Innovation in the heart
Central Bohemia Region

RIS3 Strategy of the Central Bohemian Region

2020 Update

approved by the
Central Bohemia Regional Assembly
on 1 June 2020

CENTRAL BOHEMIAN INNOVATION CENTRE

Central Bohemia Region

Regional Innovation Strategy of the Central Bohemian Region (RIS3 Strategy)

Central Bohemian Innovation Centre, association

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Strategy Section

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1. Introduction

The Central Bohemian Regional Research and Innovation Strategy for Smart Specialisation[1] (the "Central Bohemia RIS3") follows on from the National Research and Innovation Strategy for Smart Specialisation of the Czech Republic (National RIS3). The National RIS3 is intended to support economic growth and the transition to a knowledge economy. Regional RIS3 strategies take into account factors specific to the local innovation ecosystem and the economic specialisation in individual regions and refine the priority areas set at national level. Support instruments financed by the European Structural and Investment Funds and the corresponding national and regional resources are used to achieve the objective of transitioning to a knowledge economy.

This Central Bohemia RIS3 is consistent with the National RIS3's stated objectives. It is conceived as a basic strategy document for implementing innovation policy in support of the region's move towards an advanced economy that is based on the use and development of economic and knowledge specialisation and reflects the region's needs and challenges. In the future, this should be based primarily on all kinds of innovation in all areas of society, advanced technologies and services, high value-added production, skilled and creative people, and small and medium-sized enterprises that are thriving and ambitious. The Central Bohemia RIS3 also responds to the Central Bohemian Regional Development Strategy for 2019-2024 and Outlook to 2030, which was approved by the Central Bohemian Regional Assembly in November 2019 and is the region's principal conceptual and development document.

Since its approval in June 2018, the Strategy has had to be updated in response to processes in the preparation of the European Union's 2021-2027 cohesion policy. The conditions have been adjusted. The original "ex-ante conditionality" of the existence of RIS3 strategies to obtain support for research, technological development and innovation has been changed to an "essential condition". Specific substantive and formal requirements concerning the content of the RIS3 strategies of Member States and regions are associated with this.

Besides pursuing the purpose described above, the Central Bohemia RIS3 also frames the region's own activities related to innovation policy. It continues to fully reflect the region's development in recent years and takes into account global trends, especially ongoing technological changes and the resulting societal and lifestyle changes. Its priorities and key areas of change are built on these considerations. The Strategy has been updated by the Central Bohemian Innovation Centre. Ahead of its approval by regional bodies, it was discussed by the Competitiveness Council of the Central Bohemian Region, which includes representatives active in research in both the public and corporate spheres.

[1] From the English "Research and Innovation Strategy for Smart Specialisation"

2. Methodology behind the Production of the RIS3 Strategy

This version of the Central Bohemia RIS3 Strategy was prepared between autumn 2019 and March 2020. As the Strategy had been approved in June 2018, the update focused primarily on incorporating the European Commission's requirements and resolving some of the shortcomings that had been identified by the authors since the initial approval (the chapter on the Strategy's implementation have been updated and chapters on the international dimension of RIS3, financing, monitoring and evaluation have been added). Secondary statistical data on the region's macroeconomic development, the performance of the various economic sectors, and research and development activities in both the corporate and the public sphere has been updated, resulting in revisions in the Analytical Section.

In the Strategy Section, the following revisions were made, having been approved by the Competitiveness Council of the Central Bohemian Region at its 16th meeting on 5 December 2019:

- Removal of Key Area of Change D "Innovation in public space", because its concept was inconsistent with the concept of other such areas. Area D focused more on the process of implementing the Strategy and the role of public administration in it. These topics are more suited to the chapter on implementation. However, the role of public administration as a sector that demands innovation from the research and business sectors to address its needs has been maintained. Alternatively, it can serve as a test environment for new products and services or be a first customer.
- The reworking of the indicator system so that the number of indicators is halved, with the newly set indicators being monitored mainly according to the trend in their development and by comparing them with the Czech Republic as a whole or other regions of the country.

The Competitiveness Council also agreed that the region's "domains of specialisation" would be maintained.

This approach to update of the Central Bohemia RIS3 is also based on the way the "entrepreneurial discovery process" has worked to date. This is the process where the region, or more precisely its RIS3 team, involves entrepreneurs, researchers and representatives of other triple/quadruple helix entities in the activities of the region's innovation platforms, educational and other events, and support programmes. The experience gained confirms the correctness of the current concept behind the strategy and its objectives. In this respect, it is preferable to focus efforts on achieving the set objectives. The strategy therefore pursues a "bottom-up" principle, where activities and objectives are formulated with contributions from and in accordance with the views of actors from the region's innovation landscape.

3. Social and Technological Challenges and Megatrends

In recent years, we have been experiencing social and technological changes at an unprecedented rate. These changes are mainly based on the megatrends that are beginning to prevail in the world and are also reflected in the Czech Republic. They will undoubtedly also affect the economy and society in the Central Bohemian Region and its innovation landscape in the future. Consequently, this subchapter provides a basic overview of the prevailing world megatrends, which can be split, depending on their nature, into social and technological trends.

Social trends

The main social megatrends that need to be considered in the Czech Republic and, by extension, in the Central Bohemian Region are growing access to information and digitalisation, population ageing and the rise in lifestyle diseases, urbanisation or de-urbanisation, and the degradation of ecosystems caused by climate change.

A fundamental social change that has taken place in the world over the last thirty years is the transformation from an industrial society into an information society, the wealth of which is based on access to information and, increasingly, on the use of knowledge. This change is based on rapidly evolving technologies, especially those that enable digitalisation, automation and work with large volumes of data.

Another well-known general social trend is population ageing and the rise in lifestyle diseases. People have an ever higher life expectancy, but the key challenge is for this trend to be sufficiently accompanied by good health longer into life. The Central Bohemian Region has one of the youngest populations in the Czech Republic, although this population will also age rapidly. By contrast, the peripheral parts of the region, in particular, report an above-average proportion of older people. The longer healthy life years will also enable older people to keep working, especially in small-scale business and services, the importance of which will grow for the region's economy. The trend of rapid population ageing also provides a very significant impetus for innovative solutions, especially in services.

The urbanisation trend everywhere in Europe and the world is making itself felt by the growth of large urban agglomerations. In the Central Bohemian Region, it is reflected in the ever-expanding zone around the City of Prague, and might be termed suburbanisation. In the context of digitalisation, however, we are also witnessing the opposite trend: with online connections available anywhere, there is room in rich Europe for de-urbanisation and migration out of agglomerations. This gives the Central Bohemian Region, which has almost 900 small municipalities with a population below 1,000, an excellent opportunity to develop in line with this trend. This is accompanied by the extensive requirement to develop physical and data infrastructure.

Not least, the rising tide trend of ecosystem degradation, which is significantly affected by deepening climate change, is becoming increasingly important. The main factors in Europe are soil erosion, desiccation, declining groundwater levels, and contracting water retention capacity. Here, too, the Central Bohemian Region, and certain parts of it in particular, are among the most endangered. This situation needs to be addressed according to methods that have not been used before.

Trends in technology

New technologies have been evolving at an unprecedented rate in recent years. From the perspective of the potential for industrial innovation, key enabling technologies (KETs) are crucial. Key enabling technologies function as broad knowledge domains that can be applied in an extensive portfolio of branches and products far beyond their original scope. They are knowledge-intensive technologies associated with extensive R&D, high capital costs and highly skilled jobs. KETs include micro- and nanoelectronics, nanotechnology, industrial biotechnology, advanced materials, photonics and advanced manufacturing technologies. As a source of innovation in a wide range of industries (automotive, food, chemistry, electronics, energy, pharmaceuticals, construction, telecommunications, etc.), they are a focus of attention for research, development and innovation policy-makers and, as such, are a priority for European industrial policy. The European strategy for KETs aims to accelerate the uptake of KETs in the EU and stimulate employment growth through

reindustrialisation. According to the European Commission, KETs will grow by 10-20% per year, with most new jobs expected at small and medium-sized enterprises.[2]

The World Economic Forum (2015) offers a rather different view of technological trends,[3] claiming that the six fundamental technological trends of today are the connection of people and the internet (world virtualisation), the computerisation of everything and the ability to store data from anywhere (pocket supercomputers and the use of clouds), the Internet of Things (the "sensitisation of everything" and remote control), artificial intelligence and big data, the sharing economy, and the digitisation of matter (3D printing and the creation of physical products tailored to the needs of the user and based on digitally transmitted parameters.)

The OECD, like the World Economic Forum, views ICT as a key cross-cutting technology.[4] The development and ubiquity of digital/digitisation technologies is evidently the predominant megatrend, which is extremely effective in all areas of society. This opens up opportunities for countless services to be provided by individuals on the one hand, and by various types of companies and institutions on the other. ICT creates opportunities and challenges for industrial production that are associated with automation and robotics. One of the consequences of the ubiquity of ICT is that, in a relatively "dematerialised" world, human knowledge and creativity are becoming essential raw materials. A sufficiently high-capacity network for electronic communications and the transmission of large volumes of data is essential for the development of the economy and society at all its levels.

In the coming years, technological and societal changes will have a profound impact that will change the lives of individuals, ways of doing business, and how society is governed. The emerging "Society 4.0", as this phenomenon is known, opens up both challenges and opportunities. Regions that incorporate these trends into their plans can experience vigorous development and increased prosperity.

The world will face multifaceted challenges, such as population ageing, the depletion of mineral wealth, and climate change. Humankind will resort to technology to deliver new or better solutions to emerging problems. The increasing availability of technology and the speed of technological change will fuel this trend.

Throughout the region, without exception, there will be three major changes/needs: adaptation to the changing nature of industrial production (automation and robotics) and the resulting societal and lifestyle changes, the securing of sufficiently high-capacity electronic communications as the main tool to facilitate this adaptation , and the creation of environmentally friendly conditions for people's quality of life (especially considering climate change, drought and the growing risk of natural disasters). Safety and security (cyber, transport, physical, food, etc.), currently taken for granted, may pose major challenges in the period ahead.

The above changes will lead to the creation of completely new job opportunities, not only for those with tertiary education, whose share in the population has long been growing, but also for people with lower skills. The longer healthy life years will also enable older people to keep working, especially in small-scale business and services, the share of which in the region's overall performance has been growing in recent years.

This development offers considerable potential. Today, a world is conceivable in which it will be possible to obtain any service or good at the time and place we need it. New technologies give us the opportunity, in the future, to get medical care without having to visit a hospital, or a new organ perfectly adapted to our needs. The method of employment will also change. In the future, working from home will be possible for a large number of occupations. Teleworking will not be limited to the most educated, but will also include employees with a normal education. Technological developments will also enable older people, who today largely shun new technologies, to be independent for longer and to live a full life without limits.

[2] European Commission, Industrial Policy, KETs
https://ec.europa.eu/growth/industry/policy/key-enabling-technologies_en

[3] https://www.weforum.org/agenda/2015/09/6-technology-mega-trends-shaping-the-future-of-society/

[4] https://read.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-innovation-outlook-2016_sti_in_outlook-2016-en#page112

4. Summary SWOT Analysis

The following SWOT analysis is a summary of key findings and conclusions from the Analytical Section that describe the current state and development of the Central Bohemian Region's innovation environment and the influences that affect, or will affect, it in the future. The claims are based on the Analytical Section of RIS3 and were discussed and verified in working groups with representatives of companies, research organisations and public administration.

Internal analysis

Strengths	Weaknesses
Status of the region	
• The Central Bohemian Region is one of the most economically developed regions in the Czech Republic, with a long-term above-average rate of economic growth. • The region's position in the geographical centre of Europe, providing good access to strong markets where the population has high purchasing power. • A relatively young population and, consequently, high employment/participation in economic performance.	• The pace of economic growth in the Central Bohemian Region has lagged behind the South Moravian Region in the last ten years. • The region's natural centre is outside its territory. The highest quality roles, such as innovation and R&D activities, universities, and corporate headquarters, are largely concentrated in the capital. The interconnection between this natural core of the region and the region itself is hampered by underdeveloped transport infrastructure. • Large differences in the economic development of individual areas within the Central Bohemian Region. Economic development is concentrated in the environs of Prague and strong regional centres. In contrast, the region's fringes and rural areas are marginalised and economically stagnant.
Business and innovation	
• A developed manufacturing industry is of key importance for the regional economy. It is headed by the automotive industry. Other significant branches are engineering and the food industry. • The strong role played by large companies and their share in the economy. • There are a number of Tier 1 suppliers in the region that supply complete modules to final car manufacturers and often cooperate with them on development. • Compared to other regions of the Czech Republic, foreign companies play a more important role in the regional economy – they make up 70% of output and 50% of jobs in the business sector. • Foreign companies were also the drivers of renewed economic growth after 2012.	• Domestic companies are much less productive than foreign companies. • In the last five years in particular, the economic performance growth rate among domestic companies has been considerably weaker than at foreign companies. • A low level of business activity – the number of smaller companies with up to 10 employees in the region has stalled (compared to the Czech Republic as a whole). • The high dependence of economic development on the activities of foreign companies (dependence on the business strategies and decision-making of foreign companies). • The institutional backdrop for innovation support in the region is developing, but remains too underdeveloped (both in comparison with other regions and in terms of the opportunities offered by the region's potential).

• The segment of foreign companies is much more productive than domestic companies, and the R&D expenditure of foreign companies is growing at a significantly higher rate. • High R&D expenditure, almost 80% of which is in the corporate sphere. • The presence of Škoda Auto, the largest private investor in R&D, and approximately 50 other companies that invest more than CZK 10 million in R&D per year. • The number of R&D centres at foreign companies in the region has doubled in the last 10 years. • Very good patent activity. A large number of patents with international validity are being created by companies in the region. • The share of value added in output is higher for domestic companies than foreign companies and is also continuing to grow faster. This indicates the faster implementation of more knowledge-intensive activities among domestic companies.	• The region lacks a strong and respected partner for dealing with entrepreneurs. • FDI coming into (and settled in) the region is changing, as are the demands it is placing on public administration and services – neither the region nor its municipalities are creating sufficient conditions for this. • The strong focus of private R&D on the automotive industry (insufficient diversification of private R&D in the region).
Research and development in the public sphere	
• A high number of research institutes (the third highest number of all regions in the Czech Republic). In addition, the Central Bohemian Region and Prague together form a functioning geographical partnership. In these two regions, there are more than 900 such centres across all sectors.[5] • The specialisations of Prague and the Central Bohemian Region are complementary – Prague is a centre of academic and public research capacities, while corporate R&D activities predominate in the Central Bohemian Region. • In recent years, high R&D expenditure in the public sphere in the Central Bohemian Region (caused by the emergence of new research infrastructures). • The emergence of new state-of-the-art research infrastructures, which are important from a research point of view not only within the Czech Republic, but also in an international context. • Of the region's economic specialisations, the branches of engineering, the manufacture of transport equipment (including aerospace), and research and development in the natural and technical sciences have the greatest support in terms of research capacities – this is where there	• The relatively weak link between the research and business sectors. For example, according to the indicator of the volume of business expenditure on research and development in the public and higher education sectors, the Central Bohemian Region is among those regions that are average to below average. • The often limited relevance of research at public research organisations compared to the needs of society and the economy, and their insufficient readiness to cooperate with the application sphere. • The often insufficient level of managerial and strategic competence and inefficient management structure at public research organisations. • A mismatch between the main focus of private and public research in the region. • Most patents in the public sector are filed only in the Czech Republic, which suggests that this is largely only for formal reasons in order to meet the requirements of public support programmes. • Insufficient interlinking between the Central Bohemian and Prague innovation environment (the absence of a common strategy in the field of economic development and R&D&I, the absence

[5] These statistics also include private R&D centres.

is most activity in contract and collaborative research and patent activity (both corporate and public). • There are a number of entities in the region where applied research projects supported from public sources are largely concentrated (including ÚJV Řež, the National Institute of Mental Health, and Aero Vodochody).	of the purposeful creation of a common innovation ecosystem, the different approach to the financing of R&D&I, etc.).
Human resources for innovation and R&D	
• A high number of researchers in the region – in terms of the number of researchers, the region is just behind Prague and the South Moravian Region. • The proximity to Prague as a supra-regional centre of higher education and research. The capacities for higher education and research in Prague are on such a scale that there is a concentration of talents and skilled people here. Prague produces tens of thousands of graduates with impressive employment potential.	• General lack of high-quality, creative human resources for business, R&D and innovation activities. • Stagnant amount of human resources involved in companies' R&D activities. • Absence of a public higher-education institution (with the exception of the Czech Technical University's Faculty of Biomedical Engineering, although this is one of the smaller faculties). However, this scarcity is largely replaced by the proximity of Prague as a centre of higher education. • The strong position enjoyed by Prague, whose labour market attracts highly educated professionals and experts from the region. This results in the increased cost of skilled labour and competition for talent. • Primary and secondary education insufficiently prepares pupils and students for future demand on the labour market. School-leavers' skill sets are often not in line with employers' requirements and do not encourage young people to become entrepreneurs. • Insufficiently modernised facilities at primary and secondary schools. For example, modern IT infrastructure, tools, school laboratory equipment, etc., are often lacking. • Minimum permeability of academic education and hands-on experience among university teachers.

External analysis – factors influencing the development of the region

Opportunities	Threats
Policy and legislation	
• Use of a new tax concession for companies when procuring R&D results from research organisations. • Changes supporting a more flexible labour market, greater employment flexibility, including flexible hours. • Change in the system of government incentives for foreign investors, geared towards the support of more knowledge-intensive activities. • A new science and research evaluation system that places more emphasis on applied/applicable results. • More efficient distribution of government subsidies for R&D and innovation. • Greater institutional link between Prague and the Central Bohemian Region in the development and support of the innovation landscape.	• The instability of the political scene, reducing credibility for foreign partners, investors and domestic companies. • Corruption and the influence of lobbies and special-interest groups on public administration decisions. • Frequency and unpredictability of regulatory changes, including a tax system for entrepreneurs and research organisations. • Insufficient funding for public higher education. • Significant reduction in EU subsidies intended for the support of innovation and research after 2021.
Economic and financial area	
• Entry into the euro area – reduction in transaction costs for companies, higher attractiveness for foreign investors. • Interest among foreign companies in investing in activities with higher value added. • A rise in business opportunities on new, fast-growing markets. • A shift by foreign companies from production to development activities within the group hierarchy. • A change in EU funding after 2020, which may boost private sector involvement in public sector research.	• Foreign companies' R&D activities will be concentrated outside the region. If plants in the region continue to lack knowledge-intensive production, there will be a risk of their departure to countries with cheaper inputs or where they will be closer to the R&D activities of foreign companies. • Growing competition from countries in Eastern Europe and Asia in industries based not only on cheap labour, but also on knowledge- and technology-intensive activities. • Weak innovation demand in the public sector – state administration does not sufficiently support innovative solutions in the area of its competence. They are not assigned to potential suppliers. • Very precarious sustainability of funding for new public research infrastructures while maintaining the status quo.

Socio-demographic area	
• Interest among talented people from abroad in working in the region. • Positive effects of population ageing – new business opportunities (new sectors, innovation and services). • Growth in the number of people seeking self-realisation beyond material security (as a result of the development of entrepreneurship and the social benefits of the activities they engage in). • Change in consumer behaviour towards "prosumers", i.e. customers who are actively involved in creating products.	• The continuing decline in the quality of graduates and the growing share of humanities-oriented graduates, together with the retirement of experienced workers or the outflow of talented and highly skilled workers from the region, (brain drain) will lead to a shortage of labour required by industry (in terms of both area of specialisation and depth of knowledge). • Reduced need for human labour due to productivity growth and the automation and robotisation of production. • The quality of the education system can be a limiting factor in the development of science and research activities. • Social rejection of some emerging technologies (e.g. artificial intelligence).
Technology	
• Continued digitisation and automation and the development of advanced production technologies, with resulting opportunities for new economic activities and labour productivity growth. • New IT technologies facilitating the more efficient organisation and functioning of the economy and society. • Industry 4.0 and Smart City trends create pressure for the more intensive transfer of knowledge from research and development into practice. • Increasingly intensive involvement of open-innovation principles in the functioning of private companies, resulting in "hyper-collaboration" (the main power/strength of knowledge lies in sharing it). • The multiplier effect of research centres of (supra-)national importance (ELI, SUSEN, HiLASE, BIOCEV) – the possibility of the establishment and development of centres of technological gravity (the establishment/arrival of technology-oriented companies and related services).	• The high costs of intellectual property protection in Europe. • The digitalisation and automation of production will result in lower use of non-specialised labour. This could cause problems for specific groups in the labour market. • New trends such as e-commerce could weaken sole traders in small municipalities. • The slow adoption of some emerging technologies (e.g. artificial intelligence).

5. Domains of Specialisation of the RIS3 Strategy

In the Central Bohemian Region, the RIS3 Strategy is the primary tool used to create and improve conditions in the creation and use of knowledge and innovation, with the aim of strengthening the competitive advantage that those entities established or doing business in the region enjoy in the global economy. The intention behind the Strategy is to focus capacities, knowledge and skills based on the region's existing and emerging economic and social potential. At the same time, it is essential to strengthen and develop areas in which this potential reaches a certain critical mass, and to harness the existing knowledge base for new areas of application that will reflect new challenges in the region's economy and society.

The RIS3 Strategy includes investments in both public research and the business sector – in the field of corporate innovation. A prerequisite for the successful implementation of the Strategy is the involvement of actors that have insight into the potential market application of new knowledge and innovations, i.e. actors able to identify new opportunities for business activity.

Against this background, it is necessary to look at the selection of areas of specialisation in the context of the Central Bohemian Region existing competitive advantage(s) and with awareness of new societal and technological challenges that will affect the region in the future. Although the region has performed relatively well economically recently, with GDP growth one of the highest and the unemployment rate still well below the Czech average, the region can be expected to face new challenges as it seeks to maintain its successful development and ensure a good standard of living for inhabitants across the region. In particular, it will face changes in the global economy, where competition from developing countries and regions is increasing. Another factor is the successful development of the Czech economy and the Central Bohemian Region itself, entailing the loss of some existing competitive advantages. The economy must accelerate and expand the shift from cost-effectiveness to knowledge-based competition, which will build on unique know-how, knowledge and products anchored in the Central Bohemian Region's specialisation and capacities. There is a need for the greater development of endogenously based entrepreneurship, and for companies to more from subcontracted activities towards final products that deliver high value added and draw on research and development activities (both internally developed and public).

For the requirements of smart specialisation in the Central Bohemian Region, knowledge/vertical domains of specialisation are defined mainly on the basis of specific knowledge of regional conditions and the needs of regional actors acquired in the entrepreneurial discovery process,[6] but also on the basis of statistical data reflecting the structure of the regional economy and the importance and potential of individual sectors.[7] The domains of specialisation in the Central Bohemian Region echo not only the concentration and dynamics of economic performance, accumulated skills and competencies, or emerging trends in individual branches, but also the rapidly developing and changing knowledge base at research organisations.

Manufacture of transport equipment

The production of motor vehicles and their parts is the Central Bohemian economy's most important branch. In addition to manufacturers of final products (vehicles), the region also has a very broad value chain of variously specialised suppliers of units and components for the automotive industry (plastics, textiles, fabricated metal products and other products related to the automotive industry). Many of them are also significantly positioned globally. Some of them have strategic production plants in the region and are increasingly developing their design, development and even research activities here. In this domain of specialisation, aviation also plays an important role. It is developing very dynamically and concentrates considerable research potential, especially in aeronautics and aerodynamics – these areas are among the most significant in terms of contract and collaborative research between entities in the region. One of the salient characteristics of this sector in the region is the relatively disadvantageous position of a large number

[6] Acquired mainly in the implementation of RIS3 innovation platforms as a result of the participation of representatives of the corporate, research and public sectors, as well as in other activities of the Central Bohemian Innovation Centre aimed at the corporate sector.

[7] Analysis of statistical data on economic performance, the intensity of R&D expenditure, and the turnover of companies in the Analytical Section of RIS3 Strategy of the Central Bohemian Region.

of companies involved in global production networks, where they are in lower, dependent positions without contact with the end customer. This dependence is also underpinned by the fact that the majority of the most important businesses and employers are controlled by foreign entities and a large part of business activities takes place on a B2B basis or even only within the relevant group. Therefore, the key to developing this area of specialisation lies in entrenching such companies as much as possible in the region, strengthening their position in production networks, and fostering conditions conducive to the development of activities with higher value added. On the other hand, there are numerous Tier 1 suppliers in the region that supply complete modules to final car manufacturers and often cooperate with them on development. Their numbers are increasing over time. Some of them started in the region as production branches and, over time, opened design, testing or even development departments here, or set them up in Prague. This establishes good prospects for the future, as new technologies (autonomous mobility, electromobility, etc.) are expected to emerge throughout the industry. This could bring about sweeping changes in established business models.

There are almost 140 companies operating in the Central Bohemian Region that focus on the manufacture of transport equipment. The largest concentration of companies in the sector is in Mladá Boleslav and its surroundings. Of the fifty largest companies, measured by employment, twenty are located here. The best known are Škoda Auto, Faurecia Exhaust System, Faurecia Interior System, SAS Autosystemtechnik and Mahle Behr. Most of the output of these companies is focused on the production of cars or vehicle components. Other companies operating in the automotive industry are located in Kolín (TPCA Czech), Rakovník (Eberspächer, Valeo), Slaný (F. X. MEILLER) and Benešov (TRW Autoelektronika). Other major companies are usually located near important motorways, especially on the D5 connecting the Czech Republic with Germany. Of the companies manufacturing other transport equipment, the largest is Aero Vodochody, which operates in the aviation industry.

In the CZ NACE system, companies specialising in the manufacture of transport equipment can be classified under the first two digits of divisions 29 (Manufacture of motor vehicles, trailers and semi-trailers) and 30 (Manufacture of other transport equipment).

Electronics and electrical engineering

While this sector is largely connected with the development of the automotive industry in the region, it is also successfully developing outside this segment – especially in the areas of general instrumentation, electric motors and generators. This specialisation also includes the production of electrical equipment (batteries, cables, wires), which is the most important area in terms of its share in the output of this branch in the Central Bohemian economy. Research potential is mostly concentrated on sensors, measuring and regulation. This is also where cooperation in contract research is most common.

Compared to companies focusing on the manufacture of transport equipment, companies operating in electrical engineering and electronics usually have a smaller number of employees. However, this segment is represented by more entities in the region. There are 431 companies in the region that specialise in electronics and electrical engineering. The largest is Foxconn Technology in Kutná Hora, which manufactures a wide range of products relating to IT, computers and communication technologies. The second largest such business in the Central Bohemian Region is the cable manufacturer NKT, which is headquartered in Kladno. Other important plants are located in Slaný (MITSUBISHI ELECTRIC AUTOMOTIVE CZECH, Electric Powersteering Components Europe), Zruč nad Sázavou (ASMO Czech), Dražice (Družstevní závody Dražice), and Kolín (SPEL Manufacturing). Smaller companies are situated on major motorway routes, such as the D1 and D5, or in the broader hinterland of Prague.

In the CZ NACE system, companies specialising in electronics and electrical engineering can be classified under the first two digits of divisions 26 (Manufacture of computer, electronic and optical products) and 27 (Manufacture of electrical equipment).

Biotechnology/life sciences

This is evidently the most progressively developing "new" knowledge-intensive industry in the Central Bohemian Region. In recent years, it has been characterised by many investments in both production and R&D. This specialisation is mainly in the realm of biological and medical (pharmaceutical) technologies. It includes

a wide range of sub-specialisations in the fields of molecular biology, biophysics, biochemistry, and medical specialisations such as immunology, neurology, ophthalmology, and radiopharmacology. Not least, the manufacture of medical technology and equipment belongs here. There is also potential for further development in bioremediation and areas specifically related to environmental protection. As this is a branch that is growing very fast globally, it can be expected to have significant prospects in the future. R&D capacities are concentrated more on collaborative projects between companies and research organisations. There is also relatively strong patent activity here. Central Bohemia also offers a wide range of research institutions that can be potential partners to these companies in development, testing and subsequent value-added production.

Biotechnology/life sciences, encompassing 64 companies and approximately 2,500 employees, is one of the least represented domains of specialisation in the Central Bohemian Region. By contrast, it is represented by numerous major companies with a high emphasis on innovation and value added. Examples include Linet, the hospital bed manufacturer based in Slaný, and the pharmaceutical companies Fresenius Kabi (Hořátev), Exbio (Vestec), VUAB Pharma (Roztoky), and Ferring Léčiva (Jesenice u Prahy). Most other companies in this branch are concentrated in the larger cities of the Central Bohemian Region or in the hinterland of Prague.

In the CZ NACE system, it is quite difficult to classify companies specialising in biotechnology and life sciences according to the first two digits of the divisions. These are often new and progressive sectors that harness synergies from different branches and respond relatively flexibly to new market demand. On the basis of CZ-NACE codes, biotechnology and life sciences can be identified in categories 21 (Manufacture of basic pharmaceutical products and pharmaceutical preparations), 26.6 (Manufacture of irradiation, electromedical and electrotherapeutic equipment) and 32.5 (Manufacture of medical and dental instruments and supplies).

