of impacts, and solar evolution.
- **Esperanza Alfonso (Starting Grant) from Spain with the grant "Social sciences - Multiculturalism".** From the 13th to the 15th century, Jews from the Iberian Peninsula (Sepharad) lived side by side with Christians and Muslims. Although there was constant tension between the three groups, their members contributed to a joint artistic, intellectual and scientific effort that created the necessary conditions for the

dawn of the European Renaissance. Dr. Alfonso'' international team studies the production of sacred texts as objects; the history of their cataloguing and preservation; diverse and conflicting interpretations of their content; their role as social masters who promoted coexistence or created exclusions; their impact in literature and art; their relationship with medieval science; and their relationship to the Muslim and Christian scriptures.

- **Irma van der Ploeg (Starting Grant) from the Netherlands with the grant "Information technologies - Society".** Digital Identity Management (IdM) refers to the control of a person's digitised information. This type of information is usually called "personal information." With digitisation in several areas of society, the registration of personal data is increasing exponentially. The implied risks to fundamental rights, such as privacy and non-discrimination, are recognised at the highest levels of policy, but to date they are still poorly understood or analysed. In response to this challenge, the DigIDeas project examines the social and ethical aspects of digital identity. By bringing recent knowledge gained from several fields, such as science and technology, philosophy, computer ethics, Dr. Irma van der Ploeg addresses this issue through a series of selected case studies. The goal is to increase understanding of the topic and gain more accurate knowledge of how IdM is related to current transformations of our identity.
- **Mary Kaldor (Advance Grant) from the UK with the grant "Global Governance - Security".** Armed conflict, organised crime, financial crises or environmental degradation are examples of the global security risks of the 21st century. Current security models based on conventional military operations can no longer easily address these threats. The project analyses this "security gap" and the ways in which public and private actors adapt to it. It examines the need for a human security approach to the protection of individuals through military and civilian forces on the basis of an international permit. By setting new indicators of uncertainty, the project will help policy makers to evaluate and adjust their current security practices in a more appropriate way.

ERC Public Engagement with Research Award 2020

On 7 July 2020, three winners of the "ERC Public Engagement with Research Award 2020" (the "award") were announced by European Research Council (ERC) grant holders for their outstanding contribution to public participation in science. This award, the first of its kind, was awarded to highlight how ERC-funded grants inspire the public with their research. This year, Professor Anna Davies from Trinity College Dublin, Ireland with the "SHARECITY" project, Konstantinos Nikolopoulos from the University of

Birmingham in the UK with the "Exclusive Higgs" project and Erik Van Sebille from the University of Utrecht in the Netherlands with the "TOPIOS" project won the award. The award will be given every two years.

The European Commissioner for Innovation, Research, Culture, Education and Youth said: *"Excellent research requires excellent public involvement. This is especially important today when science often has to compete with misinformation. We need strong narrators and creative communicators. I am glad that many EU-funded researchers have come a long way in communicating their amazing discoveries and communicating with the public. I hope that more scientists and scholars will be inspired and that their steps will be followed…* ". Professor Fabio Zwirner, Vice President of the ERC, said: "*The ERC trusts researchers to pave the way for scientific breakthroughs. The winners of our award for public involvement in research show that this bottom-up approach also works for communication. I was impressed with the number and quality of entries in this new ERC competition…* "

The purpose of the award was to involve the public, outside the scientific community, in ERC research in an effective and original way. The award has three categories: public contact, press and media relations, and online and social media. The number of applications submitted to the competition by the deadline was 138.

P. 5 Alphabetical list of European Centres of Excellence and Regional Research and Development Centres

Table P. 5: 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 Nanotechnolgies)	Institute of Scientific Instruments CAS.	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 CAS	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 CAS	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 CAS	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 Energy)	Brno University of Technology	Regional R&D 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 CAS	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 CAS	European Centres of Excellence
ENET	ENET – Energetické jednotky pro využití netradičních zdrojů energie (Energy Units for Using Non-Tradition 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

Abbreviation	Name	Beneficiary	RDI designation
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 CAS	Regional R&D centres
RICE	Regionální inovační centrum elektrotechniky (RICE) (Regional Innovation Centre for Electrical Engineering)	University of West Bohemia	Regional R&D 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