Chemical industry

The chemical industry is one of the Central Bohemian Region's traditionally strong specialisation. There are a number of prominent manufacturing companies here that focus primarily on the manufacture of primary chemicals and raw materials. Some of them are among the region's major employers. Pressure on innovation (not only technological, but also procedural etc.) in this sector mainly stems from the increase in international competition, predominantly from countries offering lower costs, as domestic costs are higher than those of such competitors due to legislative conditions, the availability of raw materials, including renewables, energy prices, etc. Most large companies in this branch are foreign-owned, so their strategic decisions on the future direction of these companies will be the key to further development. Research activities at companies are focused primarily on industrial chemistry and chemical engineering. Patent activity centres on macromolecular chemistry and polymers.

The focus of the chemical industry in the region, especially at large companies active in it, is on heavy chemicals and basic raw materials manufactured in large volumes and, on the whole, with lower value added.

Chemical industry plants are located, in keeping with tradition, in the northern part of the Central Bohemian Region along the most important waterways – the Elbe and the Vltava. The largest company in the region is Synthos Kralupy, a multi-product manufacturer of insulation, adhesives, rubbers and construction chemicals. The second largest company in the chemical industry is Neratovice-based Spolana, whose production portfolio includes plastics, fertilisers, and even basic inorganic compounds intended for further production. Other important companies are Procter & Gamble – Rakona, based in Rakovník, building on the traditional brand of the detergent manufacturer, Lučební závody Draslovka in Kolín, operating in the field of agricultural, industrial and special chemistry, and Stachema, also headquartered in Kolín, which specialises in the production of construction chemicals and materials.

In the CZ NACE system, companies specialising in the chemical industry can be classified under the first two digits of division 20 (Manufacture of chemicals and chemical products).

Mechanical engineering and metal processing

Mechanical engineering and metal processing are among the region's prominent economic specialisations – they are second after the automotive industry. This industry has a broad focus of activities and is very heterogeneous internally. Most production is concentrated on cooling and ventilation equipment. For the most

part, this is linked to manufacture in the automotive industry and to the surface treatment/forging/pressing and manufacture of structural metal products that are used mainly in construction, but also in other industries. Engineering and metal production also overlap and involve considerable collaboration with research – there are a large number of collaborative and contract research projects, as well as relatively broad patent activity, both at companies and research organisations. The contract and collaborative research of companies in the region most often focuses on metallic materials, fatigue and fracture mechanics. Patent activity is the greatest in grinding, locks, fittings and engineering components for the operation of machines or equipment.

There are 1,142 engineering and metal-processing companies in the Central Bohemian Region. Measured by number of companies, this is therefore the largest industry in the region. On the other hand, its 22,000 employees are not even half of the numbers employed in the manufacture of transport equipment. As such, small and medium-sized enterprises account for a large proportion of entities active in this branch, and their scope of specialisation is relatively broad. The most significant companies in this sector are Vlašim-based Sellier & Bellot, the ammunition manufacturer, Beroun-based Carrier Refrigeration Operation Czech Republic, the manufacturer of cooling systems, Žebrák-based VALEO HEAT EXCHANGERS, Mělník-based Erwin Junker Grinding Technology, the manufacturer of grinding and filtration systems, and Dobříš-based Doosan Bobcat EMEA, which produces construction machinery. In addition to businesses listed above, there are 40 other companies in the Central Bohemian Region employing more than 100 employees.

In the CZ NACE system, companies specialising in engineering and metal processing can be classified under the first two digits of division 25 (Manufacture of fabricated metal products, except machinery and equipment) and 28 (Manufacture of machinery and equipment nec).

Food industry

The food industry is another of the traditional sectors in the Central Bohemian Region. In terms of employment and sales, it is one of the strongest sectors in the region. Unlike other key branches, it is focused more on the domestic market and less on exports, with smaller and medium-sized enterprises playing a greater role. It covers a wide range of sub-specialisations, the most important of which are meat products, bakers' wares, confectionery and beverages. The bulk of food production is geared towards end products for consumers.

In all, there are 513 food companies in Central Bohemia. These are entities that specialise in the production and sale of final products, especially perishables – primarily the meat industry and the production of bakers' wares and confectionery. By their very nature, they have limited territorial reach and predominantly focus on regional markets. Another reason may be the proximity of the strong market in Prague. The third most important specialisation is the production of industrial feed for livestock and pet food. In general, the specialisation in final products can be viewed in a positive light, as they deliver the highest share of value added and contact with customers in the market, which gives companies greater leeway for innovation. On the other hand, this segment of the economy can be expected to have less opportunity for innovations of a higher order. This is because the innovation efforts of food companies are less tied to research than those of knowledge-intensive companies in the branches of life sciences, biotechnology and electronics.

Unlike most other domains of specialisation, the most significant companies in the food industry are not based in the Central Bohemian Region's largest towns and cities. This reflects the tradition of this industry and the fact that these companies are located close to the sites where the agricultural products they process are produced. The most significant companies include Vitana (Byšice), Heineken (Krušovice), Tereos TTD (Dobrovice), RABBIT Trhový Štěpánov, La Lorraine (Kladno) and Polabské mlékárny (Poděbrady). Overall, companies in the Central Bohemian Region's food industry are relatively evenly distributed.

In the CZ NACE system, companies specialising in the food industry can be classified under the first two digits of division 10 (Manufacture of food products) and 11 (Manufacture of beverages).

Research and development

The research and development itself has been included among the domains of specialisation mainly due to the very rapid development of research capacities in the public sphere, both in basic and applied research. Completely new research infrastructure has been created in the region, and existing facilities at public and

private research organisations have been developed and modernised in depth. Greater links (not only) with the local economy will be crucial for future development, as will demand from the public sector and municipalities, which could be a major source of needs and problems requiring new research solutions. In tandem with this, the activities of public and private research organisations will be the key to the faster and more intensive development of corporate activities based on knowledge and high value added. The sharp growth of recent years is also demonstrated by the amount of public spending and the number of research and development employees, which doubled between 2015 and 2018.

The region is home to 22 public research institutions or centres and universities or their faculties. The number has increased mainly in response to newly created infrastructure in the last programming period of the EU Structural Funds – many new research centres were established and the capacities of some existing ones were significantly expanded or modernised. They specialise in both basic and applied research. Several private research organisations also operate in the Central Bohemian Region. A large proportion of these research institutions are located very close to Prague. They are located in the hinterland of the capital mainly so that they capitalise on the capital's labour market, transport links, the proximity of umbrella and cooperating organisations, and the overall economic and research capacity of Prague.

Particularly important areas of specialisation pursued by research organisations in the Central Bohemian Region include:

- laser technologies, photonics – HiLASE, ELI BEAMLINES (both Dolní Břežany)
- biotechnology and biomedicine – BIOCEV, Institute of Biotechnology of the Czech Academy of Sciences (both Vestec)
- materials science and engineering – Řež Research Centre, SVÚM a.s. (Čelákovice)
- nuclear energy – ÚJV Řež
- space research and space technology – Astronomical Institute of the Czech Academy of Sciences (Ondřejov)
- energy efficient construction and reductions in the negative environmental impacts of human activities – University Centre for Energy-Efficient Buildings, Czech Technical University (Buštěhrad)
- Hydrogen technologies – ÚJV Řež

In the CZ NACE system, companies specialising in research and development can be classified under the first two digits of division 72 (Research and development).

6. Strategy Section

As it stands, the Strategy Section combines the analysed needs of the various actors in the region's innovation landscape – innovative businesses, research organisations, innovation infrastructure bodies and other stakeholders in the public, private and non-profit sector. It begins by formulating the RIS3's long-term strategic vision and global objective, as discussed within regional partnership structures during the preparation of the strategy, and builds on the priorities of the region's main development document: the Central Bohemian Regional Development Strategy for 2019-2024 and Outlook to 2030.

Three key areas of change were then defined, serving as the main directions in which Central Bohemia's innovation and entrepreneurial environment is to develop by way of targeted inventions:

Key Area of Change A: People for Innovation

Key Area of Change B: Competitive and Innovative Businesses

Key Area of Change C: Quality Public Research and its Benefits for the Region's Development

The key areas of change set out individual strategic objectives, for which indicators are then proposed to monitor progress towards the strategic objectives. Standard areas of intervention/activity envisaged for support are also presented. The list of standard interventions is not yet definitive, as additions and revisions are expected, in part to reflect how the RIS3 will be implemented through specific projects. Annual RIS3 action plans will list interventions that are being prepared and planned in detail and will include additional information.

6.1 Vision and Global Objective of the Central Bohemian Region's RIS3 Strategy

Global Objective of the RIS3:

A Region of the Future – a region of progressive solutions and creative people

If Central Bohemia is to become one of Europe's richest regions and a place where all people, regardless of their age and education, can enjoy a good life, it must become a **Region of the Future – a region of progressive research-based solutions that can be implemented on world markets, and a region of enterprising and creative people who actively shape their living environment (with quality local services that can essentially be used anywhere in developed countries).**

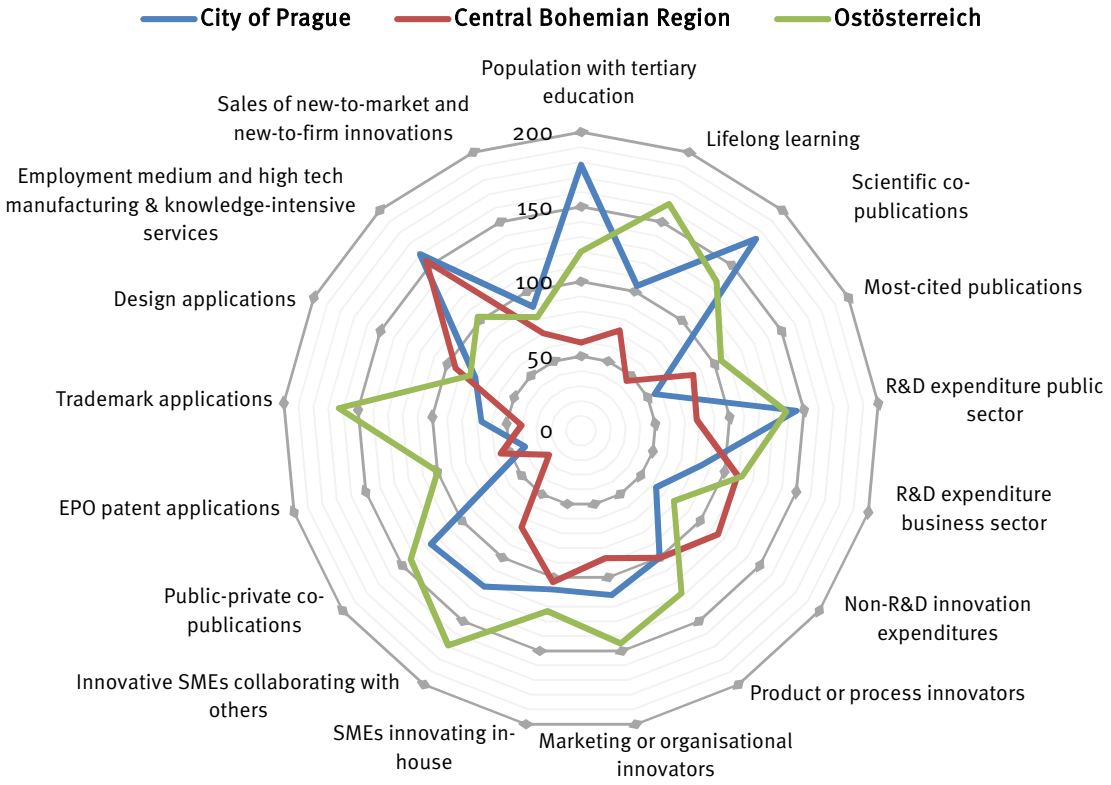
The Regional Innovation Strategy is a thematic component of the strategy for the development of the region's innovation and entrepreneurial environment.[8] The proposed activities and individual strategic objectives in each of the key areas of change will make an important contribution to the fulfilment of the global objective outlined above. This innovative strategy is pursued with a view to paving the way for a Region of the Future – a region of progressive solutions, based on public and private research, that will be implemented through ambitious businesses both on world markets and in the public arena, a region of enterprising and creative people who actively shape their living environment, and a region with quality local services that can essentially be used anywhere in developed countries.

Other regions in Europe can be used as a benchmark to track progress towards the achievement of this objective. This comparison would be based on the Regional Innovation Scoreboard,[9] according to which the Central Bohemian Region is currently a "Moderate Innovator".

[8] As such, the strategy is consistent with the region's main strategic development document: the Central Bohemia Territorial Development Strategy for 2019-2024 and Outlook to 2030.

[9] The Regional Innovation Scoreboard is published by the European Commission at https://ec.europa.eu/growth/industry/policy/innovation/regional_en

Graph 1: Comparison of selected regions according to the Regional Innovation Scoreboard 2019, comparison with the EU-28 average (100%)



Note: The Ostösterreich region consists of the federal states of Niederösterreich, Wien and Burgenland.

Data source: Regional Innovation Scoreboard 2019, European Commission

Compared to the most innovative regions and to the EU average, the Central Bohemian Region is mainly lagging behind in indicators measuring the intensity of relations between research organisations and companies, the level of education of the population, training and education, the high international quality of research, and the extent of patent activity. Conversely, it is strong in corporate R&D and indicators measuring industrial and export performance. The scoreboard does not yet fully cover developments in the Central Bohemian Region in recent years, a period in which the potential at research organisations and new research infrastructures has grown exponentially and may contribute to these values. In addition, the links between Prague and Central Bohemia provide an exceptional opportunity for the overall innovation performance of the region – in a number of areas where the Central Bohemian Region is weaker, Prague reports results that are well above average, and vice versa. These two regions, combined, have the capacity to stand alongside Europe's most innovative regions in a manner similar to Ostösterreich, a region that includes both Vienna and the two surrounding federal states and is above average in the Innovation Scoreboard, making it a "Strong Innovator".

At present, this Regional Innovation Scoreboard does not cover two factors at regional level that are very important in assessing the innovation performance of European countries – the innovation-friendly environment, comprising "broadband penetration" and "opportunity-driven entrepreneurship". The first of these challenges the Central Bohemian Region to expand fast internet, facilitating communications and the transmission of large volumes of data to all parts of the region. This essential for the development of a modern society and advanced economic activities. The second poses the challenge, in particular, of taking greater advantage of hitherto untapped business opportunities in the market. Research and demand for completely new solutions formulated in the public sector can also make a significant contribution here. These are areas that break with tradition and have not previously been commonly viewed as a source of new business opportunities and competitiveness.

6.2 Key Areas of Change

6.2.1 Key Area of Change A: People for Innovation

The availability of skilled people who are capable of lifelong learning and are flexible to the changing needs of the economy and potential investors is a prerequisite for the region's future competitiveness, which is to be based on innovation and high value-added industry, and for the region's attractiveness for foreign investment. One of the most important aspects underpinning the development of the knowledge economy is therefore the dynamic modernisation of education. In the future, the education system must be focused on meeting the needs of the economy and society, while remaining able to adapt to surrounding developments that, though currently unpredictable, will clearly result in disruptive changes. However, it can be assumed that skills such as an entrepreneurial mindset, creativity and the ability to find solutions to problems will be crucial for the future.

Due to its industrial orientation, it is even more necessary in the Central Bohemian Region than in certain other regions to place an emphasis on technical and scientific fields and the ability of the education system to foster a decent workforce suited to these areas to the required extent and quality. In this context, it is absolutely essential to focus on identifying talents, i.e. people who can generate the greatest value. Encouraging their development with a view to deploying them in key branches in the region could unlock enormous potential for the future development of the region.

The first strategic objective of this key area is structured around the education system and its ability to prepare human resources within the region for employment in the labour market of the future and to generate talents for knowledge-intensive activities and innovation. The second strategic objective is complementary to that objective and focuses on the suitable influx of gifted and skilled people from other regions and from abroad. The third strategic objective of this key area, aimed at improving the competencies of teaching staff in initial education, is also complementary to the first strategic objective in a way. It is also an equally crucial objective in its own right because educated, motivated and professionally capable teachers are a prerequisite for quality education at all levels of the education system.

Strategic objectives in this key area of change:

- Strategic Objective 1: To improve the education system's ability to foster talented, creative and enterprising people for the job market of the future.
- Strategic Objective 2: To bring skilled and talented people from other regions of the Czech Republic and from abroad to the Central Bohemian Region.
- Strategic Objective 3: To improve the competencies of teaching staff at all levels of education.

Strategic Objective 1: To improve the education system's ability to foster talented, creative and enterprising people for the job market of the future

Education must meet the future needs of the economy and the labour market. These are based on new challenges and trends of a technological and social nature. However, it is impossible to predict developments in these needs with absolute clarity. It is possible, on the other hand, to identify several general horizontal factors that can be expected to have a positive effect on the success of today's children and young people. The first factor is the development of key skills, such as creativity, entrepreneurship and problem-solving skills. The second factor is the ability to work with information and communication technologies. The third factor is practical experience and an emphasis on practice-oriented teaching (the concept of what constitutes common practical experience will change significantly over time). Finally, it is also important for as many young people as possible to gain experience abroad, preferably at high-quality foreign schools or from internships at innovation-oriented companies and institutions. This goes hand in hand with the promotion of language proficiency. An excellent knowledge of English should be a standard requirement. These general factors and the critical mass reached by incorporating them into the education system will, of course, affect the growth of

the region's human potential and the harnessing of that potential in knowledge-intensive business and research activities in the region.

An emphasis also needs to be placed on technical and science education. This will be reflected in the availability of sufficient numbers of quality graduates in these branches. The increased quality of teaching in these branches will be demonstrated, among other things, by improvements in the results of pupils and students in PISA assessments of mathematical and scientific literacy. In addition to the quality of study in these branches, it is also essential to work towards keener interest among children, especially gifted individuals, in careers in research, technology and innovation. This takes the form of activities aimed at popularising these areas. A system to identify and nurture talent in primary and secondary education also needs to be introduced and developed. This also involves the establishment of an efficient system of career advice, making it possible to identify aptitude for a career in which individuals will be most productive, and to support their development in this direction.

Strategic objective indicators:

- Students' mathematical and scientific literacy results in PISA assessments.
- The satisfaction of employers in the region with the quality of knowledge about their sector and the general competence of school-leavers (based on INKA, a periodic representative field survey).
- The proportion of pupils/students from the region going on to study technical and natural sciences at secondary schools and/or universities in the region and in Prague.

Standard interventions/operations:

- Projects and programmes that promote a greater link between education and the workplace (e.g. internships for pupils, students and teachers at companies and/or research organisations in the region, the assignment of theses and dissertations by companies, the adaptation of education programmes, and the modernisation or addition of equipment at schools).
- Activities strengthening the entrepreneurial mindset, the development of entrepreneurial skills, and innovative, critical and creative thinking.
- Programme for the mobility of pupils and students, focusing mainly on language and vocational education. In the field of language proficiency, a focus on encouraging knowledge of the English language.
- Investments in school equipment facilitating the computerisation of education and work with modern technologies, including the development of teachers' competence in the use of the necessary equipment and devices.
- Activities aimed at forging firmer links between primary and secondary schools in the region in order to improve the focus of teaching at primary school so that it is more aligned to the needs of secondary schools and the economy of the region.
- Activities to boost the popularity of science, research, technology and innovation and to attract talented young people to careers in this field.
- The establishment of a system for the identification of and subsequent care for talents at primary and secondary schools, including long-term work with talents with the aim of finding them opportunities in the region and retaining them here.
- The building of a career advice system at primary and secondary schools.
- Cooperation with relevant institutions (e.g. the Confederation of Industry of the Czech Republic), local action groups and municipalities.

Strategic Objective 2: To bring skilled and talented people from other regions of the Czech Republic and from abroad to the Central Bohemian Region

In addition to making better use of the region's own people, talent acquisition also entails purposefully attracting talented individuals from other regions and abroad. This requires an enhancement in the appeal of the Central Bohemian Region for such people by creating, among other things a system for attracting and adapting highly skilled people to the region. This system includes, in particular, support for the arrival of skilled foreigners through internships or scholarships, and also the creation of favourable conditions for their establishment in the region through soft tools encompassing supportive care services, including arrangements for foreigners' families and education.

The main target groups are professionals for technology-oriented companies, researchers for science centres, talented applicants for university studies, and, to a lesser extent, high school students. In these target groups, it is necessary to increase awareness of the Central Bohemian Region and how attractive it is by deploying targeted marketing tools and engaging in events abroad.

Strategic objective indicators:

- A rise in the share of highly skilled workers (ISCO 1-3) (compared with the Czech average)
- The share of foreign workers at research organisations in the region
- The number of foreign researchers in the region (internal survey, compared with the Czech average)
- The number of incoming foreign students at secondary schools / higher education institutions within the framework of mobility

Standard interventions/operations:

- The implementation of events aimed at increasing the attractiveness of the Central Bohemian Region for talents
- Internships of foreign workers at research organisations in the region
- A programme to educate people coming from abroad (e.g. to add the skills they need, language lessons)
- The systematic attraction and arrival of talented secondary school and university students from abroad (placements, a scholarship scheme for talented foreign students, etc.)
- Joint marketing by the Central Bohemian Region and Prague abroad
- The provision and coordination of services for newly arrived students and workers (Welcome Office – including housing assistance, supportive family care, orientation...)
- Proposals for measures at state level to support the arrival of skilled people from abroad

Strategic Objective 3: To improve the competencies of teaching staff at all levels of education

Motivated and professionally capable teachers are a prerequisite for quality education at all levels of the education system. However, teachers at all levels of education often have insufficient skills relating to new forms of teaching and they lack contact with the workplace environment. This shortcoming is often reflected in their ignorance of current market trends and needs and of the technologies and principles that are currently in use. As a result, teachers are unable to teach pupils and students how to apply the knowledge they have gained when dealing with specific problems. This strategic objective is therefore focused on improving the practical further training of teaching staff, with an emphasis on cooperation with companies and skills in the field of modern technologies. The second level of this strategic objective, which targets the greater involvement of experienced professionals from the workplace in initial education, is also related to the goal of ensuring that there is a sufficient link between people in the education system and the workplace. In this regard, it is necessary to pave the way for these professionals, who have not been trained as teachers, to enter the education system and to generally support the permeability of education with the workplace.

The third level of this strategic objective is to prepare future graduates of teaching disciplines. It is also necessary to emphasise practical skills and the share of work experience, which must be sufficiently integrated into teaching at higher-education institutions.

If the region is unable to wield direct influence over some of the above factors, it may, as far as it is able, attempt to initiate changes at national level and at higher-education institutions.

Strategic objective indicators:

- The number of teachers involved in further training, especially in the field of information technology, language education and contact with the workplace
- The number of ongoing collaborations between businesses and schools

Standard interventions/operations:

- The further training of teaching staff (e.g. encompassing information technology, practical teacher training in technical branches focused on the control and use of new production and related technologies, etc.)
- Placements for teachers at employers and the introduction of a system to interlink these placements with teachers' career paths
- Ensuring the greater participation of skilled people from the workplace in teaching
- Support for the foreign mobility of teachers
- Analyses of the qualifications and competence required of the teaching profession
- Proposed measures and lobbying to improve the quality of students of teacher training colleges and to forge firmer links between the education system and the workplace

6.2.2 Key Area of Change B: Competitive and Innovative Businesses

Until recently, the Central Bohemian economy's sources of growth were based primarily on the activities of foreign companies (with domestic companies benefiting indirectly), on the cost advantage it offered, and on operational efficiency. However, the original bedrock of these competitive advantages is gradually being eroded, and now there is a transition to new sources of growth based on high value-added activities. To ensure the future prosperity of the region, which is reliant primarily on thriving business and companies growing, investing and creating quality jobs in the region, it is necessary to support the acceleration of this transition to new sources of growth. This means working hard on the development of knowledge-intensive activities with high value added, and support for the creation of new companies with the potential for rapid growth. With foreign companies, it is necessary to focus on their maximum interconnection with the local economy and the faster introduction of more advanced business functions into local branches (design, construction, development and/or research).

In addition to the faster transformation of the operations of foreign companies in the Central Bohemian Region, if future growth potential is to be secured the main prerequisites are greater development dynamics and innovation performance at endogenous[10] companies. This requires a focus on creating a more favourable environment and conditions for the establishment and development of new companies that have global ambitions, high growth potential and a "final" product designed directly for end customers in the market. In addition, it is expedient to enable small and medium-sized businesses, in particular, to penetrate and operate successfully on foreign markets, as exports and operations on demanding foreign markets have a positive effect on the innovation momentum at companies and offer them greater growth opportunities. There are a number of reasons for the lower demand for innovation in the corporate sphere (see the Analytical Section of this Strategy) that, together, contribute to the fragmentation of the regional innovation system and low innovation performance. An increase in innovation demand and momentum in the corporate sphere will be

[10] An endogenous company is taken to mean a business entity established, owned and managed from the Central Bohemian Region.

stimulated, in part, by strengthening the research and development capacities of companies, both in-house and, in particular, by creating networks of cooperation in R&D and innovation with other companies and research organisations. Improving the non-technical competencies of companies, especially strategic management, innovation management and internal processes, where many (primarily smaller) companies are lagging behind, is also important for innovation performance. In this case, companies can also be supported in the outsourcing of specialised services, e.g. from the creative industries, that can strengthen SMEs in business and marketing processes, design, etc.

Strategic objectives in this key area of change:

- Strategic Objective 1: To increase the intensity at which new companies with the potential for rapid growth are established
- Strategic Objective 2: To increase the export performance of SMEs
- Strategic Objective 3: To improve innovation processes and strategic management at SMEs
- Strategic Objective 4: To strengthen the R&D capacity of all types of companies and their cooperation with research organisations

Strategic Objective 1: To increase the intensity at which new companies with the potential for rapid growth are established

Entrepreneurship and an entrepreneurial mindset in general are essential to innovation, because innovation delivers new value to customers, both consumers on the open market and users of public services. The rate at which new companies are established and the number of small companies with up to 10 employees in the Central Bohemian economy[11] show that a spirit of enterprise and the establishment of new companies are not among the region's strengths. To increase the Central Bohemian economy's innovation performance, it is important to create more new companies in knowledge- and technology-intensive branches with a high need for R&D, and also to form companies that have the potential to grow rapidly (e.g. services) and deploy a final product on the market. The ambitions and visions of the owners/managers of these companies play a crucial role in this development because these shape the innovation and growth potential of the company itself. The purpose of this strategic objective is to develop a business culture in the region and facilitate the development of companies with high growth potential that are in the initial stages of development. Another important factor is the gradual transformation and growth of the ambitions harboured by the owners of young endogenous companies so that as many of these companies as possible can grow quickly and become strong companies that will be a pillar of the Central Bohemian economy.

At the same time, the need to simplify the process of establishing new companies and to reduce their administrative burden must be accentuated within the scope of this objective. Although it is difficult to influence this area from a regional level, it is necessary to make efforts towards national level and to lobby for an improvement in the situation in this area.

Strategic objective indicators:

- The number of newly established companies (relatively per inhabitant of working age in the region)
- The number of fast-growing companies ("gazelles"[12])

Standard interventions/operations:

- Increased interest in entrepreneurship and the development of an entrepreneurial culture in general (education, shared infrastructure)

[11] See the findings in the RIS3 Analytical Section.

[12] Companies with turnover growth of 20% or more for four years in a row.

- The development of soft infrastructure for targeted work with new companies that have the potential for rapid growth (incubation services)
- An improvement in access to funding for start-ups

Strategic Objective 2: To increase the export performance of SMEs

Exports are essential for the Central Bohemian economy. As the whole of the Czech Republic is a small and open economy, for companies to be successful it is necessary to constantly seek out new markets and customers offering new impulses for their business. Exports by companies in the region currently largely depend on foreign companies. The purpose of the interventions is to facilitate the development of export performance among domestic SMEs, too, stimulating the development of market competencies and capacities and enabling them to grow. The aim is to reduce some of the barriers that SMEs face in internationalising their activities, such as providing services to customers on more distant markets, obtaining strategic information about target markets, etc. Another aim is to increase the number of companies that will successfully penetrate foreign markets not only in neighbouring countries, but also further afield. Foreign markets should be penetrated not only through exports, but also through direct investment in these countries in order to increase the economic benefits for the region's economy and to develop companies' market competencies. This objective is closely linked to the need to increase the innovation performance of companies and the ambitions of business owners/managers, as these are direct conditions for successful international expansion. From a development point of view, the goal is to strengthen the competencies of already exporting SMEs, while also focusing on start-up companies that are preparing for their first international expansion.

Strategic objective indicators:

- The number of SMEs involved in activities that have increased the share of exports in their sales (a comparison of changes in the sales of supported companies versus the whole Central Bohemian economy)
- The number of SMEs involved in activities that have seen them enter new foreign markets

Standard interventions/operations:

- Specialised advice aimed at facilitating entry on to a specific target market for SMEs
- The mediation of strategic information for SMEs on development trends and their implications for specific markets (analyses aimed at gauging potentially attractive foreign markets)
- Specialised management training (an "export academy" for the senior staff of companies)

Strategic Objective 3: To improve innovation processes and strategic management at SMEs

For a real change in the nature of the region's economy in order to ensure its competitiveness and more intensive use of new sources of growth in the future, it is essential to significantly increase the share of companies whose competitive advantage and development is based on innovation, technology and knowledge. The purpose of this objective will be to increase the innovativeness of the regional economy, especially by supporting the development of companies that have their own products and know-how, and by increasing the efforts of companies to make higher-order innovations, in particular technology-oriented ones, where there is a high need for internal research and development. It is also appropriate to facilitate a shift in companies' strategic focus from a competitive advantage based primarily on low costs and high efficiency to an advantage based on quality, design and innovation, even of a lower order not requiring extensive research and development, and on the ability to market a product in the face of keen competition (i.e. to increase marketing and sales competence).

The key to increasing innovation performance, especially at small and medium-sized companies, is to improve strategic management, particularly the ability to correctly identify customer needs, the ability to find and activate the necessary internal resources, and the ability to bring innovation to market promptly (including its marketing and sale). A company's strategy and the establishment of key business (not only innovation)

processes are therefore crucial for the effectiveness of activities aimed at the ability to implement technological innovations.

Strategic objective indicators:

- The number of companies supported where sales have increased by X% within three years of receiving the support
- The number of companies participating in programmes to support the improvement of innovation processes and strategic management (innovation vouchers, Platinn, selected programmes of the Ministry of Industry and Trade and the Technology Agency, the change over three years).

Standard interventions/operations:

- A scheme to improve strategic management and to accelerate growth and innovation at SMEs (including: (i) the identification of new growth opportunities/development needs for SMEs; (ii) finding a way (solution) for their use/fulfilment; and (iii) coaching/mentoring the implementation of identified solutions at the company)
- The facilitation of process and product upgrading at SMEs, including through production and development cooperation with large (and not only) foreign companies
- The mediation of quality management training in the field of strategic management and the management of innovation, marketing and sales, and other necessary skills
- Creative vouchers

Strategic Objective 4: To strengthen the R&D capacity of all types of companies and their cooperation with research organisations

This objective is closely linked to activities under Strategic Objective 3. The actual increase in research and development capacity is important, but must be linked to improved market knowledge and to improved strategic management and internal processes at companies. The purpose of this objective is to increase the ability of companies to implement technical innovations for which a crucial role is played by research and development. Therefore, it is important to enable companies to develop their own R&D capacities,[13] which means not only resources for R&D funding, but also the infrastructure needed for this.

For small and medium-sized companies, the only effective way to obtain the necessary inputs for innovation processes is external cooperation with other companies and, especially, with research organisations (public and private) or innovation infrastructure entities (science and technology parks, innovation centres, clusters, etc.). In that respect, this objective is intended to facilitate external cooperation, remove barriers to such cooperation, and facilitate greater knowledge transfer between partners.

The gradual development of R&D capacities at large companies, which are the engine of the economy, and also at branches of foreign companies that have production capacities in the region, is another major challenge for the Central Bohemian economy. It is necessary to create conditions for more of them to acquire a larger share of the group development and/or research activities of their parent companies.[14] It is also essential to work with large companies that are pillars of the economy in the region so that they participate in the development of the region (for example, through corporate social responsibility tools) and are more involved in addressing the region's problems.

An important supporting activity in the context of this strategic objective is the promotion of the Central Bohemian Region as a "region of the future". The aim is to arouse interest in the region among companies and

[13] Including, for example, industrial design, construction and other related activities.

[14] There is a need to capitalise more on the current trend where: (i) there is much greater interaction between key subcontractors and final manufacturers, including in the field of development ("Tier 0.5 suppliers"); and (ii) group R&D departments are relocated so that they are close to key production plants (for a number of foreign companies, these are located in the Central Bohemian Region).

investors in high value-added areas and to facilitate the interaction of major foreign entities with domestic companies in the region.

Strategic objective indicators:

- The number of companies supported under the Central Bohemian Innovation Vouchers scheme, a Technology Agency programme and other selected programmes, where internal non-capital expenditure on R&D has increased by X% within three years of the end of the project.
- Non-capital expenditure on R&D in the business sphere in the region

Standard interventions/operations:

- A scheme targeting a reduction in entry barriers for cooperation between companies and research organisations – Innovation vouchers
- A scheme to improve the availability of talents for business development and innovation at SMEs (e.g. internship or placement programmes for researchers or experts in innovation processes at companies)
- The mediation of expert services in the field of patent protection and intellectual property protection at SMEs
- Implementation of events aimed at increasing the attractiveness of the Central Bohemian Region for foreign companies and investors in areas with high value added
- Public sector projects representing demand for new solutions using the results of research and development and, especially, supporting cooperation between the research and business sectors

6.2.3 Key Area of Change C: Quality Public Research and its Benefits for the Region's Development

A strong research and development base is one of the pillars underpinning the development of a knowledge economy. Quality research is a prerequisite for the region's ability to generate outputs and technological solutions facilitating the manufacture of products with high value added. The focus is not only about the ability of research institutes to generate ideas and discoveries that can eventually be put into industrial practice after development in applied research. Research organisations are also a source of opportunities for high-tech industry thanks to their contracts and requirements, such as precise scientific instruments, which stimulate its further development. Research centres in the Central Bohemian Region, some of which are outstanding in a global or (Central) European context, therefore have the potential for the region to play a significant role in characterising the broader region as knowledge-ready and able to receive knowledge-intensive investments.

For these reasons, it is essential for the Central Bohemian Region that the research centres of companies have good conditions for their development and that publicly funded research and development centres strengthen their quality and international competitiveness. It is equally important to work towards the interlinking of public research and development capacities with both the business and public sectors so that it is possible to profit fully from these capacities for the development of the region. The last fundamental pillar of this key area of change is work with people whose profession is research and development, as they are in an exceptional position to create the knowledge that could spell a major shift in the competitiveness of a research organisation, companies and the region itself. Support for the development of public research in the above directions forms a basis for the use of the results of such research in the region.

Strategic objectives in this key area of change:

- Strategic Objective 1: To strengthen the quality and international openness of public research
- Strategic Objective 2: To increase the benefits of research organisations for the economy in the region

Strategic Objective 1: To strengthen the quality and international openness of research

There are a number of public and private research organisations in the Central Bohemian Region where quality research is carried out. Some of the research centres in the region are outstanding in both a European and global context and, as such, are flagships of activities with high knowledge value in the region.

All research centres must strive continuously for research excellence and thus strengthen their international competitiveness and attractiveness to talents from the Czech Republic and abroad. Besides highly qualified people, research excellence depends on international openness and cooperation, as well as sufficient infrastructure and technological facilities.

Increasing the expert potential of people involved in research and development extends beyond research competencies. It also encompasses the development of managerial knowledge and skills, because improving the standard of strategic management at research organisations is another important prerequisite for their long-term development. It is also important to increase legal awareness in the field of intellectual property protection and the commercialisation of research results, and to introduce the specialisation of selected employees of research organisations in these areas.

The tools implemented in this respect will be aimed at establishing conditions favourable for the development of quality research centres in the region and at their more intensive involvement in international research cooperation. The support of the centres to this end will be reflected not only in research results published in prestigious journals, but also in greater success in obtaining international grants and involvement in the international projects of research organisations and teams. It is also necessary, through the region's activities at national level, to maximise funding for the region's research centres from national and (future) European sources. This funding should meet the needs of the centres, help their sustainability and support their professional development.

Strategic objective indicators:

- The number of papers produced by research centres in the Central Bohemian Region that are published in the first decile/quartile of periodicals according to the industry impact factor (classified according to the focus of the research)
- The financial volume and number of foreign grant projects (including Horizon 2020 and the follow-up programme) and the share of project promoters
- The headcount and share of foreign researchers employed at research organisations in the Central Bohemian Region
- The number of placements held

Standard interventions/operations:

- The development of excellent research teams especially support for long-term international research partnerships with leading research institutions abroad, internal research activities and the technological upgrade of equipment at research organisations
- The facilitation of international networking and exchanges of experience in the operation of large research infrastructures and the strengthening of open access to large research infrastructures
- Foreign mobility schemes (placements for regional researchers abroad, placements of foreign workers at research organisations in the region, exchanges of experience with foreign countries and the sharing of examples of good practice, etc.)
- Cross-sectoral mobility between research organisations and companies
- Projects facilitating the career development of young researchers (junior start-up grant projects etc.)
- Activities to improve grant support, especially for international grants, e.g. co-financing from national/regional sources

- The strengthening of research cooperation with strong and complementary partners in Prague and other regions
- The co-financing of strategically important research projects, including their preparation
- General and specific training for researchers
- Activities to improve the strategic management of research in the field of human resources management and the commercialisation of research. Support for the specialisation of selected employees of research organisations in the field of intellectual property protection and commercialisation
- The preparation of measures to cut red tape and administrative costs in the support of research, development and innovation
- Lobbying to establish conditions suitable for future national and European resources and to cut red tape

Strategic Objective 2: To increase the benefits of research organisations for the economy in the region

The use of the capacities of public and private research organisations for the economic development of the region falls well short of potential. This strategic objective therefore focuses on the greater application of the benefits of research for the development of the region. In particular, it strives to increase the relevance of research activities at research organisations. This depends on interaction and cooperation with the users of the results, i.e. with companies and the public sector. This cooperation needs to be stimulated by implementing support tools and interventions that encourage more frequent and more intensive networking of the research sphere and users of research results, resulting in a search for new solutions to society's needs and in innovations. Improvements in the readiness of research organisations themselves for this cooperation and for the commercialisation of research results, and the transfer thereof to the application sphere, are equally crucial. The strengthening of partnerships between research organisations and companies and the rising commercialisation of research results will be reflected in a higher number of implemented projects, more intensive patent activity, and, mainly, the higher volume of funding obtained by research organisations from private sources.

There is another important aspect underlying the presence of basic research organisations in the region – the stimulation of the development of regional technology companies through contracts for precise scientific instruments awarded by research institutes, often within the framework of international projects. The performance of these contracts has an immediate effect – the transfer of international project funds managed by research organisations to a technologically advanced segment of the local economy. A long-term positive effect is the acquisition of experience and contacts for local companies, enabling them to seek similar contracts at European/global level, albeit without the direct participation of academic institutions in the region. To unlock this potential, it is necessary to actively support the pairing of basic research institutions in the region and their projects (on the demand side) with local technology companies as potential contractors.

Strategic objective indicators:

- The financial volume of R&D funds obtained by research centres in the Central Bohemian Region from business sources (contractual R&D, licences for research results, donations from donors, etc.; the volume of R&D expenditure in higher education by financed companies, relative to the Czech average)
- International patent activity (number of PCT patents, 10% growth compared to the Prague average)

Standard interventions/operations:

- The facilitation of the preparation and implementation of joint projects of academic and application partners (e.g. innovation and creative vouchers)
- Instruments to support active interconnection between corporate practice and public research (the mobility of employees between the research environment and companies, the strengthening of contacts through networking events, etc.)

- Support for the creation of spin-off and start-up companies based on research results
- Projects supporting the streamlining and professionalisation of processes in the commercialisation of intellectual property
- Assistance in the use of company tax deductions for research acquired from research organisations
- The active mediation of contacts between research institutions – authors of international projects/contracting authorities of technologically demanding contracts – and local companies capable of implementing these contracts (e.g. information days for industry on individual projects)
- Public sector projects representing demand for new solutions using the results of research and development in the public sector

7. Implementation of the RIS3 Strategy in the Central Bohemian Region

Framework of implementation in the Czech Republic

The implementation of Central Bohemia's RIS3 Strategy should be viewed in the context of relevant national strategies, especially the National RIS3 Strategy and the Innovation Strategy of the Czech Republic 2019-2030 (also known as "Czech Republic – the Country for the Future"). The National RIS3 Strategy serves, among other things, as a vehicle for obtaining support from the European Structural and Investment Funds. In most cases, its objectives overlap with the objectives of the second strategy mentioned above. National and regional RIS3 strategies are also similar in the methodological approach taken to their production. As the state is the main driver of research, development and innovation policy in the Czech Republic, a regional RIS3 strategy logically does not cover the same range of topics as the national strategy, but focuses on priorities and areas where it has the potential to influence the achievement of objectives.

Implementation structure and instruments of the Central Bohemian Region

The implementation of the Central Bohemian Region's RIS3 falls within the independent competence of the Central Bohemian Region itself, i.e. regional self-government. Specifically, the innovation policy agenda falls within the competence of the Regional Development Department of the Central Bohemian Regional Authority, which is responsible for the Central Bohemian RIS3, and for its updating and implementation, and, in cooperation with the Central Bohemian Innovation Centre, engages in activities to promote the innovation landscape in the region. The basic actors implementing RIS3 in the Central Bohemian Region are, in addition to the region's political representation, the Competitiveness Council, the regional RIS3 manager, the Central Bohemian Innovation Centre and innovation platforms, whose roles are described below.

Competitiveness Council of the Central Bohemian Region

The Competitiveness Council of the Central Bohemian Region is an advisory body of the Central Bohemian Regional Council for the support of innovative business, research and development in the Central Bohemian Region. Based on the conditions of the "Smart Accelerator II" call under the Operational Programme Research, Development and Education, it also has certain approval powers in the Smart Accelerator II project in the Central Bohemian Region. It has been formed on the principle of partnership between the public, private and research sectors in the region. Competitiveness Council members are representatives of innovative companies, academic entities operating in the region, representatives of regional self-government and representatives of supporting organisations active in the field of innovation support in the Central Bohemian Region.

The roles of the Competitiveness Council include coordinating the preparation and implementation of the regional RIS3 and monitoring and evaluating the results of RIS3 implementation. The Competitiveness Council discusses the method for the implementation of activities under the Central Bohemia RIS3 Action Plan, proposes possible changes, comments on proposed updates of the Central Bohemia RIS3 document, approves – and recommends to the Central Bohemian Regional Council for approval – strategic interventions and projects that, in scope and content, are strategic for the region's development and are financed from public funds.

Central Bohemian Innovation Centre

The Central Bohemian Innovation Centre is entrusted with the implementation of selected Central Bohemia RIS3 interventions, including support activities and tools under the Smart Accelerator project. Smart Accelerator is a tool specifically focused on the development of regional innovation systems and on strengthening the institutional capacity of the region. It is financed from the European Structural and Investment Funds, and specifically under the Operational Programme Research, Development and Education of the Ministry of Education, Youth and Sports.

The members of the Central Bohemian Innovation Centre association are currently the Central Bohemian Region and four significant research and educational institutions: the Institute of Physics of the Czech Academy of Sciences, the owner of two large infrastructures in the region, specifically in Dolní Břežany – ELI and HiLASE; the Astronomical Institute of the Czech Academy of Sciences, based in Ondřejov, one of the oldest research organisations in the region; the Research Institute of Geodesy, Topography and Cartography in Zdiby, the only research organisation of its kind in the Czech Republic; and the Czech Technical University in Prague, which owns two important centres in the region – the Faculty of Biomedical Engineering in Kladno and the UCCEB in Buštěhrad. The main role of the Central Bohemian Innovation Centre focuses on interventions aimed at strengthening competitiveness and developing the knowledge economy in the Central Bohemian Region. Central Bohemian Innovation Centre specialises in supporting research, development and innovation in the region, strengthening partnerships between companies, public administration and academia, and promoting the growth and development of small and medium-sized innovative companies. It also covers the development of the entrepreneurship and creativity of pupils and students and the support of talents.

Regional RIS3 manager

The regional RIS3 manager is a central position within the above-mentioned Smart Accelerator project, which is intended to support the implementation of the Central Bohemia RIS3. The regional RIS3 manager manages and coordinates project activities, which include: the creation of the RIS3 Strategy and its action plans, the role of the secretary of the Competitiveness Council of the Central Bohemian Region, the coordination of innovation platforms, pilot verification, training events and twinning activities, and the coordination of analytical activities. The manager works with other members of the Central Bohemian Innovation Centre team to encourage the building of regional partnerships and cooperation in the region, and seeks out and develops new interventions to achieve the Central Bohemia RIS3's objectives. The manager, together with the regional RIS3 coordinator operating directly within the structure of the regional authority, is also the region's contact person for the National RIS3 manager.

Innovation platforms

Regional innovation platforms play a supporting role in shaping RIS3 interventions in the region. They consist of working groups of the regional Competitiveness Council currently focused on cross-cutting themes consistent with the region's needs: digitalisation, smart city, the circular economy, and the management of innovations at companies. Innovation platforms are composed of the representatives of companies, towns, municipalities, and academic and research institutions in the Central Bohemian Region. They aim to initiate cooperation on specific projects across disciplines and sectors, identify and share project ideas, and identify barriers and look for ways to overcome them.

Action plan

The updated Central Bohemia RIS3 forms a framework for the creation of specific interventions and project plans that will meet its objectives. For each key area of change under the Central Bohemia RIS3, specific interventions are subsequently created – projects of strategic importance for the development of the region, which are drawn up in the form of an action plan. At present, these are mainly projects being prepared by research organisations and strategic interventions formulated and fully or partially implemented by the Central Bohemian Innovation Centre, which are supplemented by selected projects of companies or municipalities. The Action Plan is thus a broad portfolio of interventions and project plans that contribute to the fulfilment of the Central Bohemia RIS3 objectives. It provides an overview of the steps taken by individual actors in the region.

This is important because the updated Central Bohemia RIS3 creates a basic framework for the guidance of available financial resources to relevant areas from national and European sources. It is an opportunity to focus regional financial interventions on areas with the greatest potential for positive change. In this respect, it provides information on the demand and absorption capacity of the region in the use of domestic and foreign subsidy schemes.

8. International Aspect of the Central Bohemia RIS3's Implementation

The principles of smart specialisation require policymakers to heed the situation and practices in other regions and countries. As a result, it is possible, for example, with the help of systematic benchmarking, to map the European and international context and seek out examples of tools and good practices suitable for transfer to regional conditions. Cooperation with foreign organisations benefits everyone involved because the sharing of diverse expertise and know-how creates new knowledge, technologies and/or services. Therefore, we are looking for suitable partners or consortia to establish new partnerships. Experience of international cooperation subsequently helps to implement the most efficient tools in the Central Bohemian Region.

The Central Bohemian Region draws on numerous impulses from abroad, which take various forms, in order to implement the regional innovation strategy successfully. These include:

- the region's membership of the European Commission's S3 Platform – this is a Joint Research Centre – the Institute for Prospective Technological Studies in Seville, which methodically covers the European Commission's RIS3 agenda and provides professional support to those implementing RIS3 strategies throughout the EU;
- involvement in international projects implemented by consortia from multiple countries for purposes of "policy learning", or pilot projects – the region, or more precisely the Central Bohemian Innovation Centre, has so far implemented (or is implementing) projects under Interreg Europe (the Color Circle project), Interreg Central Europe (the KetGate project), and Interreg Danube (the D-STIR and RI2Integrate projects). It has also drawn on support from the Visegrad Fund (Evaluation of Smart Cities in V4);
- involvement in international networks that make it possible to harvest foreign know-how and pass it on to domestic target groups (Central European Public Procurement of an Innovation Network; KetGate Points; the Wetzlar Network);
- the implementation of "twinning" (the transfer of knowledge and good practice), i.e. intensive training courses acquainting participants with specific support tools at foreign innovation agencies and organisations, with the intention of transferring them to the Central Bohemian Region;
- the implementation of bilateral cooperation on the basis of memoranda of cooperation;
- the promotion of the region abroad, support for the arrival of foreign skilled labour in the region;
- participation in major international events where companies, researchers, policymakers and other actors in the international innovation landscape meet, e.g. Innovation Growth Lab, CyberWeek, European Week of Regions and Cities.

9. Financial Resources for Implementation of the Strategy

Various financial resources, depending on their availability and acquisition conditions, are used for the implementation of the RIS3 Strategy. They include, in particular, subsidies from the Central Bohemian Region (operating subsidies to the Central Bohemian Innovation Centre, the co-financing of projects), Community programmes of the European Union, national operational programmes subject to the European Structural and Investment Funds, central government schemes in support of research, development and innovation, and co-financing by project partners.

Specific sources and the amount of co-financing are agreed between the project partners and are subsequently subject to the approval of individual projects by regional bodies and/or in the relevant approval processes of the subsidy programmes concerned.

10. Monitoring and Evaluation of the RIS3 Strategy in the Central Bohemian Region

Monitoring and evaluation activities are integral to the strategic management of the development of the innovation landscape. Under the RIS3 Strategy of the Central Bohemian Region, these activities consist of action plan monitoring reports, and evaluations of the implementation of the RIS3 Strategy based, among other things, on the indicator system.

Action plan monitoring reports will contain information on the actual implementation of the planned interventions and projects. These reports will be drawn up annually, along with the preparation of the new action plans.

The RIS3 Strategy will be evaluated during 2022 as part of the Smart Accelerator II project in the Central Bohemian Region so that, in 2023, an update of the strategy can be prepared for the second half of the EU's 2021-2027 programming period. Monitoring indicators are prepared for individual key areas of change in the Strategy Section.

Analytical Section

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List of Abbreviations

CAS	Czech Academy of Sciences
BERD	Business expenditure on research and development
BIOCEV	Biotechnology and Biomedicine Centre of the Academy of Sciences and Charles University in Vestec
CZSO	Czech Statistical Office
CVUM	Sustainable Mobility Vehicles Centre
ČVUT	Czech Technical University in Prague
EPO	European Patent Office
EU-28	European Union (28 Member States)

Eurostat	Statistical Office of the European Union
ExAM	Experimental Animal Models Project
FBMI	Faculty of Biomedical Engineering (Czech Technical University)
FTE	Full-time equivalent
HC	Headcount
GDP	Gross domestic product
GVA	Gross value added
ICT	Information and communication technologies
ISCO	International Standard Classification of Occupations
KIS	Knowledge-intensive services
MoD	Ministry of Defence
MIT	Ministry of Industry and Trade
SMEs	Small and medium-sized enterprises
MoH	Ministry of Health
NACE	Statistical Classification of Economic Activities in the European Community (Nomenclature statistique des activités économiques dans la Communauté européenne)
NUDZ	National Institute of Mental Health
NUTS	Nomenclature of Territorial Units for Statistics
OP R&DI	Operational Programme Research and Development for Innovation
ORP	Municipality with extended powers
p.p.	Percentage point
VA	value added
PPS	Purchasing power standard
FDI	Foreign direct investment
RVVI	Research, Development and Innovation Council
SUSEN	Sustainable Energy Project
TPCA	Toyota Peugeot Citroën Automobile
TACR	Technology Agency of the Czech Republic
ÚJV	Nuclear Research Institute
UCEEB	University Centre for Energy-Efficient Buildings (Czech Technical University)
R&D	Research and development
HEI	Higher-education institution
STP	Science and technology park
VTR	Annual Research and Development Report
WEF	World Economic Forum
ZP	Manufacturing

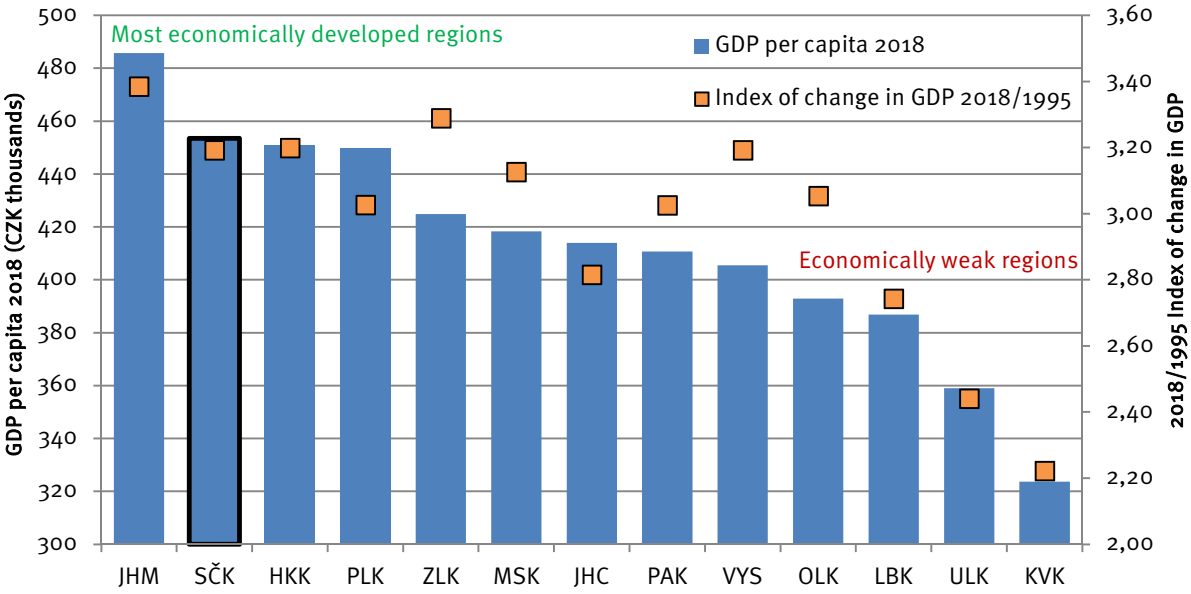
Regions

HKK	Hradec Králové Region	PAK	Pardubice Region
JHC	South Bohemian Region	PHA	City of Prague
JHM	South Moravian Region	PLK	Plzeň Region
KVK	Karlovy Vary Region	SČK	Central Bohemian Region
LBK	Liberec Region	ULK	Ústí nad Labem Region
MSK	Moravian-Silesian Region	VYS	Vysočina Region
OLK	Olomouc Region	ZLK	Zlín Region

1. Macroeconomic Status of the Region

The introductory chapter summarises the basic macroeconomic parameters of the Central Bohemian Region's development compared to the national average, other regions of the Czech Republic, and other countries. The main aim of this chapter is to determine what level of economic performance the Central Bohemian Region has achieved and how it is developing over time compared to other regions of the Czech Republic and the EU. It is also intended to describe the main aspects of economic growth in the Central Bohemian Region and how the economy is developing in the context of the EU.

Graph 1: Per capita GDP of the regions of the Czech Republic in 2018 and the change compared to 1995

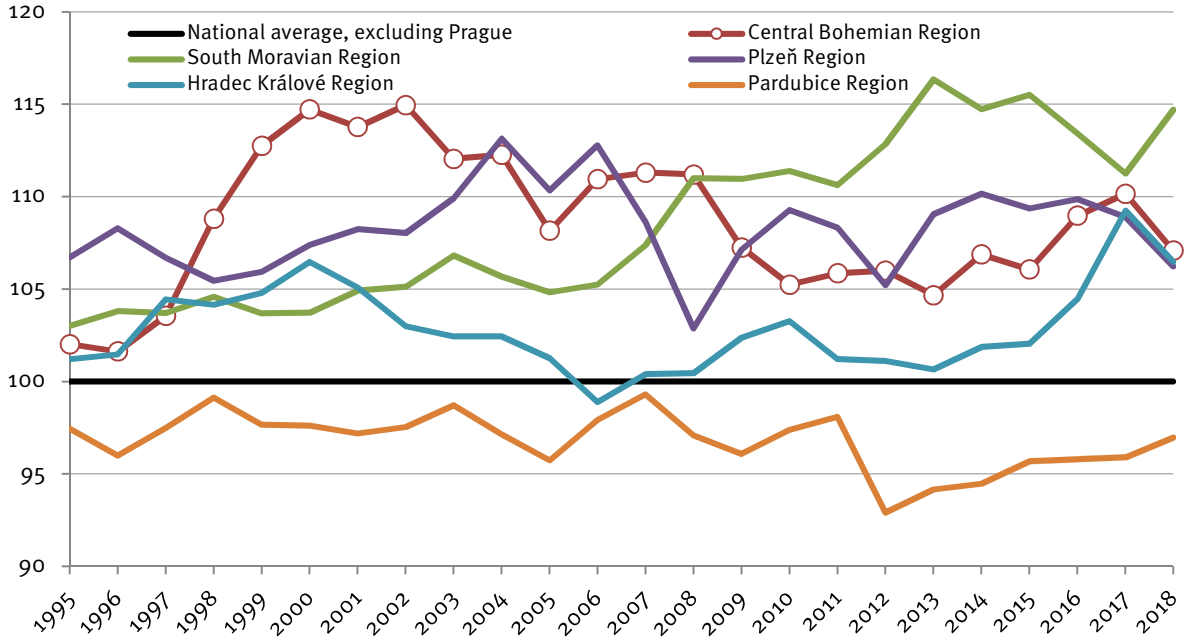


Note: For the sake of better clarity, the graph does not show Prague (in 2018 per capita GDP was CZK 1,057,000 and the 2018/1995 index of change was 4.04)

Data source: Czech Statistical Office – regional accounts

Per capita GDP is the most commonly used indicator of economic performance as it facilitates interregional comparisons. The Central Bohemian Region is one of the most developed regions in terms of economic performance, ranking third in comparison with other regions. In addition, it has achieved very rapid growth in economic performance since 1995, with per capita GDP more than tripling over that period. The Central Bohemian Region is therefore one of the regions that most successfully went through the Czech economy's transition period.

Graph 2: Per capita GDP of selected regions compared to the average of the Czech Republic, excluding Prague (= 100), 1995–2018



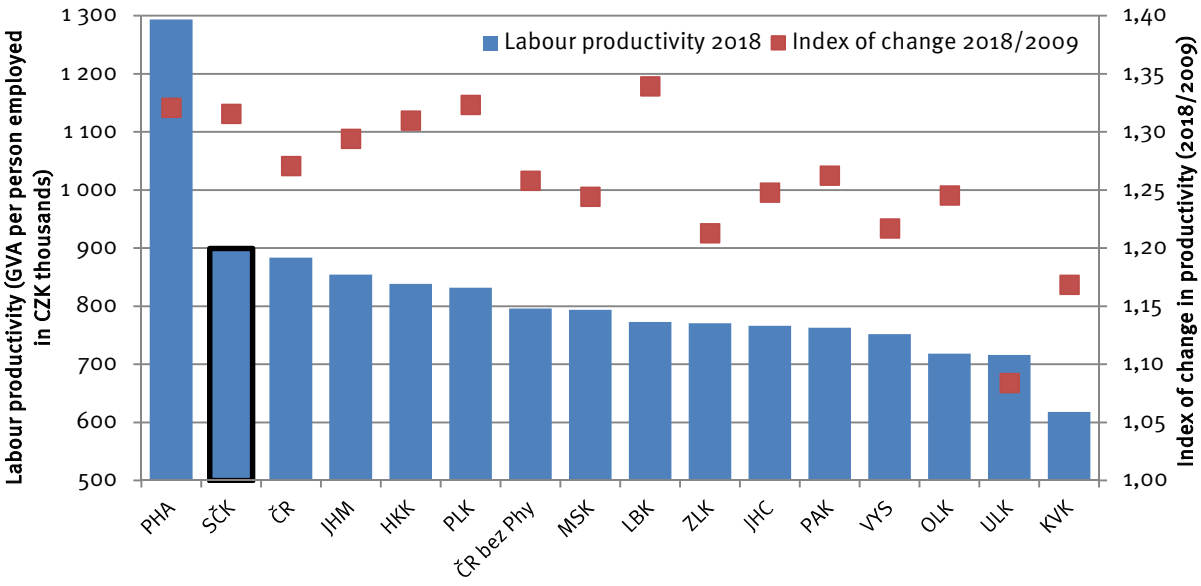
Data source: Czech Statistical Office – regional accounts

The Central Bohemian Region has long achieved above-average economic performance compared to other regions of the Czech Republic (excluding Prague). In the 2002-2008 period, when the Czech economy was growing at a very fast pace, it was one of the most economically developed regions, reporting an economic level 10-15 percentage points higher than the average in other Czech regions (excluding Prague). After 2009, there was a universal slowdown in economic growth. In the Central Bohemian Region, however, this slowdown was more pronounced and the region weakened compared to the economic performance of other regions. This was followed by only average economic growth in comparison with other regions. In the last three years, per capita GDP in the region has been about 7-10 percentage points higher than the average in other regions (excluding Prague).

In the South Moravian and Plzeň Regions, per capita GDP reached a higher level in the post-crisis period. This can be attributed to a smaller decline and faster growth, especially in 2012-14. In 2017, all three regions, including the Hradec Králové Region, were practically at the same level. In 2018, after a slowdown in previous years, only the South Moravian Region's growth momentum increased.

The Central Bohemian Region is therefore one of the most economically developed regions in the Czech Republic, with growth momentum in the last three years lagging behind only the Hradec Králové Region.

Graph 3: Labour productivity (GVA per person employed) in 2017 and index of change (2017/2009)

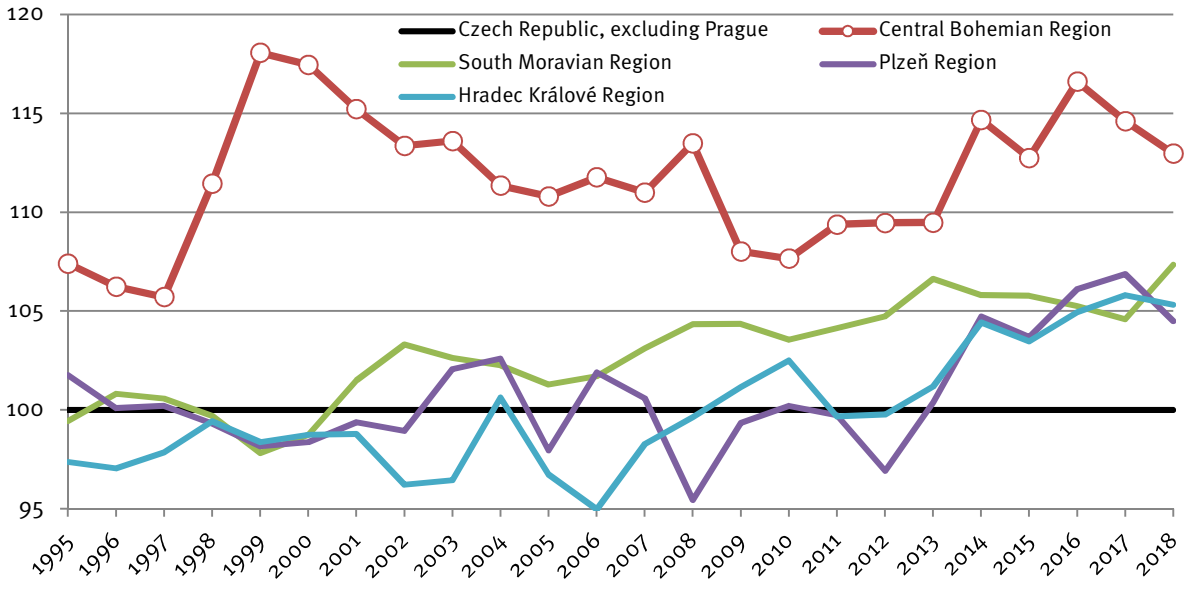


Data source: Czech Statistical Office – regional accounts

From a macroeconomic point of view, one of the key sources of economic growth is labour productivity, which expresses the economic efficiency of human labour. It is the main factor influencing economic performance (measured by the GDP indicator).

After Prague, which easily dominates the regional productivity ranking due to its metropolitan nature, the Central Bohemian Region is the region with the highest level of labour productivity in the Czech Republic, reporting a quite significant lead over other regions. The high labour productivity and its relatively fast momentum in the last 20 years have been the main reason for the region's rapid economic growth.

Graph 4: Productivity (GVA per person employed) in selected regions compared to the average of regions, excluding Prague (= 100), 1995–2018

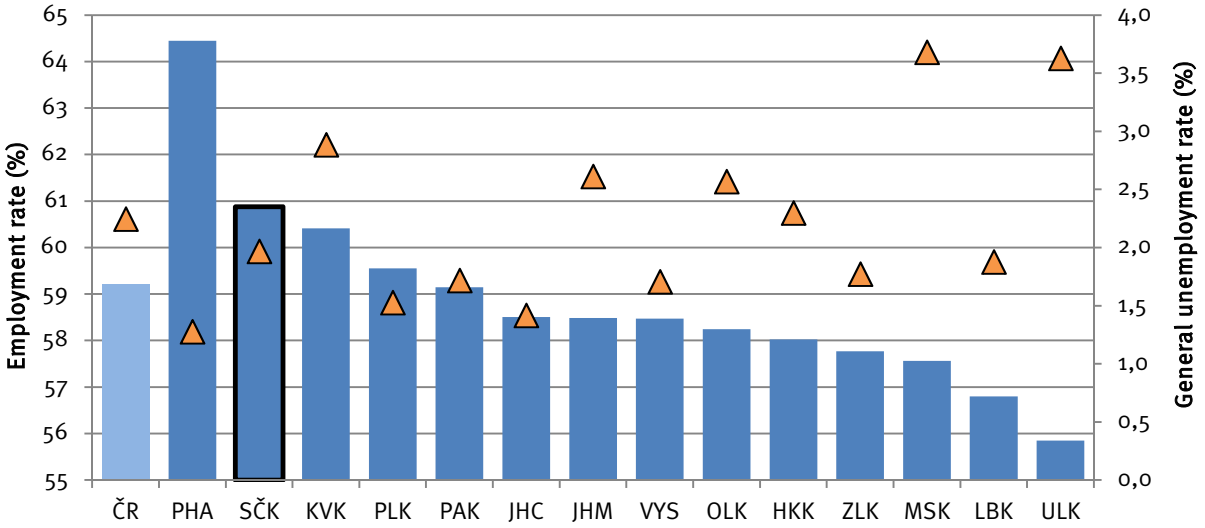


Data source: Czech Statistical Office – regional accounts

Labour productivity in the region, which has long been above average compared to other Czech regions, is one of the main sources of rapid economic growth. However, it has stagnated somewhat in the last 10 years compared to other regions of the Czech Republic (excluding Prague). This situation is quite plain after 2008. Nevertheless, it still reports 113% of the national average (excluding Prague).

The post-2008 slowdown in labour productivity growth is one of the main reasons for the region's slower economic growth in this period (compared to the South Moravian and Plzeň Regions). In the last five years (2014-8), labour productivity in the region has been growing at a faster pace, as also reflected in the increased GDP growth rate.

Graph 5: Employment rate (share of employed persons in the population aged 15+) and general unemployment rate, 2018



Data source: Czech Statistical Office – Public Database

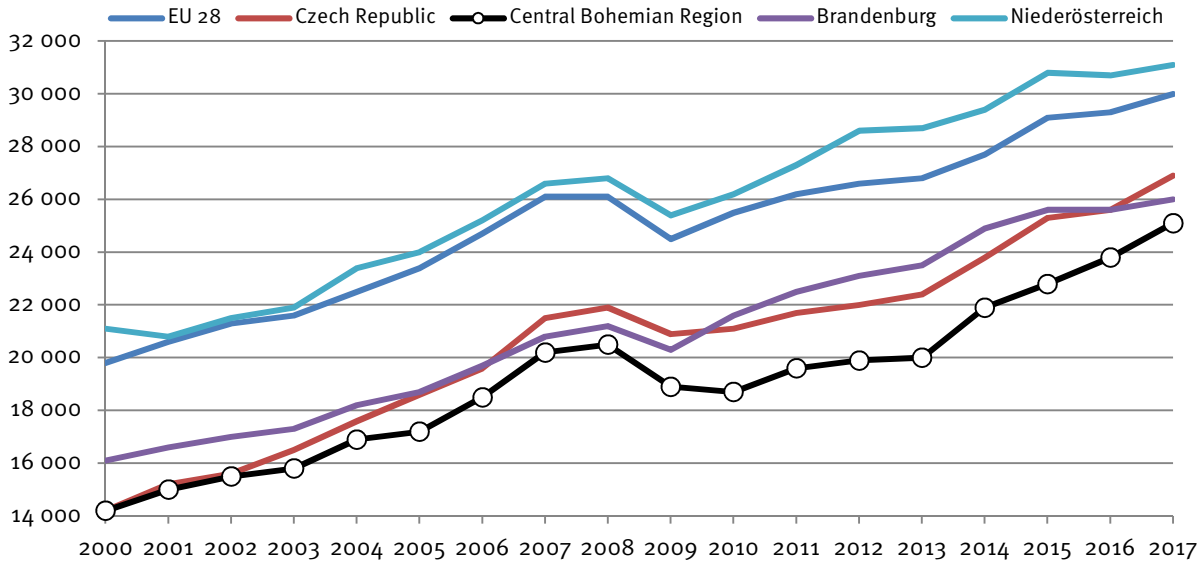
Another source of economic growth is the participation rate of the population in the creation of economic product, i.e. the level of employment. This rate is at its highest levels in the last 25 years in the region because, in this period, young families with children moved here on the back of Prague's suburbanisation. This is also reflected in the fact that the Central Bohemian Region reports very low unemployment (see the chapter on human resources).

The ever-increasing participation of the population in the economic product is almost exhausted as a source of economic growth. Therefore a factor crucial to economic development in the coming years will be how fast labour productivity increases. Innovation activities in the corporate sector and the development of activities with high value added can contribute to this.

1.1 Comparison of the Central Bohemian Region with the EU

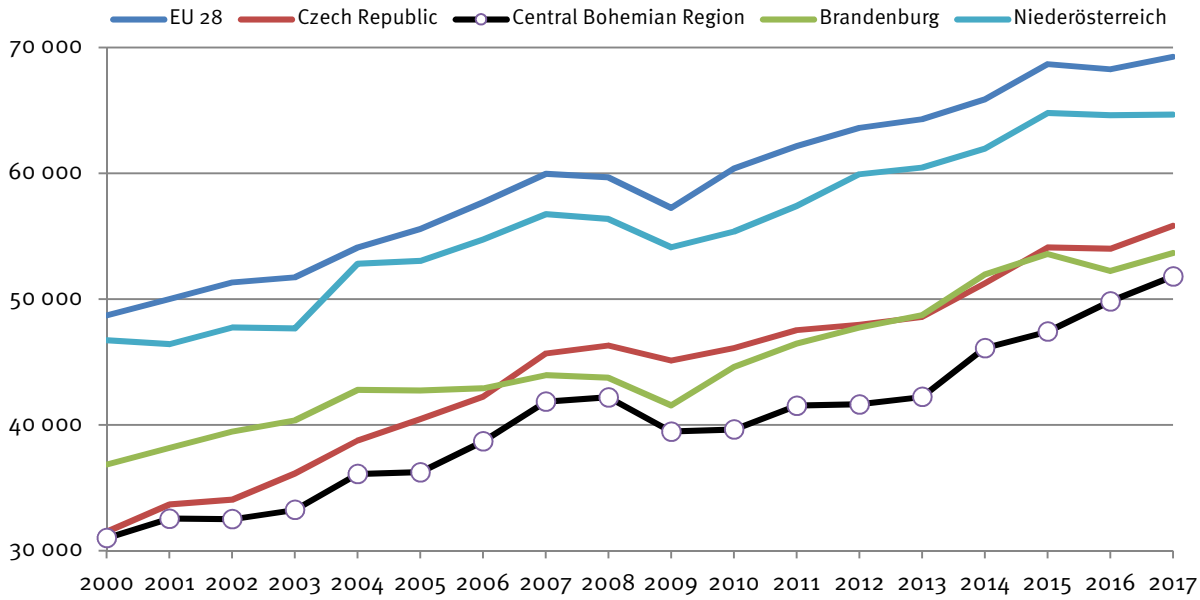
The comparison with the EU-28 average and selected European regions is made to show that the region, as well as the Czech Republic as a whole, has stopped converging with EU economic performance since 2009, as evidenced by the graph on per capita GDP in PPS (taking into account the different price levels in the countries compared).

Graph 6: GDP per capita in PPS, 2000–2017



Data source: Eurostat – Regional Statistics

Graph 7: Productivity (GDP in PPS per person employed) of the Central Bohemian Region and selected regions of the EU-28, 2000–2017



Data source: Eurostat – Regional Statistics

The interruption of convergence trends from the first decade of the 21st century, when the Central Bohemian Region and the whole of the Czech Republic approached the economic performance of the EU countries, can mainly be attributed to the stagnant level of productivity (see the graph above). This negative development after 2009 suggests that the model of economic growth[15] that had worked in the

[15] Based mainly on a combination of advantageous geographical location (close to the developed markets of Western Europe) and the relatively cheap (compared to traditional EU countries) and highly technically skilled workforce. This led to the economy's specialisation primarily in manufacturing, assembly and distribution activities with lower value added and took local companies further away from end customers and markets (lower down the value chains). The significant inflow of FDI also contributed to this.

last decade is gradually being depleted. This only confirms the need to focus more on developing high value-added activities and on innovations that will lead to a renewed increase in productivity growth and the restoration of convergence with regions in the EU's most developed countries.

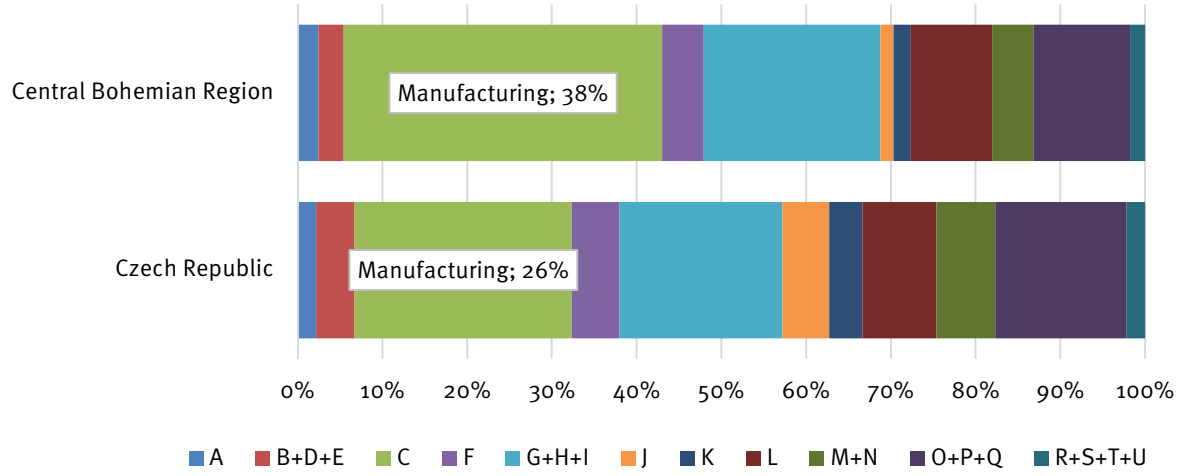
A comparison with the Brandenburg and Niederösterreich Regions, which are very similar in nature to the Central Bohemian Region,[16] shows that these two regions have been moving further ahead in economic performance and labour productivity in the last six years, even though the Central Bohemian Region was growing faster and converging with their level up to 2009.

2. Economic Structure and Specialisations

The following chapter aims to determine the regional economy's sectoral structure, key sectors, and main driving forces. It also draws attention to the internal breakdown and important specialisations in the main economic branches, i.e. to those product specialisations that are important to the Central Bohemian economy from a macroeconomic point of view. It also discusses the importance and nature of foreign investments in the region and how they have developed over time.

2.1 Internal Economic Structure

Graph 8: Structure of the economy by value added generated in NACE 1 sections in the region and the Czech Republic, 2018



Note: A – Agriculture, forestry and fishing; B+D+E – Mining and quarrying, Electricity, gas, steam and air conditioning supply; C – Manufacturing; F – Construction; G+H+I – Wholesale, retail, Transporting, Accommodation and food service activities; J – Information and communication; K – Financial and insurance activities; L – Real estate activities; M+N – Professional, scientific and technical activities, Administrative and support service activities; O+P+Q – Public administration and defence, Education, Human health and social work activities; R+S+T+U – Other activities

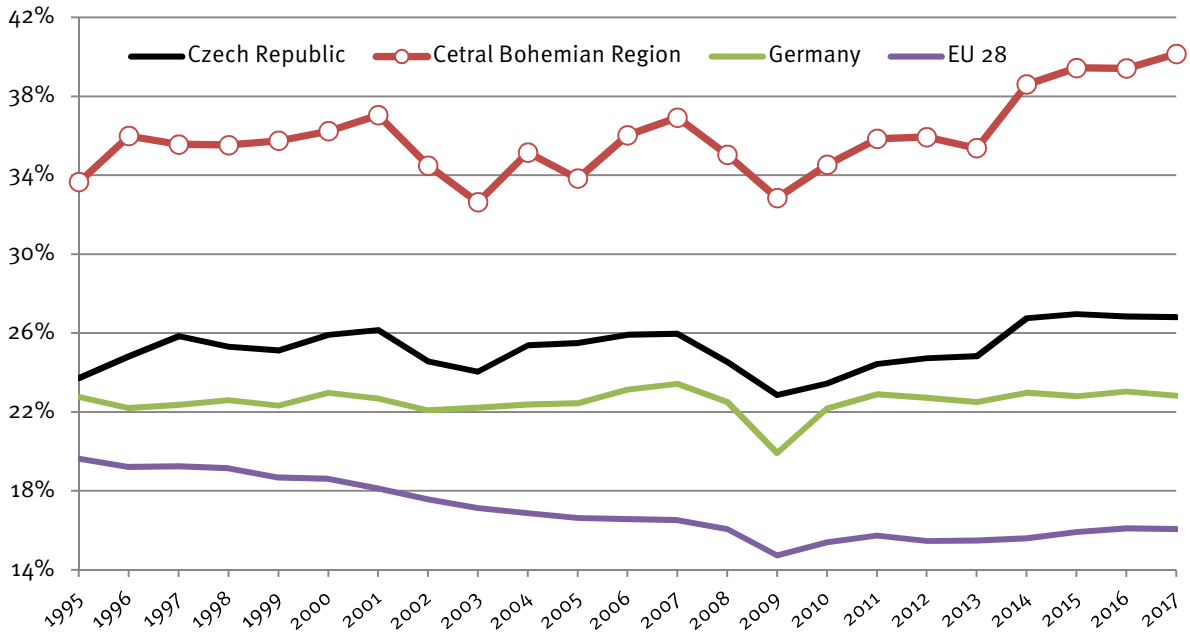
Data source: Czech Statistical Office – regional accounts

What mainly sets the Central Bohemian Region's economy apart is the **much higher share of the manufacturing industry in the structure of its economy**, accounting for 38% of the total gross value added (in the whole Czech Republic it is only 26%). This underlines the key specialisation of the regional economy, and in further analyses an emphasis will therefore be placed primarily on manufacturing.

This was one of the phases in the evolutionary development of the Czech economy that yielded a number of positive effects (rapid economic growth, involvement in the global economy, and the transfer of know-how, knowledge and capital to the Czech Republic). However, the sources of this development are gradually being depleted (Innovation Capacity Mapping 2014+, Technology Agency).

[16] They are also regions in the hinterland of the capital of their countries and are strongly linked to the metropolis by functional (and not only) economic ties.

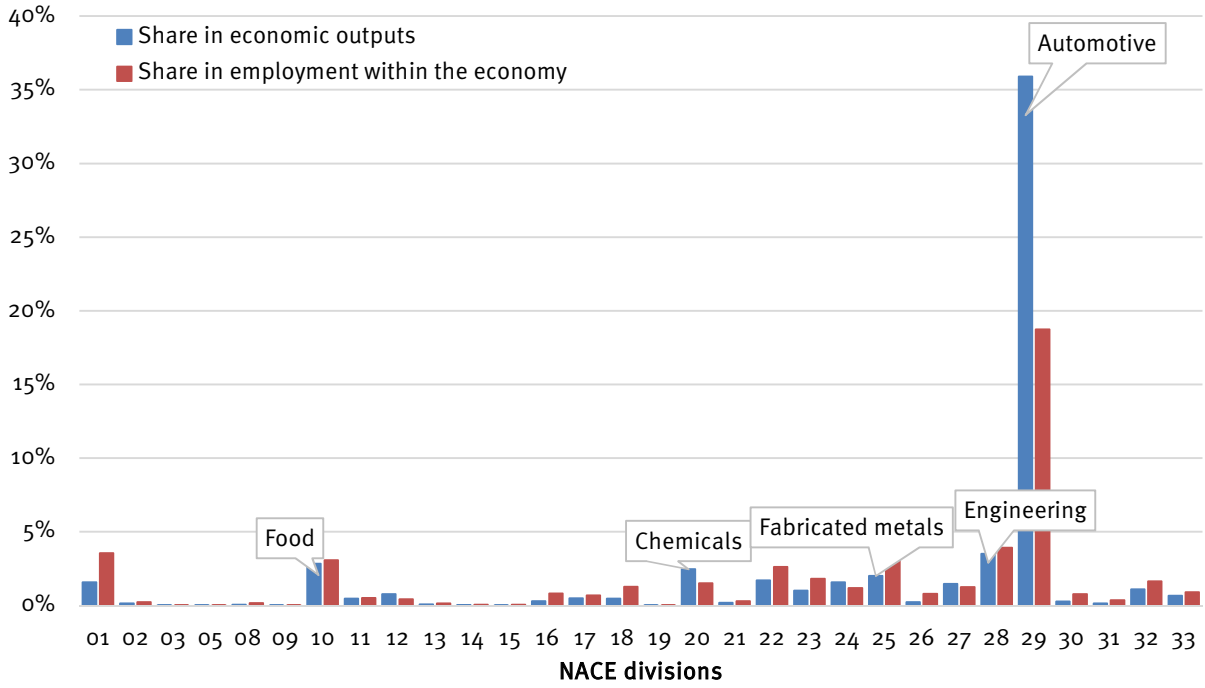
Graph 9: Share of manufacturing in the generation of GVA, 1995–2017



Data source: Czech Statistical Office – regional accounts, Eurostat – Regional Statistics

On the other hand, the regional economy reports a **lower share of activities in ICT** (only 1.5% of the total GVA generated, compared to 5.5% for the Czech Republic as whole), **finance and insurance** (2%, compared to 4% for the Czech Republic), and **public services**. These are economic activities that are naturally concentrated in the largest centres of population, which in the Central Bohemian Region's case means Prague, or, as in the case of ICT, they are dynamically developing activities which do not yet have a major presence in the economy.

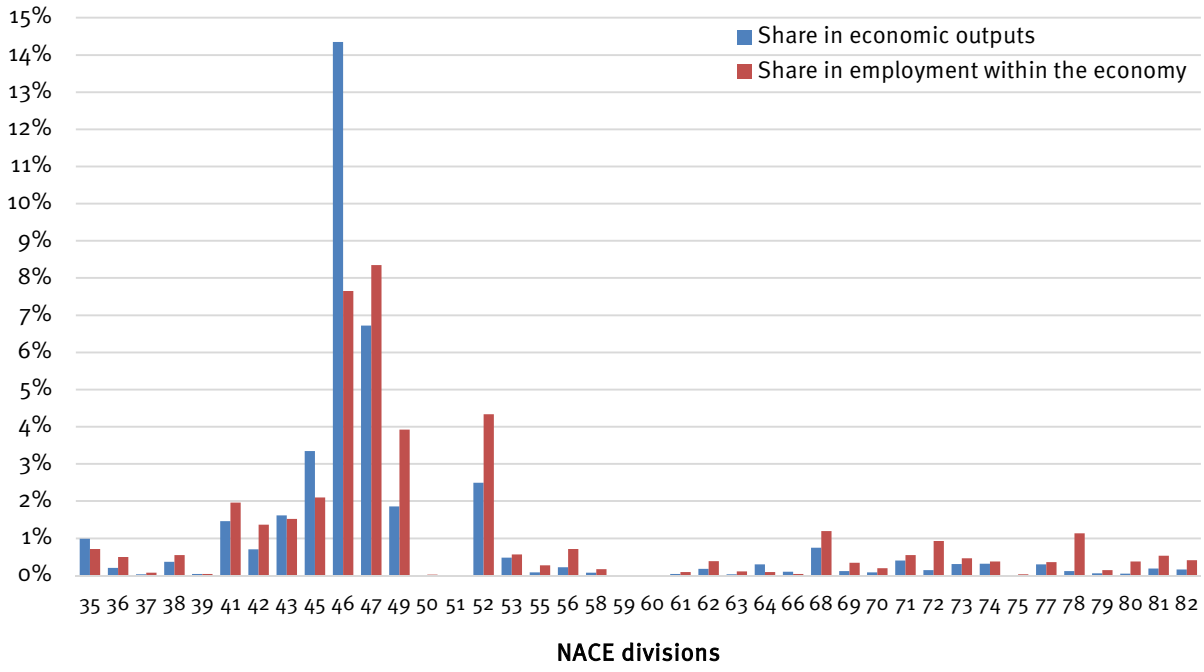
Graph 10: Output and employment at companies in the Central Bohemian Region according to NACE divisions 01-33, 2019



Data source: Bisnode MagnusWeb, 25 September 2019

In agriculture and manufacturing, there is an evident specialisation in the automotive industry – NACE 29 (accounting for almost 36% of all outputs of business entities in the region's economy). This is followed at some distance by agricultural primary production (NACE 01) and related food manufacture (NACE 10), which account for 4.9% of economic output, then by mechanical engineering (NACE 28, with a 3.5% share of output), the chemical industry (NACE 20, a 2.5% share), the fabricated-metal industry (25, a 2.0% share), the electrical equipment and electronics industry (NACE 27 and 26, with a 1.7% share), and plastics and rubber manufacture (NACE 22, a 1.7% share).

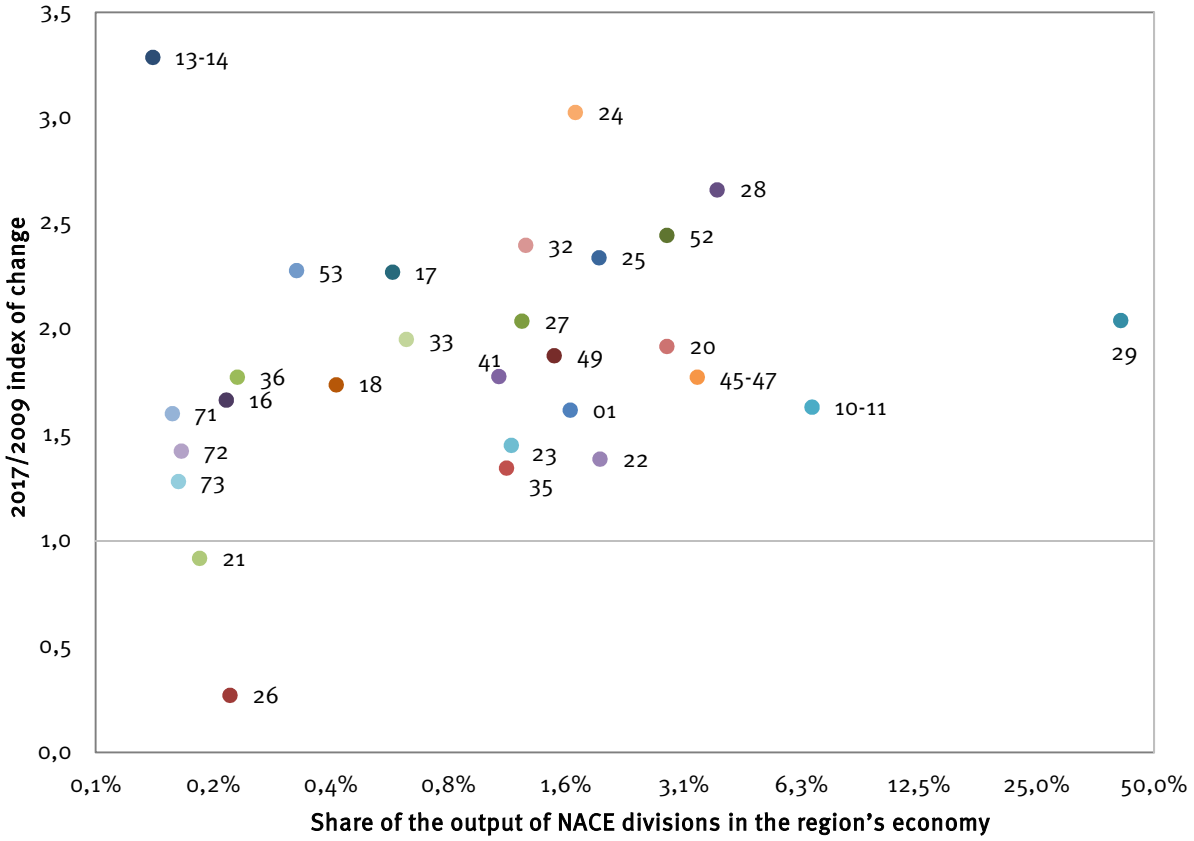
Graph 11: Output and employment at companies in the Central Bohemian Region according to NACE divisions 35-82, 2019



Data source: Bisnode MagnusWeb, 25 September 2019

In the commercial services sector, the region's economy is most specialised in the branches of the wholesale and retail trade (NACE 45, 46, 47), construction (NACE 41, 42, 43), and transport and storage (NACE 49 and 52). Other service sectors are not significantly represented in the regional economy.

Graph 12: Output of selected NACE divisions and their share in the region's economy, 2009–2017



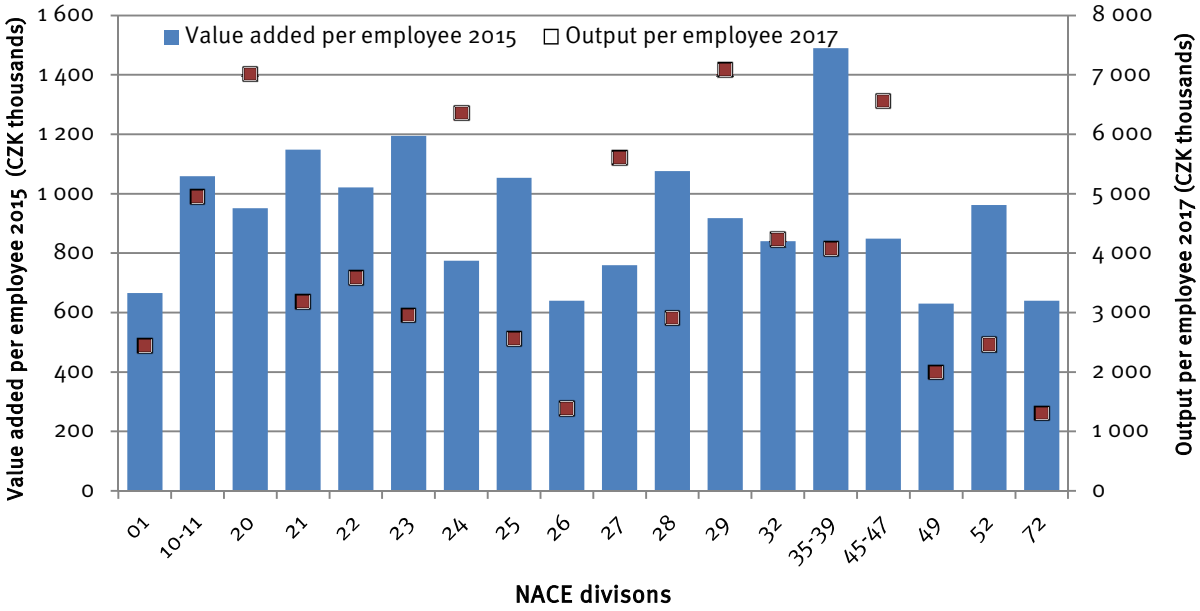
Note: A logarithmic scale is used on the x-axis due to the extreme value of the manufacture of transport equipment.

Explanatory notes: NACE: 01: Agriculture; 10-11: Food and beverages; 13-14: Textiles and wearing apparel; 16: Woodworking industry; 17: Paper industry; 18: Printing; 20: Chemicals; 21: Pharmacy; 22: Rubber and plastics; 23: Glass, ceramics, porcelain and building materials; 24: Metal production, metallurgy; 25: Fabricated metal products; 26: Electronics; 27: Electrical engineering; 28: Mechanical engineering; 29: Motor vehicles; 31: Furniture; 32: Other manufacturing; 33: Repair of machinery; 35: Generation and supply of electricity, gas, heat; 36: Water treatment and supply; 41: Building construction; 45-47: Wholesale and retail trade; 49: Land transport and transport via pipelines; 52: Warehousing and support activities for transportation; 53: Postal and courier activities; 71: Architectural and engineering activities; technical testing and analysis; 72: Research and development; 73: Advertising and market research.

Data source: Bisnode MagnusWeb (data for 9,600 legal entities, 25 September 2019).

From the point of view of development momentum, the fastest growing branch in the regional economy (measured on the basis of approximately 10,000 legal entities) is NACE 30 Manufacture of other transport equipment, which has recorded more than a nine-fold increase in output in the last eight years (and is therefore not shown in the chart). Even so, its significance in the Central Bohemian economy is still low (0.3%), much like the second most dynamically developing branch, Manufacture of textiles and wearing apparel, with a more than threefold increase in output and a 0.1% share of the economy. Other dynamically developing branches of significance in the economy include the manufacture and processing of metals, mechanical engineering, logistics and other manufacturing industries (especially the manufacture of toys). The output of the main branch of the regional economy, car manufacture, doubled in the 2009-2017 reporting period. Conversely, a decline in output was recorded in this period by certain branches, especially the manufacture of computers and electronic devices and, rather less so, pharmacy.

Graph 13: Labour productivity (value added per employee, 2015) and output per employee, 2017, by key NACE divisions



Explanatory notes: NACE: 01: Agriculture; 10-11: Food and beverages; 20: Chemicals; 21: Pharmacy; 22: Rubber and plastics; 23: Glass, ceramics, porcelain and building materials; 24: Metal production, metallurgy; 25: Fabricated metal products; 26: Electronics; 27: Electrical engineering; 28: Mechanical engineering; 29: Motor vehicles; 32: Other manufacturing; 35-39: Energy generation and supply, water supply, waste management activities; 45-47: Wholesale and retail trade; 49: Land transport and transport via pipelines; 52: Warehousing and support activities for transportation; 72: Research and development.

Data source: Bisnode MagnusWeb (data for 6,666 legal entities, 25 September 2019)

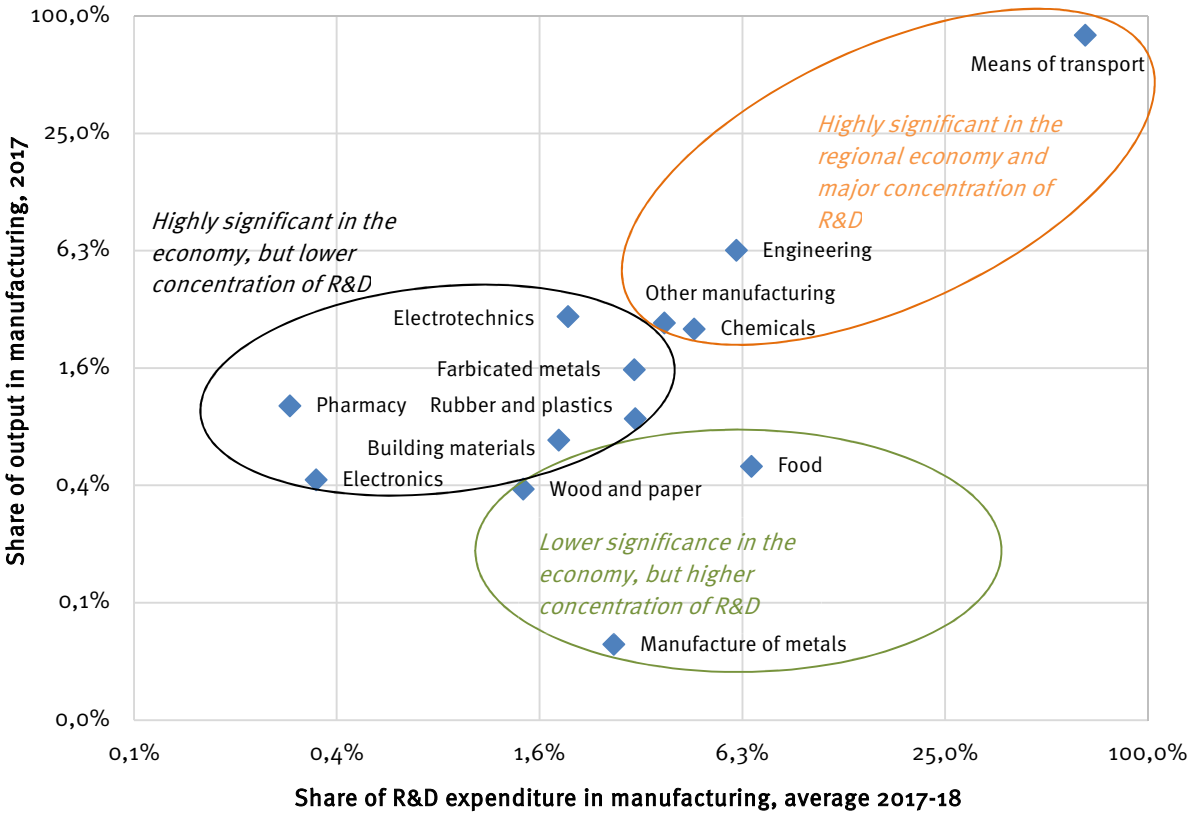
A comparison of labour productivity across economic branches is highly problematic as each branch inherently has a different level of productivity due to the different demands on human labour. A comparison with the indicators of value added per employee and output per employee within individual branches is more interesting as it shows how sophisticated activities are implemented in a particular branch in the region, and/or how much of the value added from the total output is generated by local companies. Of the industrial branches, it can be concluded from the available data that a higher share of more knowledge-intensive activities (or a higher share of value added per employee than output per employee) exists, for example, in the pharmacy, metalworking, plastics or engineering industries. The opposite is true, for example, of the automotive industry and other manufacturing, where, according to macroeconomic data, standard activities with less value added predominate (although even in these branches there are companies whose activities focus on end products, where the share of value added is higher).

The significance of individual sectors to the regional innovation system is an important input when determining the key specialisations of the regional RIS3 Strategy. The above graph depicts the share of individual industries in the total output of the manufacturing industry. This shows the importance of branches in the Central Bohemian economy. This indicator is combined with the indicator of the knowledge intensity of a sector, i.e. the share of the sector in the total expenditure on R&D in the manufacturing industry. By far the most important sector in terms of both knowledge intensity and output in the economy is the manufacture of transport equipment (NACE 29+30), followed by mechanical engineering (NACE 28) and the chemical industry (NACE 19+20).

In terms of significance in the economy, other branches are also important, e.g. electrical engineering (NACE 27), fabricated metal products (NACE 25), manufacture of plastic products (NACE 22), pharmacy (NACE 21) and other sectors.

These are followed by the food industry (NACE 10-12), metal production (24) and the wood and paper industry (NACE 16-17, 31), which are rather less important in terms of economic output, but concentrate significant R&D expenditure.

Graph 14: Branches of manufacturing by share in output and expenditure on R&D, 2017–2018



Note: A logarithmic scale is used in the graph due to the extreme values of the vehicle industry. Modified NACE names: Food (NACE 10-12), Wood and paper (16-17, 31), Chemicals (19-20), Pharmacy (21), Rubber and plastics (22), Building materials (23), Manufacture of metals (24), Fabricated metal products (25), Electronics (26), Electrical engineering (27), Mechanical engineering (28), Means of transport (29+30), Other manufacturing (13-15, 18, 32-33).

Data source: Czech Statistical Office – Annual R&D Survey, Bisnode MagnusWeb

However, the individual divisions at NACE 2 level are still very diverse internally, and economic output or even knowledge intensity may be concentrated only in certain segments of a particular branch or even within just a handful of companies. Therefore, in the next chapter, the Central Bohemian economy's key domains of specialisation are analysed in more internal detail. These analyses, on the basis of aggregate data, will be supplemented by field surveys at companies. This will help to provide a comprehensive grasp of the nature of the various branches.

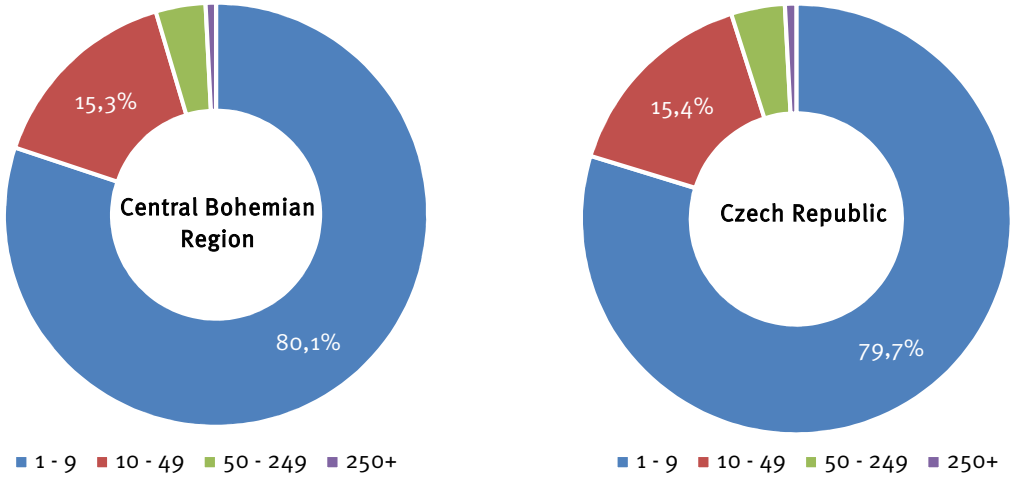
Analyses conducted so far in order to formulate the first version of the Central Bohemia RIS3 (in 2013) and its update during 2017 have identified the following **priority sectors of the Central Bohemian economy, which are "vertical domains of specialisation" in the structure of the RIS3 Strategy**:

- **Manufacture of transport equipment** – NACE 29+30;
- **Electrical engineering and electronics** – NACE 26+27;
- **Chemical industry** – NACE 20;
- **Mechanical engineering and metal processing** – NACE 28+25;
- **Food industry** – NACE 10+11;
- Knowledge gained so far in the field indicates that **biotechnology and life sciences** can be included among promising specialisations. This is an area that is difficult to define statistically,

but there are a number of fast-growing and strong companies + an overlap with the research base. Defined statistically, the categories of NACE 21 and NACE 32.5 are closest to this branch.

2.2 Organisational Statistics

Graph 15: Size structure of companies by number of employees (micro 1-9; small 10-49; medium-sized 50-249; large 250+) in the region and the Czech Republic, 2018

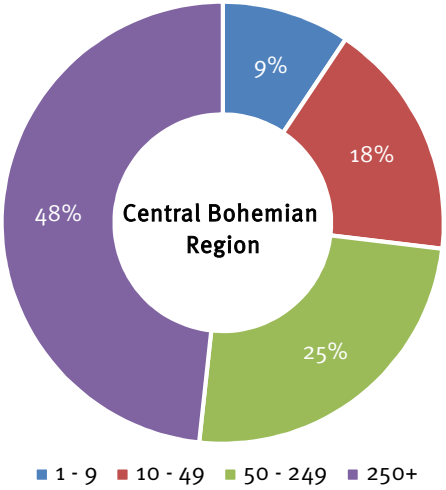


Note: The graphs show the structure for 28,000 companies in the region and 285,000 companies in the Czech Republic. The number of employees is unknown at a further 31,000 entities in the Central Bohemian Region and 314,000 in the Czech Republic. At 125,000 and 904,000 entities, respectively, there are no employees.

Data source: Czech Statistical Office – organisational statistics

The structure of the economy from the point of view of the share of companies, broken down by size category, in the region does not show any significant deviations from the national average. The largest share consists of small companies (up to 49 employees), most of which are micro-companies (1-9 employees).

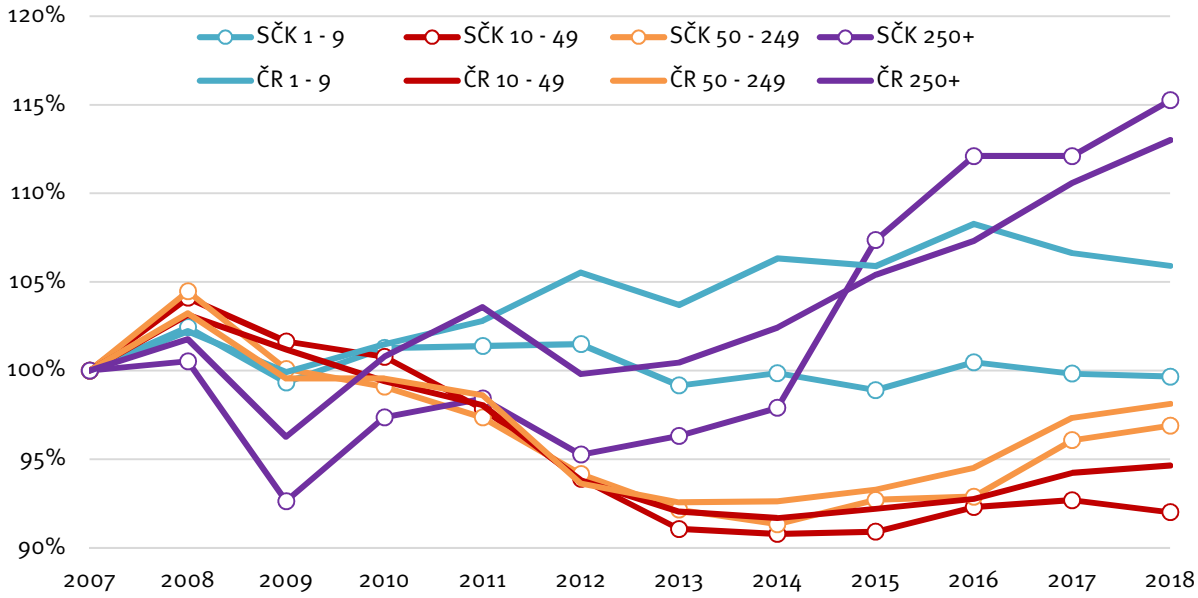
Graph 16: Employment, by size category of companies in the Central Bohemian Region, 2018



Data source: Bisnode MagnusWeb (data for 23,400 legal entities, 25 September 2019)

Monitoring the importance to the economy from the perspective of employment, large companies in the Central Bohemian Region account for almost half of all jobs (specifically more than 138,000 jobs), with another quarter contributed by medium-sized companies (71,000). In other words, medium-sized and larger companies are very important for the overall performance of the region's economy.

Graph 17: Companies categorised by number of employees (micro 1-9; small 10-49; medium-sized 50-249; large 250+) in the Central Bohemia region and the Czech Republic, 2007-2018 (2007 = 100%)



Data source: Czech Statistical Office – organisational statistics

In general, the number of small and medium-sized companies has evidently decreased or stagnated in the Czech Republic and in the Central Bohemian Region in recent years. On the other hand, the number of micro-companies (up to 9 employees) grew throughout the Czech Republic in 2009-2016, which would indicate growing business activity. By contrast, the number of the smallest companies with up to 10 employees in the region has been stagnant for a long time, indicating that business activity is not growing. Conversely, after 2014 the number of large companies with more than 250 employees grew quite significantly in the region.

Graph 18: Employment measured according to the size categories of companies in individual key branches in the Central Bohemian Region, 2018

Data source: Bisnode MagnusWeb, 25 September 2019

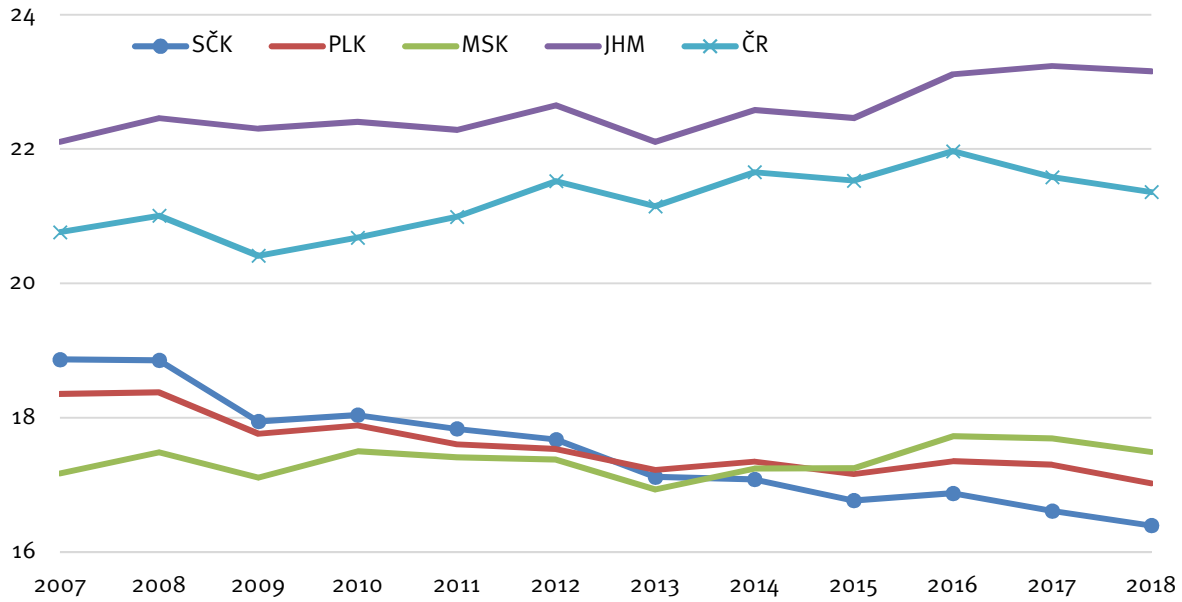
The graphs above clearly show the difference in character between the key sectors of the economy in the Central Bohemian Region – some of them are dominated by large companies, which make up the majority

of jobs. This is mostly the case for the automotive industry, but also, to a lesser extent, for the chemical industry and for biotechnology and life sciences. On the contrary, in branches such as mechanical engineering, electronics and electrical engineering, and the food industry, small and medium-sized companies are more represented, many of which are reporting very good results and are growing rapidly.

Even in comparison with other regions, the situation surrounding small companies which have up to 10 employees and are in the early stages of their business is quite negative. Their numbers in the Central Bohemian Region have been declining for a long time and lag behind the South Moravian Region and the average for the Czech Republic as a whole (some of this can be put down to the proximity of Prague). In general, entrepreneurship and the establishment of new companies in the Central Bohemian Region are not particularly dynamic.

Entrepreneurship is generally a vital aspect of a well-functioning regional innovation ecosystem, as it is entrepreneurs who bring innovation to the market and to customers. The rate at which new companies are established and the number of companies who are in the early stages of development in the region are stagnating. This is hardly an ideal situation.

Graph 19: Number of micro-enterprises (1-9 employees) per 1,000 inhabitants in selected regions, 2007–2018



Note: Micro-companies are growing most dynamically in Prague (from 36.1 in 2007 to 46.1 in 2018) and because their share in the Czech Republic (in absolute terms) is more than 26% (versus the 9.8% of the Central Bohemian Region), they are driving the growth of the Czech Republic as a whole.

Data source: Czech Statistical Office – organisational statistics

2.3 Internal Specialisation of Key Branches

As these branches are defined relatively broadly, they are further divided into partial internal specialisations in order to identify the key and most important product areas in terms of economic performance and employment in the sector.

Table 1: Internal categorisation of the specialisation domain of Transport Equipment, 2019

Product areas	NACE groups	Number of companies	Companies with output of more than CZK 100 million	Employment		Sales/output (CZK)	
				absolute	share (%)	CZK millions	share (%)
Motor vehicles and engines	**29.1**	**14**	**4**	**36,249**	**62%**	**463,695**	**77%**
Modules and parts for motor vehicles	**29.2, 29.3**	**84**	**49**	**17,814**	**31%**	**112,438**	**19%**
Aircraft and parts thereof	30.3	11	2	1,939	3%	3,995	1%
Motorcycles and bicycles	30.9	20	1	278	0%	321	0%
Other		8	0	90	0%	112	0%
Transport Equipment, total		**137**	**56**	**58,037**	**100%**	**602,084**	**100%**

Data source: Bisnode MagnusWeb, 25 September 2019

The Transport Equipment domain is characterised by a strong specialisation in motor vehicles, both in the manufacture of passenger cars (Škoda Auto, TPCA) and in subcontracting for the automotive industry (there are 49 companies in the region with annual output of more than CZK 100 million). Therefore, a significant part of the entire automotive value chain is represented in the regional economy. The whole branch is by no means completely dominated by Škoda Auto and TPCA, as subcontractors (Eberspächer, SAS Automotive, VALEO, Faurecia, ZF, MAHLE Behr, KOSTAL, MITSUBISHI) are also very well connected to other global car manufacturers abroad. There are a number of Tier 1 suppliers[17] in the region that supply complete modules to final car manufacturers and often cooperate with them on development. Their numbers are increasing over time. Some of them started in the region as production branches and, over time, opened design, testing or even development departments here, or set them up in Prague. This establishes good prospects for the future, as new technologies (autonomous mobility, electromobility, etc.) are expected to emerge throughout the industry. This could bring about sweeping changes in established business models. Aero Vodochody is a major player in the aviation industry.

Table 2: Internal categorisation of the specialisation domain of Electronics and Electrical Engineering, 2019

Product areas	NACE groups	Number of companies	Companies with output of more than CZK 100 million	Employment		Sales/output (CZK)	
				absolute	share (%)	CZK millions	share (%)
Batteries, cables, wires	**27.2, 27.3**	**6**	**3**	**653**	**11%**	**9,388**	**41%**
Electric motors, generators	**27.1**	**85**	**5**	**1,526**	**25%**	**5,158**	**23%**
Domestic electrical appliances	27.5	29	3	568	9%	2,144	9%
Computers and other consumer electronics	26.2, 26.3, 26.4	44	1	1,259	21%	1,874	8%
Electronic components and boards	26.1	72	2	482	8%	1,093	5%
Measuring, testing and precision instruments	26.5	27	2	625	10%	663	3%
Optical instruments and devices	26.7, 26.8	9	0	4	0%	11	0%
Other		159	5	993	16%	2,351	10%
Electronics and Electrical Engineering, total		**431**	**21**	**6,110**	**100%**	**22,683**	**100%**

Data source: Bisnode MagnusWeb, 25 September 2019

In the Electronics and Electrical Engineering domain, the most important specialisation is the manufacture of batteries and cables, as there are several major companies in the region (nkt cables, IBG) whose

[17] Suppliers who supply a complete module or a whole part of the final product directly to the final manufacturer (e.g. a dashboard or a brake system to car manufacturers).

supplies are strongly linked to the automotive industry. Other important specialisations in this domain in the region are electrical machinery – motors, generators, substations (ASMO, SENCO, SOPO) – and the manufacture of domestic electrical appliances (Dražice), computers and electronic components (Foxconn, Connectronics).

Table 3: Internal categorisation of the specialisation domain of the Chemistry Industry, 2019

Product areas	NACE groups	Number of companies	Companies with output of more than CZK 100 million	Employment		Sales/output (CZK)	
				absolute	share (%)	CZK millions	share (%)
Manufacture of chemicals in primary forms	20.1	31	13	2,704	62%	35,239	86%
Cleaning and cosmetic products	20.4	24	5	929	21%	3,117	8%
Other		43	6	710	16%	2,578	6%
Chemical Industry, total		**98**	**24**	**4,343**	**100%**	**40,934**	**100%**

Data source: Bisnode MagnusWeb, 25 September 2019

The key specialisation of the chemical industry in the region is the manufacture of primary chemicals, especially the manufacture of basic inorganic (Lučební závody Draslovka) and organic chemicals (Butadiene, Ethanol Energy) and plastics/rubber in primary forms (Spolana, Synthos, proseat), which are then used as raw materials in other industries. The focus of the chemical industry in the region, especially at large companies active in it, is on heavy chemicals and basic raw materials manufactured in large volumes and, on the whole, with lower value added.

Table 4: Internal categorisation of the specialisation domain of Mechanical Engineering, Fabricated Metal Products 2019

Product areas	NACE groups	Number of companies	Companies with output of more than CZK 100 million	Employment		Sales/output (CZK)	
				absolute	share (%)	CZK millions	share (%)
Machinery for construction and mining	**28.92**	**10**	**3**	**1,354**	**6%**	**24,762**	**27%**
Cooling and ventilation equipment	**28.25**	**52**	**14**	**3,530**	**16%**	**15,446**	**17%**
Surface treatment, forging, pressing	25.5, 25.6	286	13	2,685	12%	8,103	9%
Structural metal products	25.1	183	18	2,903	13%	6,722	7%
Weapons and ammunition	25.4	7	1	1,600	7%	4,524	5%
Machine tools	28.41	10	6	1,185	5%	4,314	5%
Hydraulic equipment	28.22	38	8	1,422	6%	3,250	4%
Tools, cutlery	25.7	266	9	1,521	7%	3,418	4%
Other machinery and equipment		95	17	2,507	11%	11,172	12%
Other fabricated metal products		195	23	3,890	17%	10,615	11%
Mechanical Engineering and Fabricated Metal Products, total		**1,142**	**112**	**22,597**	**100%**	**92,326**	**100%**

Data source: Bisnode MagnusWeb, 25 September 2019

Mechanical engineering and the fabricated metal industry are an internally highly heterogeneous sector. This sector's main specialisations in the region include the manufacture of machinery for mining, quarrying and construction (Doosan Bobcat EMEA), the manufacture of cooling and ventilation equipment (Carrier), which is partly (VALEO) linked to manufacture in the automotive industry, surface

treatment/forging/pressing, and the manufacture of structural metal products that are used mainly in construction, but also in other industries.

Table 5: Internal categorisation of the specialisation domain of the Food Industry, 2019

Product areas	NACE groups	Number of companies	Companies with output of more than CZK 100 million	Employment		Sales/output (CZK)	
				absolute	share (%)	CZK millions	share (%)
Meat industry	**10.1**	**87**	**14**	**1,832**	**18%**	**10,183**	**19%**
Pastries, mill products	**10.6, 10.7**	**169**	**11**	**2,527**	**25%**	**9,408**	**17%**
Industrial feed	**10.9**	**32**	**5**	**751**	**7%**	**8,991**	**17%**
Sugar, confectionery	10.81, 10.82	7	3	1,084	11%	7,473	14%
Dairy products	10.5	14	5	957	9%	5,131	9%
Beer	11.05	36	3	913	9%	3,941	7%
Soft drinks	11.07	17	4	468	5%	2,539	5%
Other		151	11	1,576	16%	6,711	12%
Food Industry, total		**513**	**56**	**10,108**	**100%**	**54,376**	**100%**

Data source: Bisnode MagnusWeb, 25 September 2019

The food and beverages industry is one of the regional economy's strong areas of specialisation and the second most important branch after the automotive industry. These are entities that specialise in the manufacture and sale of final products, especially perishables – primarily the meat industry (LE& CO, RABBIT), and the manufacture of bakers' wares and confectionery (La Lorraine).[18] By their very nature, they have limited territorial reach and predominantly focus on regional markets. Another reason may be the proximity of the strong market in the City of Prague. The third most important specialisation is the production of industrial feed for livestock (Primagra) and pet food (VAFO). In general, the specialisation in final products can be viewed in a positive light, as they deliver the highest share of value added and contact with customers in the market, which gives companies greater leeway for innovation.

Table 6: Internal categorisation of the specialisation domain of Biotechnology/Life Sciences, 2019

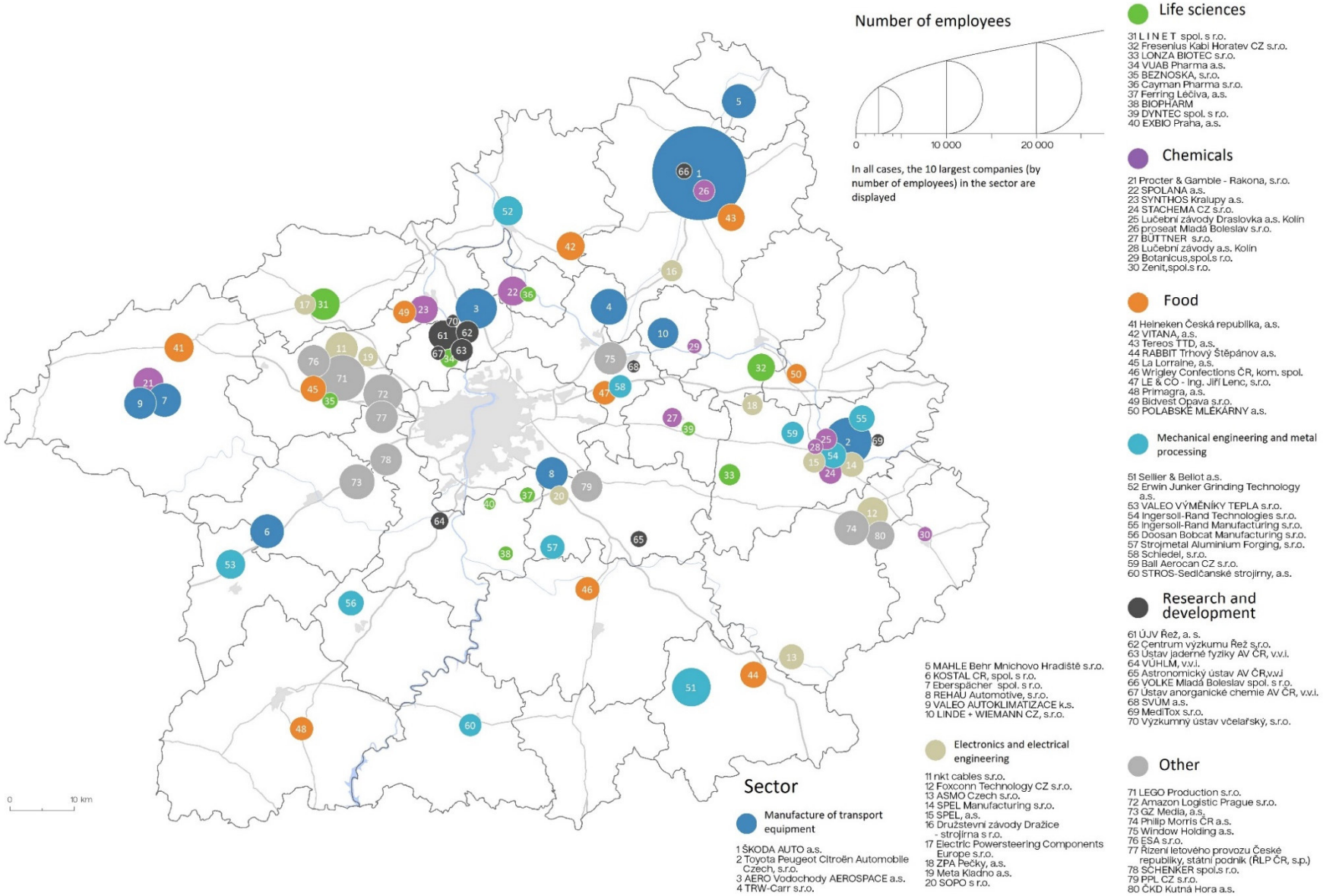
Product areas	NACE groups	Number of companies	Companies with output of more than CZK 100 million	Employment		Sales/output (CZK)	
				absolute	share (%)	CZK millions	share (%)
Pharmaceutical products	21.1, 21.2	17	6	866	34%	2,727	37%
Medical instruments	32.5	47	3	1,683	66%	4,621	63%
Total		**64**	**9**	**2,549**	**100%**	**7,348**	**100%**

Data source: Bisnode MagnusWeb, 25 September 2019

Life sciences are a branch that has so far been of minor importance in the Central Bohemian economy. However, a number of fast-growing companies operate in this field in the region. This branch is also important in that it has a background in research capacities, with a number of new public research infrastructures in the region focused on this area (the National Institute of Mental Health, BIOCEV, the University Centre for Energy-Efficient Buildings, and others).

[18] See the conclusions from the document Statistical Analysis of the Food Cluster in the Central Bohemian Region, 2017, Central Bohemian Innovation Centre

Figure 1: Largest companies in selected key branches of the Central Bohemian Economy, 2017

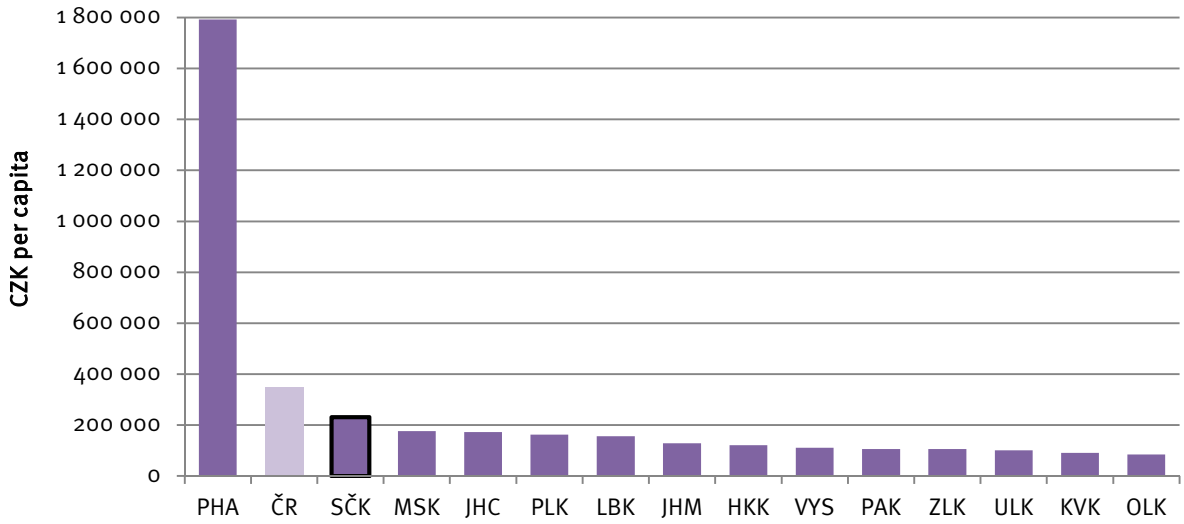


Data source: Magnusweb, 1 February 2018

2.4 Internationalisation of the Economy – Foreign Direct Investment

The growth of the Czech economy in the last 15 years has been driven strongly by the inflow of foreign investment (FDI), which has capitalised on a combination of several factors[19] and was the main source of growth in competitiveness, mainly due to improved cost-effectiveness. Foreign-controlled companies have contributed directly and indirectly (via their control over domestic companies) to the introduction of modern technologies and new management methods, and have facilitated links between the Czech economy and the global economy (see, for example, the conclusions of the Innovation Capacity Mapping – INKA project). The situation in the Central Bohemian Region is very similar, with FDI also playing an important role in this regional economy (as shown in the graph below).

Graph 20: FDI per capita in the regions of the Czech Republic in 2018

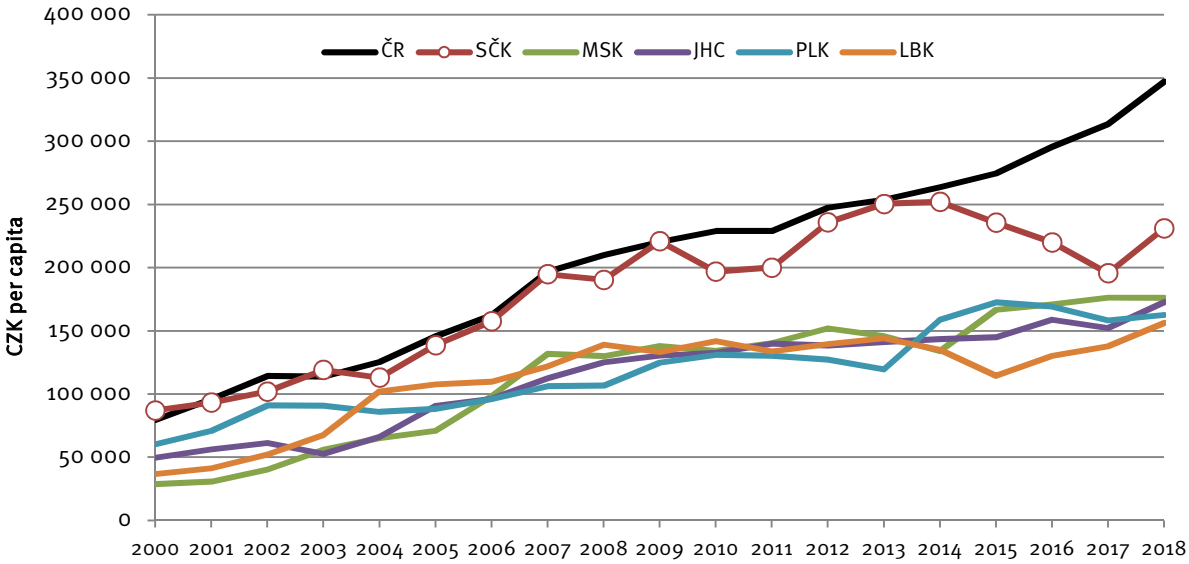


Data source: CNB – FDI Statistics

Compared with other regions, the Central Bohemian Region reports the second highest relative intensity of FDI in the economy, right after Prague, although the capital enjoys a specific status that sets it apart from the rest.[20] As the next graph shows, the region has long been high attractive for FDI. Throughout the reporting period it is the region into which the highest volume of foreign investment has been channelled.

[19] The significant price differential between the Czech Republic and countries west of its borders, the relatively good availability of technically skilled labour, a geographical location close to rich EU markets, and entry into the single European market.
[20] A metropolitan area; the administrative seat of many foreign companies that physically also operate outside Prague.

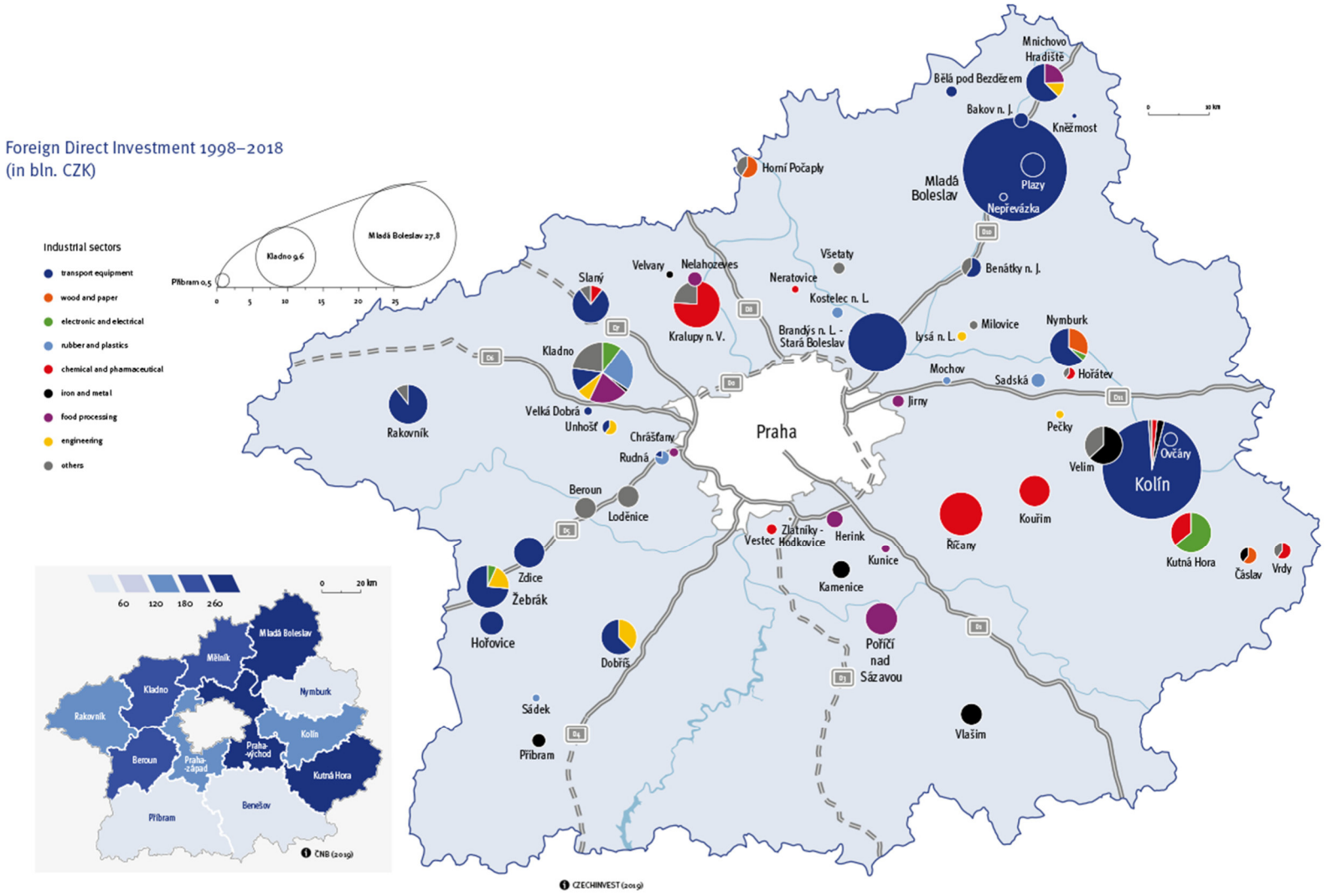
Graph 21: Foreign Direct Investment per capita in the regions of the Czech Republic, 2000–2018



Data source: CNB – FDI Statistics

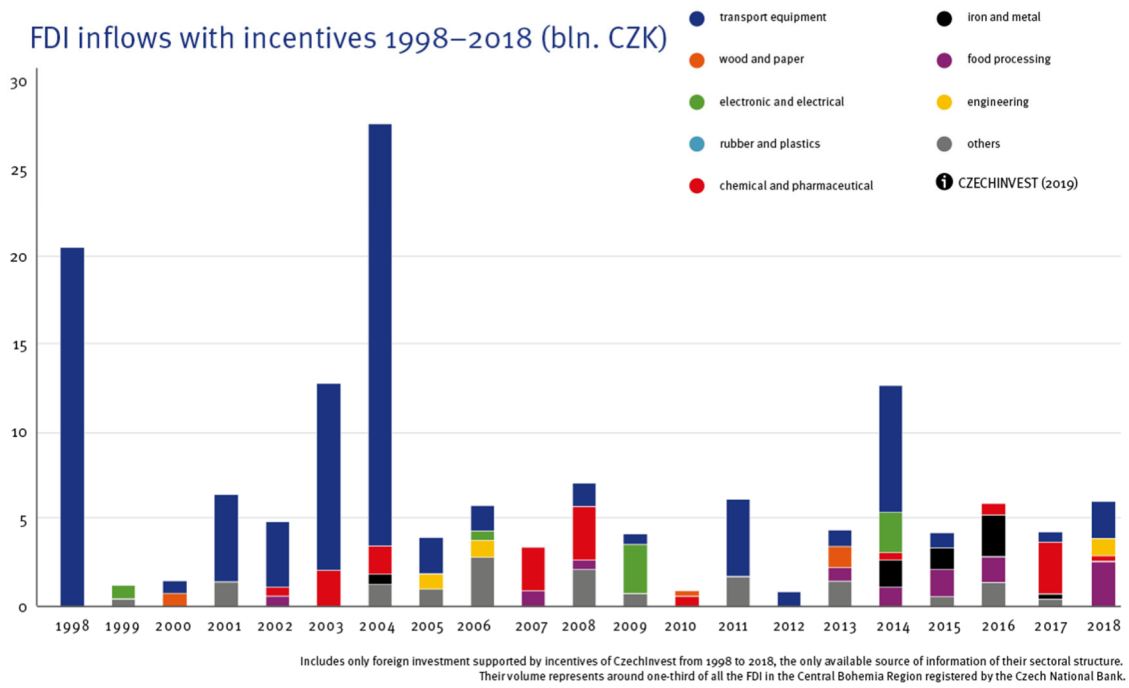
A comparison of trends shows that the inflow of FDI into the region did not slow down much even after 2009, when the rate of new FDI inflow decreased in other regions where FDI is of paramount importance in relative terms. In 2014-2017, however, there was also a significant decline in the Central Bohemian Region, which was mainly due to a discernible drop in other capital in the Mladá Boleslav district. In the last year of the reporting period (2018), sharp growth was resumed.

Figure 2: Foreign direct investment in the Central Bohemian Region by location and industry in 1998–2018



Note: Foreign direct investment in 1998-2019 (in CZK billions) is the sum of all FDI of companies benefiting from an investment incentive from CzechInvest. In contrast, the share of foreign direct investment per head of population in the district in 2017 (in CZK thousands per capita) is based on the balance of all FDI registered with the CNB in 2017, i.e. including those companies that did not receive an investment incentive. Data source: CNB (2019), CZECHINVEST (2019)

Graph 22: Structure of foreign investment inflow by time and branch, 1998–2018



Note: This encompasses only foreign investment supported by CzechInvest incentives in 1998-2019, as this is the only source of information available on the branch structure. The volume of this investment accounts for about a third of all FDI monitored by the CNB.

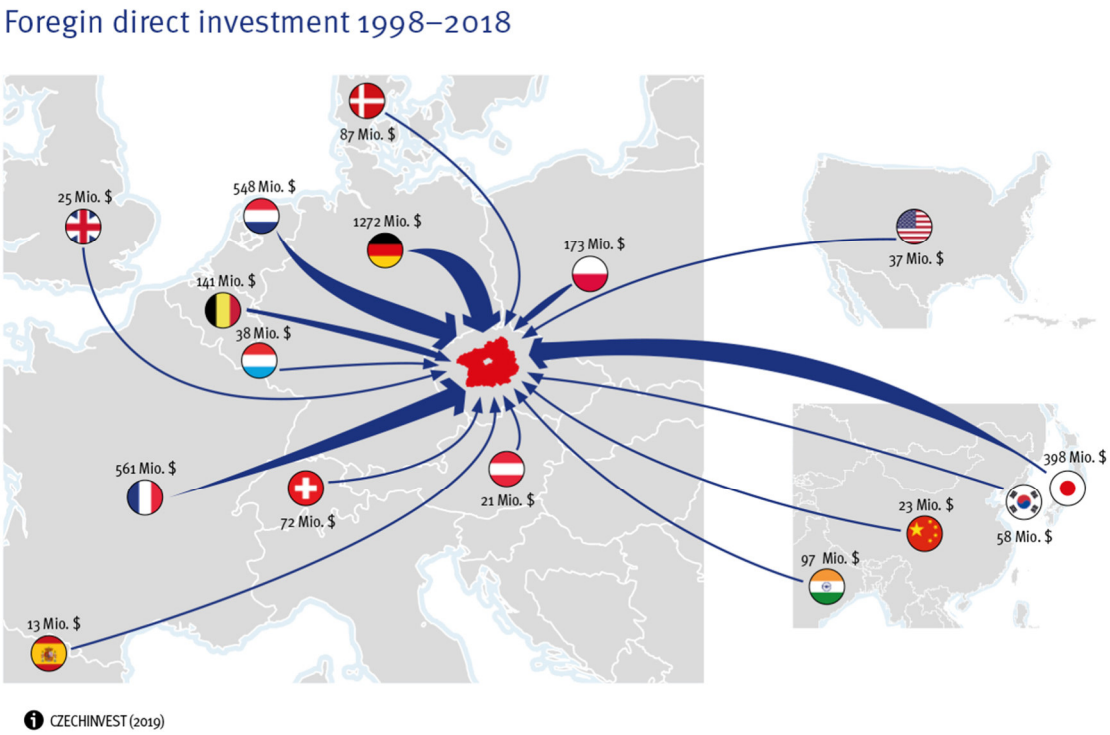
Data source: CZECHINVEST (2019)

Foreign direct investment (FDI) was one of the main drivers of economic growth and the modernisation of the Czech economy, and the same applies to the Central Bohemian Region, which has the second highest relative amount of FDI after Prague. In terms of territorial distribution, the region is clearly dominated by the environs of Prague and the district of Mladá Boleslav, as FDI is of the highest relative relevance to their economy. At the other end of the scale, the southern part of the region and the districts of Rakovník and Nymburk have the least foreign investment in relative terms. This is mainly due to their lower attractiveness, the absence of stronger micro-regional centres, and a smaller industrial tradition (most FDI in the region was channelled into manufacturing).

Incoming foreign investments are mainly being made in the manufacture of transport equipment, not only in Mladá Boleslav, Kolín and their surroundings, which are the main hubs of motor vehicle manufacturers and their subcontractors, but also along the D5 motorway towards Plzeň. In other parts of the region, FDI branch-based specialisations are distributed according to local conditions and are diverse in the fields they encompass. However, they often mirror historical links to manufacturing in the relevant locations.

Companies hailing from Germany most often invest in the region. They make up about 12% of all foreign investment supported by CzechInvest, and are followed by France, the Netherlands, Poland and Belgium. Investors from Japan, India and South Korea are also making broad inroads into the region.

Figure 3: FDI in the Central Bohemian Region by the investor's source country, 1998–2018



Data source: CZECHINVEST (2019)

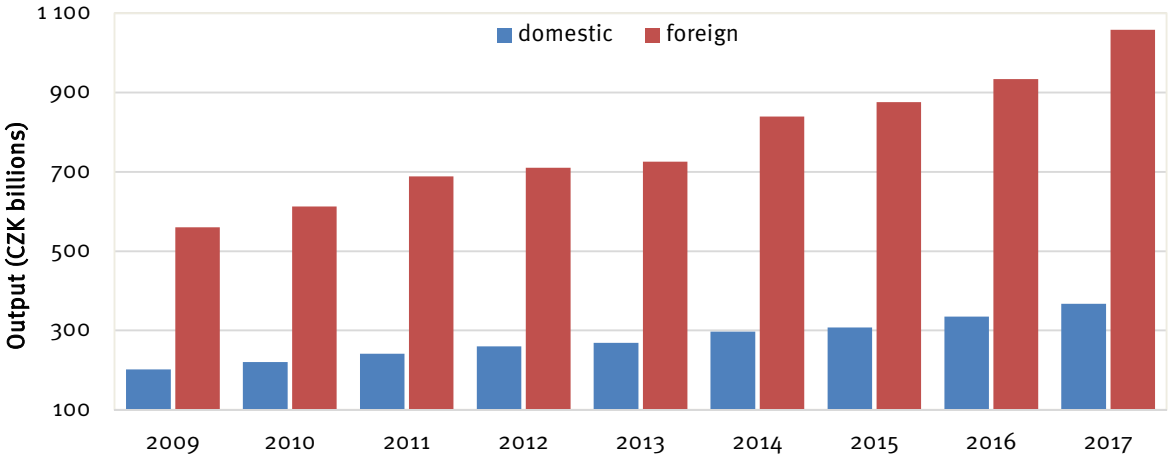
The nature of activities carried out by foreign investors in the region is also gradually changing. Manufacturing and assembly are being replaced by ever expanding activities in the field of design, development and even research. The aim is to create better conditions in the future and to attract foreign companies that will invest in such activities with high value added, creating quality jobs.

Why does it make sense to monitor the performance and characteristics of companies separately according to their ownership?

Foreign companies are constantly providing the domestic economy with new technologies, management methods and access to world markets. They have also created numerous other benefits, the impact of which is virtually impossible to quantify. Microeconomic benefits resulting from the inflow of FDI are the main reason for the high growth of aggregate productivity, which has been the main source of growth performance of (not only) the Central Bohemian economy in the last twenty years. In addition to direct impacts, the indirect impacts stemming from the gradual interconnection of investing foreign companies with local companies merit attention. An example of this is the very strong pressure exerted on local suppliers to increase productivity and implement related changes. As such, successful practices have emanated from foreign companies, and in this way they have increased the competitiveness of local companies. These foreign companies have also had – and continue to have – the effect of expanding people's experience of modern management methods and contact with global markets.

Ownership often affects the degree of business autonomy that a company has. Although it is not true that foreign ownership is the same as strategic management from abroad, it is always necessary to look pragmatically at the true nature of relations between a foreign owner and the local management. Business autonomy goes hand in hand with leeway for one's own innovations (i.e. not innovations – especially of a lower order – that companies make on the basis of orders from another part of the group). If companies have limited opportunities to decide on their own strategic direction, it is more difficult for them to focus, for example, on developing technologies and products for the longer term on the markets on which they operate (or do not yet operate, but could or would like to operate). This curbs their innovation performance and, for instance, the scope and nature of their cooperation with research organisations.

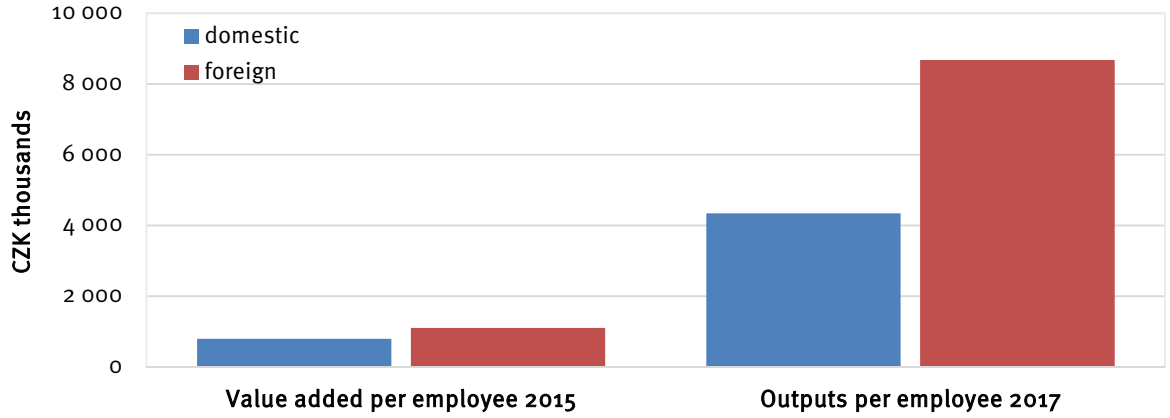
Graph 23: Output by ownership structure, 2009–2017



Data source: Bisnode MagnusWeb (data for 9,600 legal entities)

Data available on companies in the region shows that foreign-controlled companies make up the majority of the regional economy's performance (over 70%) and, over time, their economic performance is growing faster than that of domestic companies. This is particularly evident after 2013, when economic growth in (not only) the Central Bohemian Region was revived, driven mainly by foreign companies.

Graph 24: Labour productivity (value added per employee, 2015) and output per employee, 2017, by ownership structure

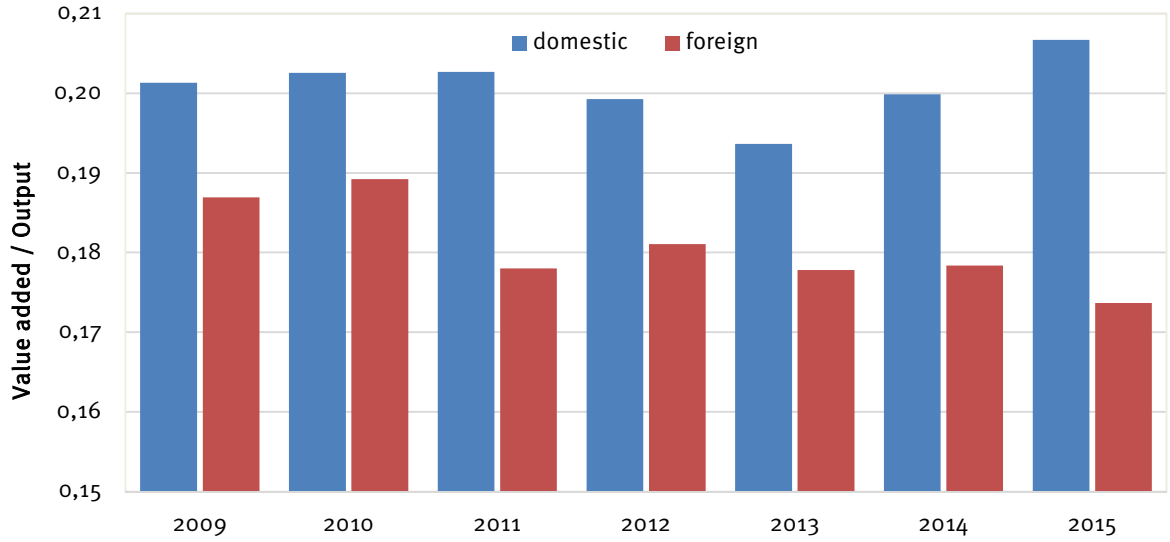


Data source: Bisnode MagnusWeb – data for 9,600 (2017) and 11,700 (2015) legal entities

Labour productivity is also significantly different – for companies under foreign control it is more than a third higher than for domestic companies. Measured by output per employee, the difference is actually double. This is also a consequence of the different average size, as foreign companies are significantly larger, meaning they can achieve economies of scale and operate more efficiently. Branches of foreign companies are also more oriented towards other areas and markets (especially end products for mass markets), where economies of scale can be achieved more easily.

The share of value added in output makes for an interesting finding. There is a clear difference here for foreign companies, at which, according to the data, the focus is more often on standardised and routine (especially manufacturing) activities with a smaller share of value added. Furthermore, that share decreases slightly over time. Conversely, domestic companies generally have a higher share of value added in output and report a growing tendency in this respect, i.e. in this segment more knowledge-intensive activities or activities that are closer to end customers and have a larger share of value added are very likely to develop faster.

Graph 25: Share of value added in output, by ownership structure, 2009–2015



Data source: Bisnode MagnusWeb, own adaptation (data for 11,700 entities)

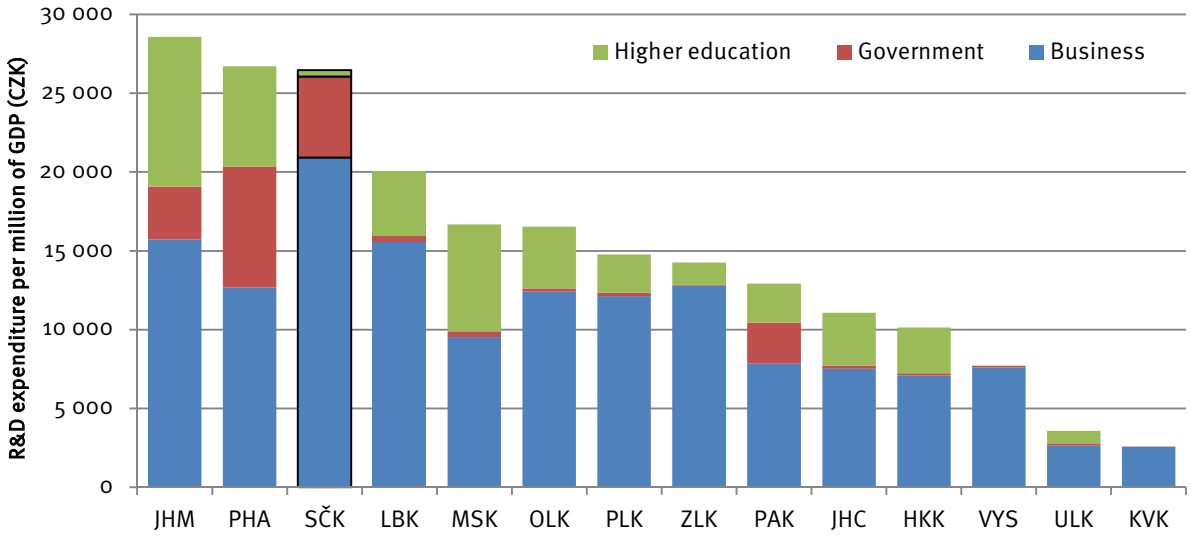
3. Research and Innovation

The key to the innovation performance of the economy is the corporate sector, where the economic potential of innovations is harnessed. Depending on their position in the production network, companies are able to pinpoint customer behaviour and preferences quite effectively because of their proximity to customers. These impulses are crucial for focusing innovation processes correctly. Customers/users are at the beginning and end of these processes. In the Central Bohemian Region, just as in all other regions and countries (including those rated as the most innovative), the companies that take over the innovations, i.e. that innovate on the basis of knowledge and/or technologies for foreign companies, are the largest group. However, there is a big difference in the scope of the sector of companies for whose innovations the key technologies and knowledge are acquired in-house or in cooperation with external entities (research organisations, universities, suppliers and others). They are also much more likely to develop higher-order technical innovations, which can have a much greater impact on the economy. The most common way to determine the scope of the segment of these companies is to apply knowledge intensity indicators, which draw on data about research and development (R&D) expenditure in relative terms in combination with GDP or other indicators of economic performance.

The relevance of innovations to the economy

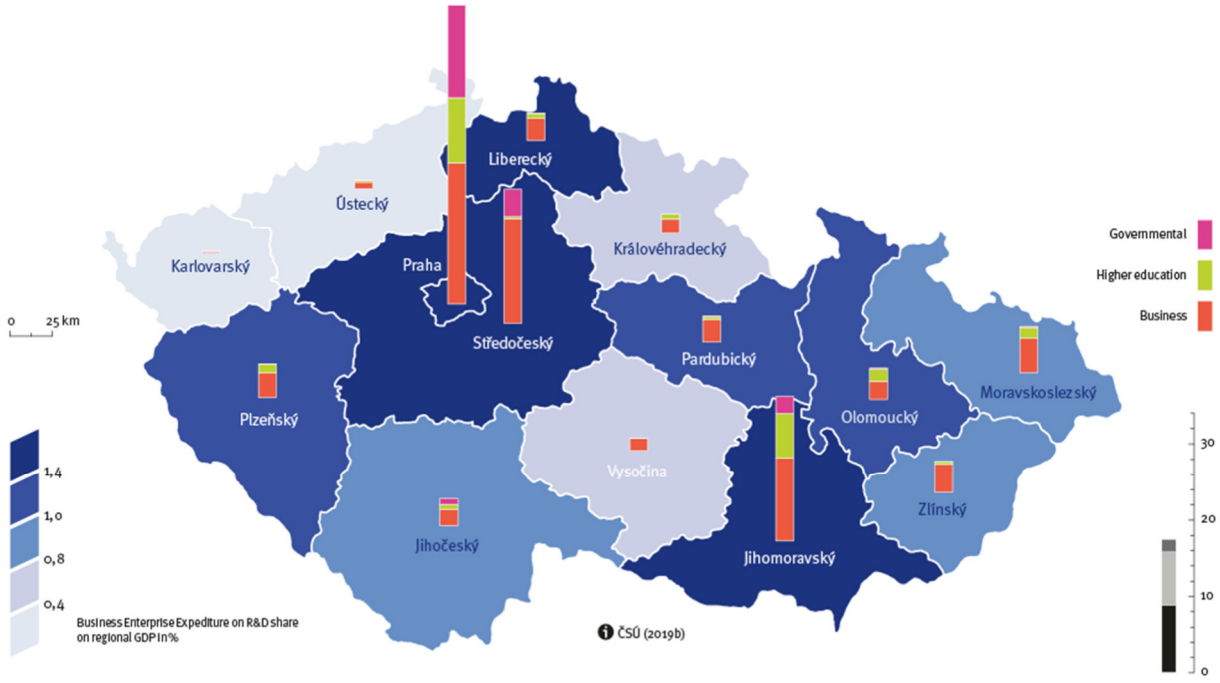
The economies of individual countries and regions undergo a certain development over time that can roughly be characterised as a shift from the phase where the main source of competitiveness is the availability and price of production factors (labour, raw materials) to competitiveness based on the efficient performance of activities, and ultimately to the phase where the competitive advantage relies primarily on innovations based on internally developed knowledge and technologies. As economies move on to subsequent phases, the original sources of competitive advantage are not lost, but their relevance to economic performance decreases (see, for example, the Global Competitiveness Report – WEF). Numerous characteristics indicate that the Czech Republic and the Central Bohemian Region are currently on the divide between the second and third developmental phases. Therefore, in order to build a competitive and growing economy, it is more important than ever to grasp the nature of and relationships within the innovation ecosystem and, based on this knowledge, to efficiently design, target and carry out innovation and economic policies.

Graph 26: R&D expenditure per CZK million of GDP in the regions, by sector of implementation, 2018



Data source: Czech Statistical Office – regional accounts; Czech Statistical Office – R&D Statistics

Figure 4: R&D expenditure in the regions of the Czech Republic, 2018



Data source: Czech Statistical Office – R&D Statistics

The **Central Bohemian Region's innovation ecosystem is characterised by the dominant role played by the corporate sector in R&D activities – almost 80% of all R&D expenditure is incurred in the corporate segment**, showing that companies play a key role in R&D activities. Compared to other regions, the Central Bohemian Region reports a lower share of R&D activities in both the higher-education sector and the general government sector (public research institutions). Here, however, some new research infrastructures are included in statistics for Prague because, administratively, they are integrated into an institute of the Czech Academy of Sciences or a university based in the metropolis. **In reality, the share and volume of R&D investments in the government and higher-education sector in the region is much**

higher. In the last few years in particular, public research capacities in the region have grown rapidly, as several research infrastructures of European importance have been built here.

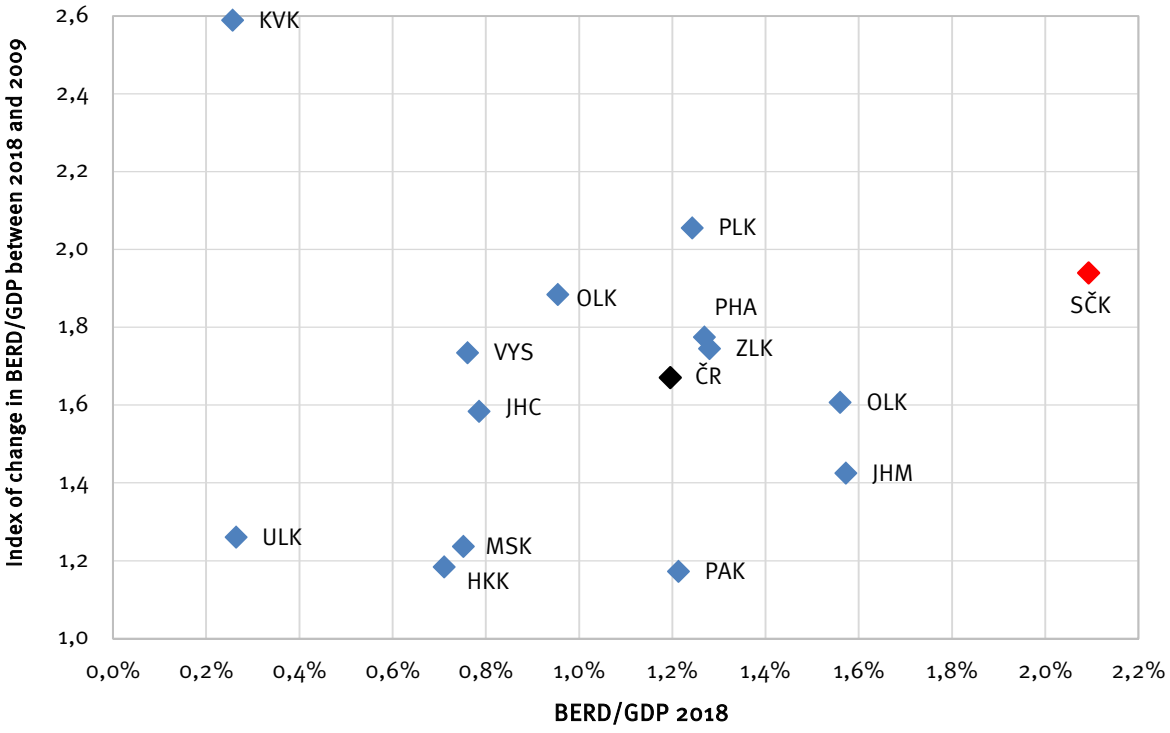
Table 7: R&D expenditure by sector of implementation in the Central Bohemian Region (CZK millions), 2005–2018

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Business	3,539	4,326	5,266	4,551	4,541	4,949	5,250	5,602	8,319	8,303	8,465	8,660	11,245	12,915
Government	1,120	1,069	984	1,061	1,140	1,046	1,056	966	985	1,119	1,241	2,320	2,885	3,170
Higher-education	10	9	12	17	16	22	40	105	395	449	275	190	221	254
Private non-profit	4	2	1	1	1	1	4	4	20	9	9	5	6	3
Total	**4,672**	**5,406**	**6,263**	**5,630**	**5,697**	**6,017**	**6,350**	**6,677**	**9,718**	**9,879**	**9,991**	**11,175**	**14,357**	**16,343**

Data source: Czech Statistical Office – R&D Statistics

From a long-term perspective, R&D expenditure in the Central Bohemian Region is growing fastest in the business sector, underlining its importance for the regional innovation system. The growth of R&D investment at businesses nearly dried up in 2013-2016, but has increased significantly in the last two years. In the last five years, R&D investment in the public sector (higher-education and government institutions) has also increased at a faster pace. This is mainly related to new R&D investment by centres under the Operational Programme Research and Development for Innovation, such as BIOCEV, ELI Beamlines, HILASE, UCEEB, CVUM, NUDZ, SUSEN, and ExAM). **This means that the public research segment is on the rise in the region. Its capacity has been growing rapidly in recent years and is one of the important development impulses for the regional innovation ecosystem.**

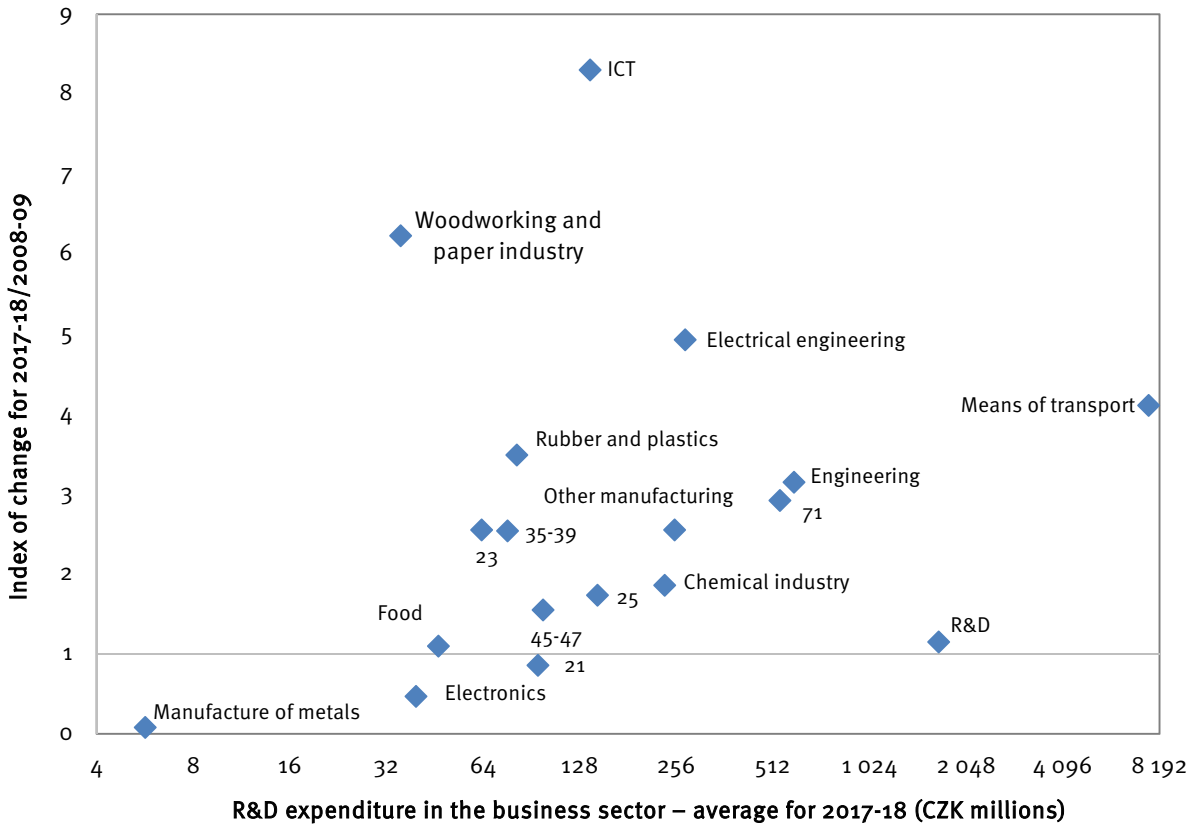
Graph 27: R&D expenditure in the business sector as a share of GDP, situation in 2018 and the 2018/2009 change



Data source: Czech Statistical Office – R&D Statistics

Compared to other regions, R&D expenditure in the business sector is high even in terms of the level of economic performance achieved (measured by GDP). This points to the relatively high knowledge intensity of the Central Bohemian economy. R&D expenditure stands at 2.1% of GDP, which puts the Central Bohemian Region ahead even of the South Moravian Region. With the exception of 2014-2016, the growth momentum is slightly above average. The volume of R&D investment in the corporate sector has increased by 94% since 2009.

Graph 28: R&D expenditure in the business sector, by NACE 2 divisions, 2008–2018



Note: A logarithmic scale is used on the x-axis due to the extreme values of the manufacture of transport equipment
Explanations of selected NACE divisions: 21: Pharmaceutical industry; 23: Glass, ceramics, porcelain and building materials; 25 Fabricated metal products; 35-39: Generation and supply of electricity, gas, water and heat, waste management and remediation activities; 45-47: Wholesale and retail trade; 71: Architectural and engineering activities; technical testing and analysis

Data source: Czech Statistical Office – data from the Annual Research and Development Report, own adaptation

Corporate R&D expenditure in individual branches of the Central Bohemian economy reports different levels and dynamics. The largest R&D capacities are at companies in the automotive industry, mechanical engineering, and architectural and engineering activities. The highest momentum is recorded by the ICT sector, the wood and paper industry, and electrical engineering.

The largest R&D investor in the corporate sector is Škoda Auto, which annually accounts for about half of all R&D expenditure by companies in the region. However, there are also numerous other companies that invest in R&D in relatively large amounts exceeding CZK 10 million per year. There are 75 such companies in the Central Bohemian economy.

Human capacities in research and development

Table 8: Number of researchers in the corporate sector, 2005 and 2018

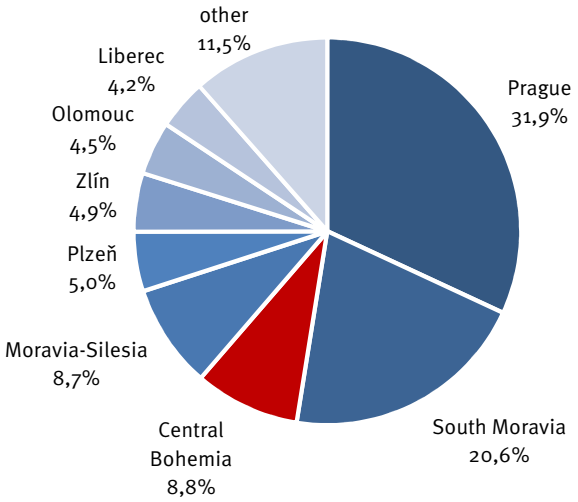
	2005		2018		Change in 2018 compared to 2005			
	HC	FTE	HC	FTE	HC	FTE	HC (%)	FTE (%)
Prague	3,157	2,654	7,633	6,491	4,477	3,837	142%	145%
Central Bohemia	**2,107**	**1,950**	**2,840**	**2,521**	**733**	**571**	**35%**	**29%**
South Bohemia	240	218	361	282	121	64	50%	29%
Plzeň	435	396	1,283	1,047	848	652	195%	165%
Karlovy Vary	48	24	155	125	107	101	222%	418%
Ústí nad Labem	201	181	325	241	124	60	62%	33%
Liberec	380	345	753	649	373	304	98%	88%
Hradec Králové	359	337	719	618	360	281	100%	83%
Pardubice	756	704	996	865	240	161	32%	23%
Vysočina	355	347	703	597	349	250	98%	72%
South Moravia	1,497	1,336	5,061	4,128	3,564	2,792	238%	209%
Olomouc	480	389	1,173	941	694	551	145%	142%
Zlín	498	360	1,360	1,012	862	652	173%	181%
Moravia-Silesia	558	476	1,913	1,633	1,355	1,157	243%	243%
Czech Republic, total	**11,069**	**9,716**	**25,275**	**21,150**	**14,206**	**11,434**	**128%**	**118%**
Central Bohemia/Czech Republic – share	**19.0%**	**20.1%**	**11.2%**	**11.9%**	-	-	-	-

Note: HC – Headcount; FTE – Full time equivalent; Data source: Czech Statistical Office – R&D Indicators

From the point of view of human R&D capacities in the corporate sector, the growth momentum of the Central Bohemian Region lags quite far behind the average of other regions. From 2005 to 2018, the number of researchers (FTE) in the region increased by less than 30%, which is the second lowest number of all regions.

There was much faster growth occurred in the government sector (at institutions of the Czech Academy of Sciences), where the number of researchers (HC) in the region increased by about 80% (from 538 to 966). Compared to the Czech average for the period (20%), this is above average. Due to the small size of the higher-education sector in the region, the number of researchers in this sector is very low, but is growing rapidly (from 8 to 170 researchers), mainly reflecting the development of research centres of some Prague universities in the Central Bohemian Region.

Graph 29: Share of regions in the change in employment (FTE) in R&D in the corporate sector in 2010–2018



Data source: Czech Statistical Office – R&D Indicators

A comparison of the growth of R&D capacities in the corporate segment among the regions of the Czech Republic (see the graph above) shows that, in the last eight years, the growth has been quite disproportionate. Prague and the South Moravian Region contributed the most to the growth in the number of R&D employees – these two regions accounted for more than half of the growth. The Central Bohemian Region's share in the increasing number of R&D employees in the corporate sector in the Czech Republic as a whole in this period was the third highest (8.8%), amounting specifically to 1,390 employees. **This just goes to show that, although the overall scope of R&D capacities in the corporate sector is relatively high in the Central Bohemian Region, the growth momentum lags quite far behind Prague and the South Moravian Region**. This finding is confirmed by the above table, which shows only the number of researchers[21] in the corporate sector, separately as FTE (full-time equivalent) and the HC (headcount), i.e. the total number of employees.

Table 9: R&D expenditure in the business sector by size of enterprises in the Central Bohemian Region and the Czech Republic (CZK million), 2005–2018

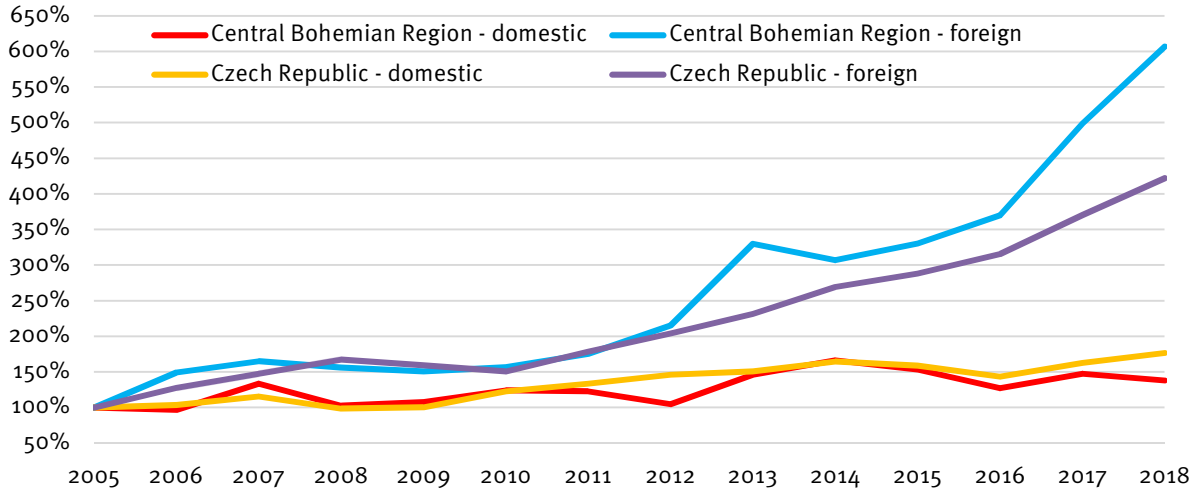
	2005	2008	2013	2014	2015	2016	2017	2018	18/05 index	Share 2018
Central Bohemian Region										
small (up to 49 employees)	275	269	451	538	502	324	502	584	2.1	4.5%
medium-sized (50-249 employees)	361	672	1,110	1,279	1,285	1,052	867	994	2.8	7.7%
large (250+ employees)	2,903	3,611	6,759	6,486	6,678	7,284	9,875	11,337	3.9	87.8%
Czech Republic										
small (up to 49 employees)	2,632	3,486	4,666	5,151	4,318	3,797	4,773	5,732	2.2	9.0%
medium-sized (50-249 employees)	6,304	8,560	12,734	13,424	12,613	10,372	11,818	12,769	2.0	20.1%
large (250+ employees)	13,250	16,683	24,113	28,405	31,216	34,811	40,220	45,153	3.4	70.9%
Central Bohemia/Czech Republic – share										
small (up to 49 employees)	10.4%	7.7%	9.7%	10.4%	11.6%	8.5%	10.5%	10.2%	1.0	
medium-sized (50-249 employees)	5.7%	7.9%	8.7%	9.5%	10.2%	10.1%	7.3%	7.8%	1.4	
large (250+ employees)	21.9%	21.6%	28.0%	22.8%	21.4%	20.9%	24.6%	25.1%	1.1	

Data source: Czech Statistical Office – R&D Statistics

R&D capacities in the corporate sphere are heavily concentrated at large companies. This is a general phenomenon – large companies usually have the largest financial and human capacities and can afford larger investments in R&D, which are of a longer-term nature and are risky. In the Central Bohemian Region, the concentration of R&D capacities at large companies is even more pronounced (almost 88% in 2018) than it is on average in the Czech Republic (mainly due to Škoda Auto's activities). Although the scope of R&D capacities is lower among SMEs in the region, the momentum here is much higher – small companies in the region increased their R&D expenditure by 113% between 2005 and 2018, and medium-sized companies by as much as 175% (compared to 103% for the Czech Republic as a whole). It follows that **R&D activities in the SME sector in the Central Bohemian Region are growing dynamically and there are a number of knowledge-intensive companies here that are investing more and more resources in their own research**.

[21] The total number of R&D workers also includes technical and other employees working in R&D

Graph 30: R&D expenditure of domestic/foreign companies in the Central Bohemian Region and the Czech Republic (2005 = 100%), 2005–2018



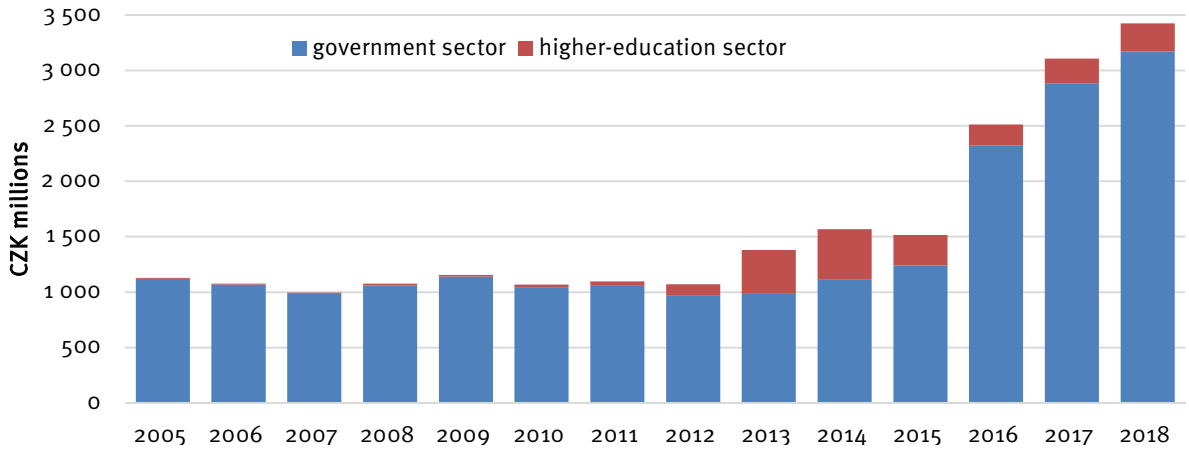
Data source: Czech Statistical Office – R&D Statistics

In response to the well-worn myth that the Czech Republic serves as foreign companies' "assembly plant" for the European market, it is useful to look at R&D investments in the corporate sphere by ownership. R&D expenditure has grown at a much higher rate in the last 13 years among foreign companies – the total volume in the Central Bohemian Region increased more than sixfold to CZK 10.4 billion. At domestic companies, this increase was significantly smaller – by about 40% to CZK 2.5 billion. This shows that foreign companies' R&D activities in the region are developing much faster and their total volume is higher. The indication is that they are quite quickly transforming their activities towards higher value-added activities based on innovation and development.

3.1 Public Research

The public research segment is an area that is developing very dynamically in the Central Bohemian Region. There are 22 public research institutions (or centres) and higher-education institutions (or their faculties) in the region. The number has increased mainly in response to newly created infrastructure in the last programming period of the EU Structural Funds – many new research centres were established and the capacities of some existing ones were significantly expanded or modernised. They specialise in both basic and applied research.

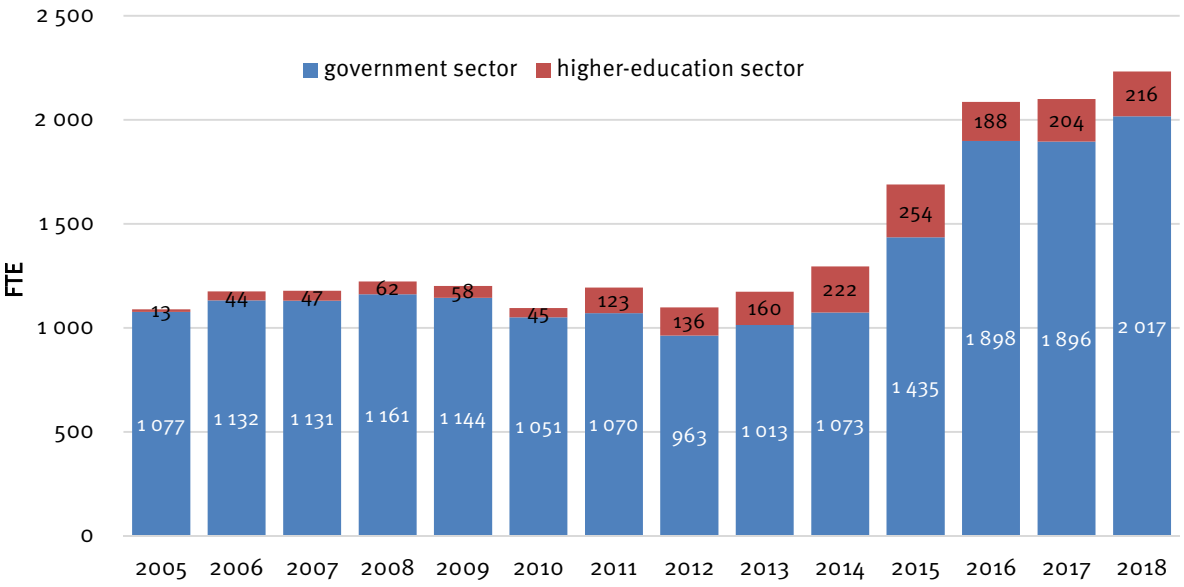
Graph 31: R&D expenditure in the sector of general government and higher-education institutions in the Central Bohemian Region, 2005–2018



Data source: Czech Statistical Office – R&D indicators

The growing scope of R&D activities at public research organisations is also documented in the graph above. In the last three years in particular, there has been a sharp increase in their capacity. A number of new research centres are still formally reported in statistics for Prague because they administratively fall under their parent institutes of the Czech Academy of Sciences. Public research is therefore quite concentrated in Central Bohemia and Prague – together, almost 60% of all public R&D capacities in the whole of the Czech Republic are concentrated here.

Graph 32: R&D employees in the sector of general government and higher-education institutions in the Central Bohemian Region, 2005–2018 (FTE)



Data source: Czech Statistical Office – R&D indicators

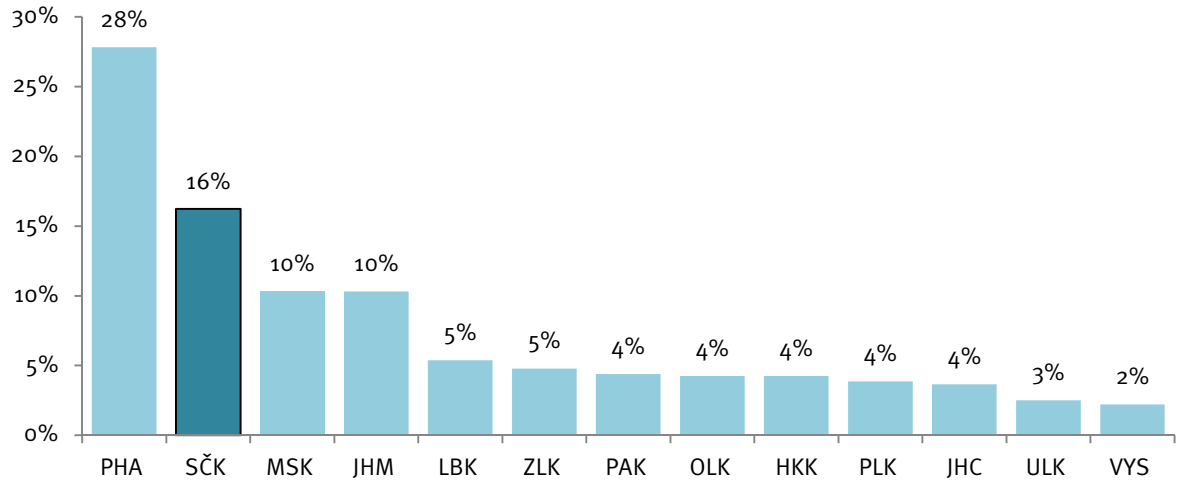
The increase in public research capacities in the region is also shown in the previous graph – the number of employees at these organisations has been growing rapidly since 2015. This trend is the opposite than that recorded, for example, in Prague or on average for the Czech Republic as a whole, where the number of employees in public research more or less stalled (and has even decreased slightly in the higher-education sector) and has only started to grow slightly in the last two years. More details can be found in the appendix (Graph 39)

3.2 Protected Intellectual Property

Protected intellectual property is created during the handling of research projects, during the performance of contract research, and often also as a by-product of these activities or completely independently of these types of external financing. We monitor protected intellectual property separately for research organisations and for companies.

The Central Bohemian Region ranks second in the number of patent applications filed by Czech applicants. The top spot is held by Prague, where almost a third of all patent applications submitted by Czech applicants in the Czech Republic are filed. In total, almost half of all national patent applications filed by Czech applicants are concentrated in Prague and the Central Bohemian Region.

Graph 33: Patent applications filed by applicants from the Czech Republic, by region, 2019 (%)



Data source: Czech Statistical Office – R&D

In the context of how research and development outputs are used in practice, the most interesting indicator is income from industrial property licences. **The total income of intellectual property licensers in the last five years exceeded CZK 8 billion, of which more than CZK 2 billion comprised income from newly granted licences. The average value of newly granted licences has increased in the last five years.** More than 70% of the licensing income of licensers from the Central Bohemian Region **comprises revenues from the sale of industrial designs (CZK 6.3 billion), while more than 20% is from the sale of know-how (CZK 1.8 billion).** These two types of intellectual property have gained in importance in the last four reporting years. In particular, the value of industrial design licences and know-how has increased by several orders of magnitude. In total, patents and utility models account for less than 3% of income. This places the Central Bohemian Region fourth among the regions of the Czech Republic, not only in terms of overall volume, but also from the perspective of its share in the Czech Republic and the amount of income per licence.

Table 10: Academic organisations by number of foreign patents in the Central Bohemian Region, 2009–2017

Organisation	Number of patents	Top branches	Top co-owners
Czech Technical University (Faculty of Biomedical Engineering)	3	Medical technology	VŠB – Technical University of Ostrava
Czech Technical University (Sustainable Mobility Vehicles Centre)	1	Engines, pumps, turbines	KNOB ENGINES s.r.o.
Czech Technical University (University Centre for Energy-Efficient Buildings)	1	Basic communication processes; Measurement	
Institute of Inorganic Chemistry of the Czech Academy of Sciences	1	Materials, metallurgy; Organic chemistry; Pharmacy	Institute of Molecular Genetics of the Czech Academy of Sciences; Institute of Organic Chemistry and Biochemistry; Palacký University, Olomouc
Institute of Animal Physiology and Genetics of the Czech Academy of Sciences	1	Analysis of biological materials; Biotechnology	Palacký University, Olomouc

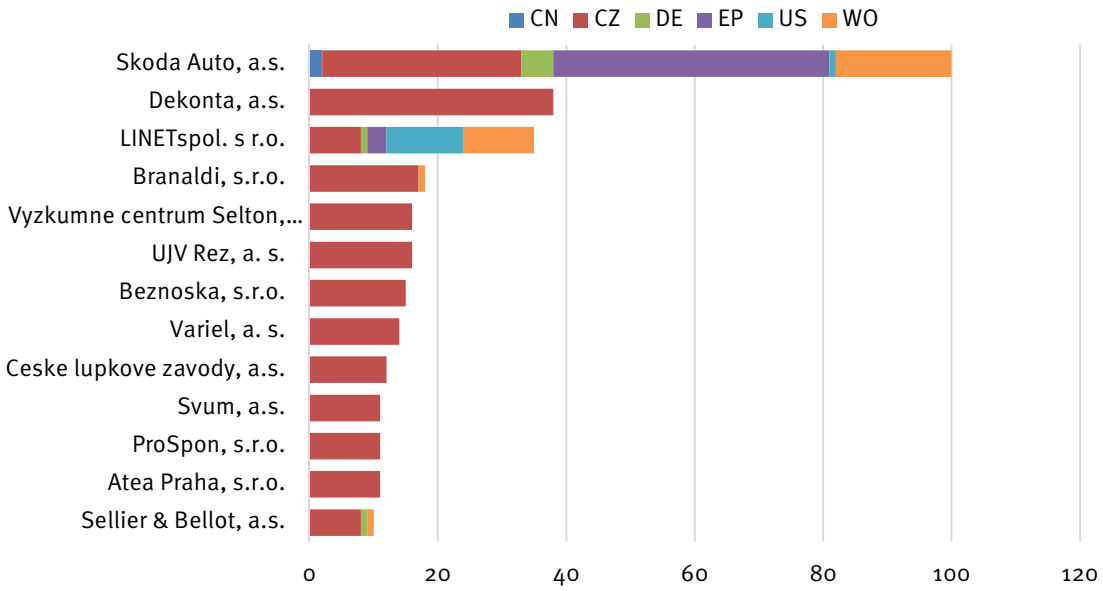
Data source: Orbit, patents, including applications

The very low number of patents in the region can mainly be attributed to the structure of research organisations in the Central Bohemian Region. These organisations are often very young (their establishment was supported by the Structural Funds, especially under the Operational Programme Research and Development for Innovation), so research there has often not yet matured enough for international patent protection.[22] In the coming years, we anticipate an increase in the number of international patents.

However, international patents are filed not only by research institutions, but also by companies. Between 2009 and 2016, companies in the Central Bohemian Region filed **175 foreign patents, accounting for a quarter of all patents filed by companies.**[23] Most of these patents directed at the European Union in the form of an application to the EPO,[24] at the world in the form of a PCT application, and at the United States of America and Germany. Most foreign patents were filed by **IQ Structures, s.r.o. (6), Witrins, s.r.o. (6), Optaglio, s.r.o. (7), Erwin Junker Grinding Technology, a.s. (8), LINET spol. s r.o. (27) and Škoda Auto, a.s. (69).** Linet spol. s r.o. and Škoda Auto a.s. have the largest share of foreign patents in their patent portfolios.[25]

Škoda Auto a.s. and Linet spol. s r.o., together with Dekonta, also report the largest total number of patents and utility models from among companies in the Central Bohemian Region. It is also worth mentioning Sellier & Bellot, a.s. and Branaldi, s.r.o., which, in addition to their high number of patents and utility models, have at least one foreign patent.

Graph 34: Territorial structure of the patent portfolio of companies with more than 10 patents, 2009–2016



Note: CZ – Czech Republic; EP – EU; WO – world; US – United States of America; DE – Germany; CN – China

Data source: Bureau van Dijk

[22] It should also be remembered that international patent applications are usually filed on the basis of a Czech patent within a 12-month protection period ("priority") and up to 12 months may elapse between the filing of a patent and the publication of the application. The actual delay between a result with international potential and the publication of a foreign patent application can therefore be up to two years.

[23] The share of foreign patents in all patents at companies is higher on average, standing at around 40% (though this includes various foreign patents from a single patent family).

[24] EPO – European Patent Office

[25] including utility models

Companies in the Central Bohemian Region most often patent in the field of **security elements** (locks, keys, windows or door fittings, safes), which made up **almost 40% of all company patents** applied for between 2009 and 2016. A significant number of patents are also filed in the field of **"medical and veterinary science"** (just under 10%). However, the branch structure of patents filed by companies varies depending on the territory. Unlike all patents without distinction of territory, the foreign patents of companies are not as concentrated in any one particular field. Most foreign patents (14%) encompassed the field of "medical and veterinary science" and security features (locks, keys, windows or door fittings, safes) (12%). Unlike patents without distinction of territory, foreign patents were often filed in the fields of "agriculture", "control and regulation" and "basic electrical components".

4. Cooperation in Research and Development

Cooperation in research can also be viewed through the mutual relations of individual entities. If we look at collaborative research projects within the scope of selected public projects, we can visualise the relationships between individual entities by means of a relation network. This visualisation **makes it possible to reveal clusters of collaborating entities and identify important players, and also to assess the relationship between different disciplines in a research area**. Considering the focus of the analysis, we selected the following programmes: Ministry of Industry and Trade – TIP and TRIO, Technology Agency – ALFA and EPSILON, OMEGA, Ministry of Health, Ministry of Defence, and the Operational Programme Enterprise and Innovation, encompassing the 2009-2017 period.[26]

The first visualisation (Figure 5) captures only entities from the Central Bohemian Region that cooperate with other entities from the Central Bohemian Region. **Groups of entities operating in the same fields** (especially the green cluster of agriculture, the violet of chemistry, the blue of engineering and the grey-blue of physics) **can be distinguished immediately in the network. The network is dominated by several main players operating in the Central Bohemian Region. These are ÚJV Řež, the Institute of Nuclear Physics of the Czech Academy of Sciences, the Institute of Inorganic Chemistry of the Czech Academy of Sciences, and the Institute of Botany of the Czech Academy of Sciences.** The number of relationships in the network is limited not only by the number of entities in the Central Bohemian Region, but also, and in particular, by the fact that, in a large percentage of cases, there is cooperation with entities from other regions, especially from Prague.

The second network (Figure 6) captures cooperation on projects from the above-mentioned programmes where at least one of the cooperating entities is located in the Central Bohemian Region. Only relationships where more than one collaboration took place in the reporting period were selected for the network. This repeated collaboration sheds more light on long-term relationships between individual entities. Considering the number of overall relationships, this narrowing of the network was also a methodological necessity.

The network in Figure 6 resembles the structure of the previous network. Here, too, we can observe entities clustered according to their individual fields. However, this network is more complex and the structural nature of individual fields and their position in relation to other fields can be distinguished more clearly. **The cluster collectively referred to as agriculture (green, part of which includes, for example, the SELTON Research Centre), health care (yellow, centrally occupied by the National Institute of Mental Health) and the clusters of engineering and materials research (shades of blue, dominated by AERO Vodochody, the Faculty of Mechanical Engineering of the Czech Technical University, Prague, and SVÚM, a.s.) are readily distinguishable.** Entities operating in biology and genetics (light orange), which are somewhere between health and agriculture, are more scattered. The Institute of Animal Physiology and Genetics of the Czech Academy of Sciences and the Institute of Botany of the Czech Academy of Sciences are centrally positioned in this cluster. The white-marked faculties of science of several universities can also be found roughly in this position (on the border of multiple fields). The cluster drawing together entities in the field of physics and mathematics is more scattered, but two entities (ÚJV Řež and the

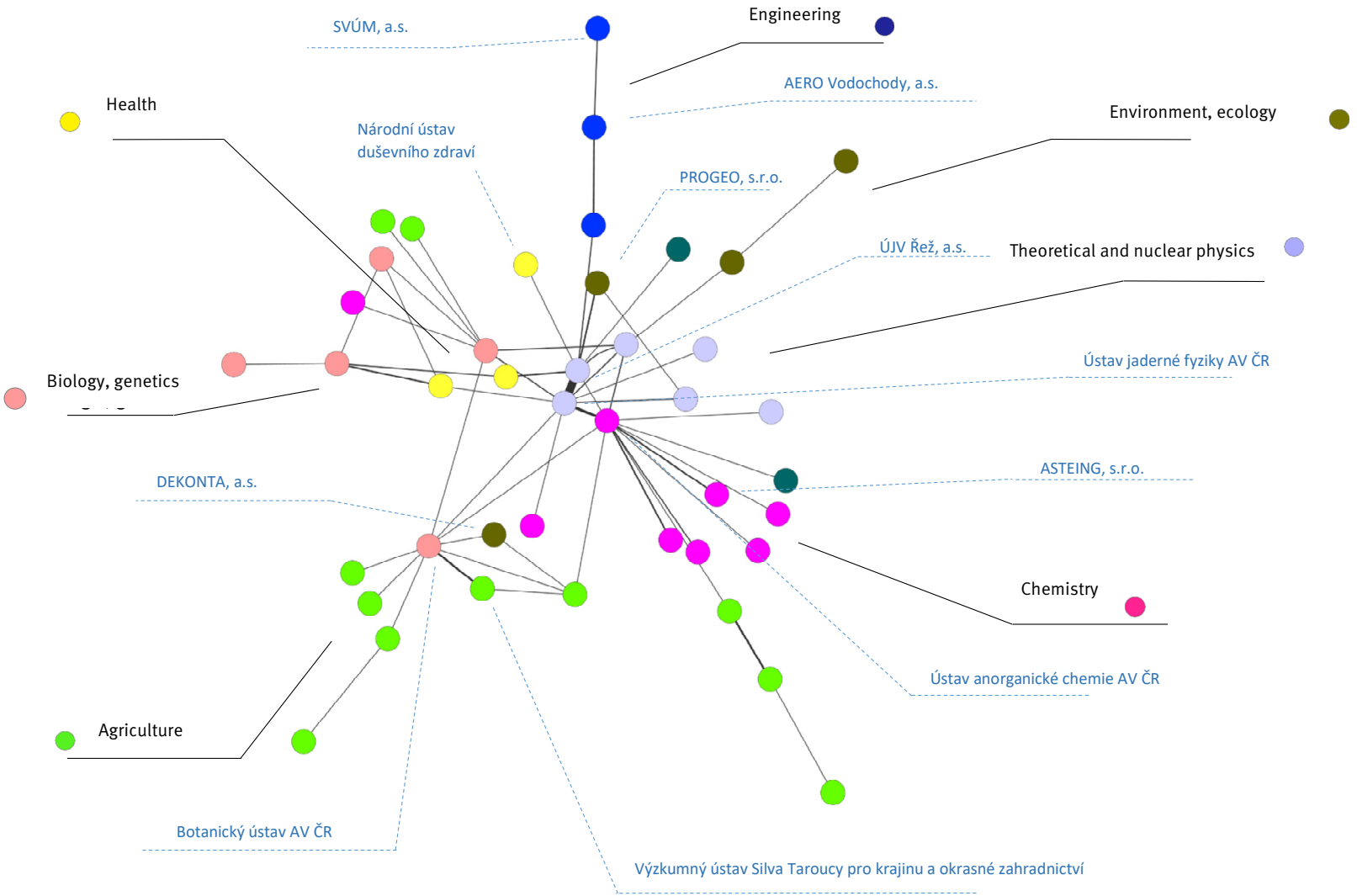
[26] Visualised in the open-source Cytoscape (www.cytoscape.org).

Institute of Nuclear Physics of the Czech Academy of Sciences) are strongly centrally positioned. **There are even more scattered entities operating in the field of chemistry. The central position here is occupied by the Institute of Inorganic Chemistry of the Czech Academy of Sciences. Interestingly, there are practically no clusters in the field of electrical engineering (dark green; a small cluster can be found at the top of the network).**

In addition to monitoring individual clusters separately (the cluster rate, compactness, central entities, etc.), we can also gauge relationships between individual fields from the network graph. **It is instantly clear that the engineering and material-oriented fields are quite significantly separated from the rest of the network**. This is mainly due to the nature of the research carried out in this field. The main integrator with the rest of the network is ÚJV Řež. **Conversely, clusters in the fields of health care, biology and genetics, agriculture, the environment and ecology, and chemistry intersect a lot**, although even here we can observe the transitions between them quite clearly.

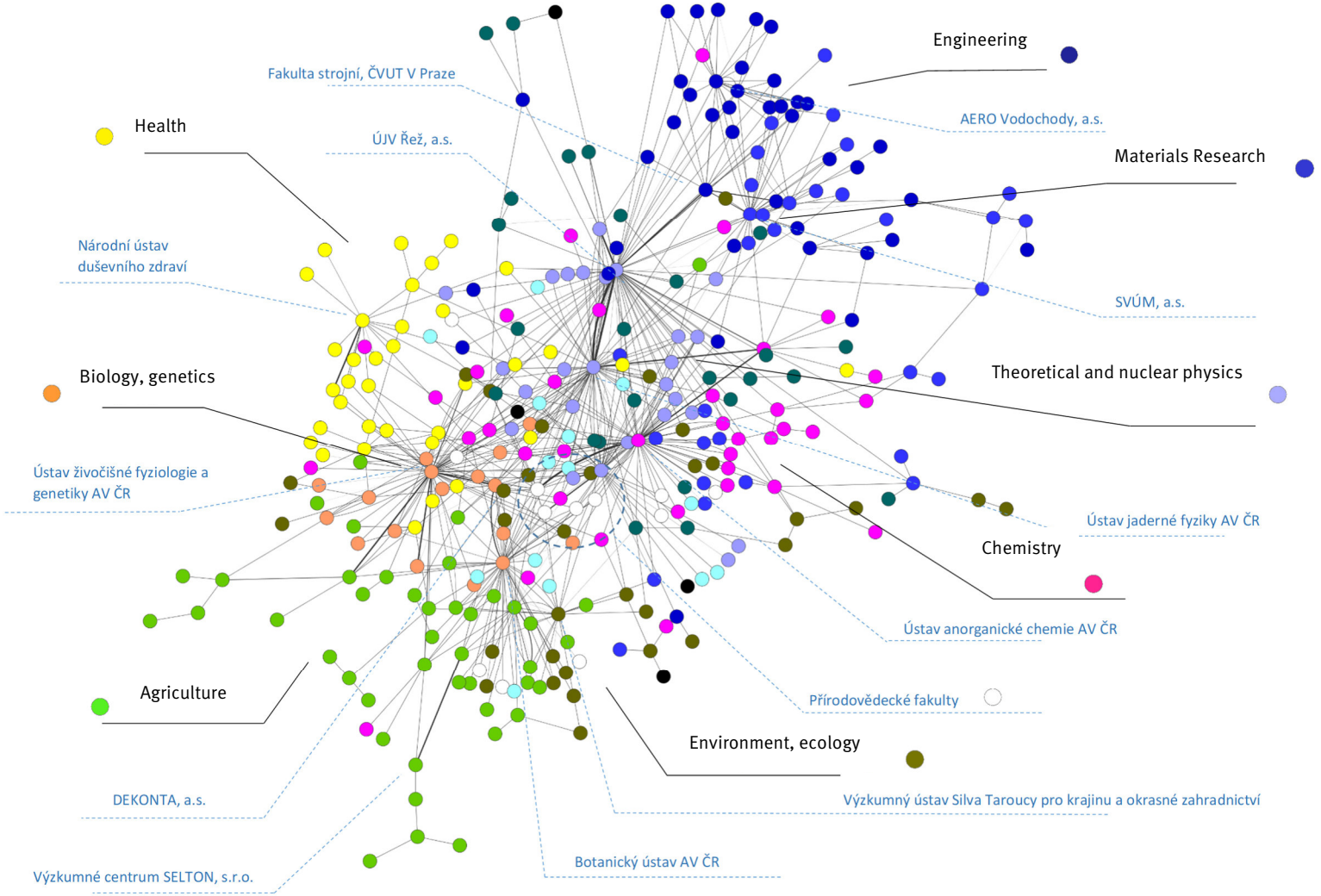
In the future, it would be interesting to monitor not only the current state of the network (here 2009-2017), but also its evolution and trends related to the structure of individual fields. For example, we can assume that individual clusters will converge due to the broader coherence of fields.

Figure 5: Network of cooperation between entities from the Central Bohemian Region in the field of applied research, 2009–2017



Data source: Research, Development and Innovation Council – https://www.rvvi.cz (support programmes of the Ministry of Industry and Trade – TIP and TRIO, Technology Agency – ALFA and EPSILON, OMEGA, Ministry of Health, Ministry of Defence, and the Operational Programme Enterprise and Innovation). Note: The individual dots (nodes) represent individual institutions, the connecting lines between these dots (edges) express joint projects (the thickness of the line expresses the number of joint projects).

Figure 6: Network of cooperation of entities from the Central Bohemian Region with entities from the Czech Republic as a whole in the field of applied research, 2009–2017



Data source: Research, Development and Innovation Council – https://www.rvvi.cz (support programmes of the Ministry of Industry and Trade – TIP and TRIO, Technology Agency – ALFA and EPSILON, OMEGA, Ministry of Health, Ministry of Defence, and the Operational Programme Enterprise and Innovation). Note: The individual dots (nodes) represent individual institutions, the connecting lines between these dots (edges) express joint projects (the thickness of the line expresses the number of joint projects).

4.1 Central Bohemian Innovation Vouchers – Existing Cooperation between Companies and Research Organisations

Central Bohemian Innovation Vouchers are the main vehicle used so far to facilitate cooperation between companies and research organisations in the region. Small and medium-sized companies, sole traders and entrepreneurs from the Central Bohemian Region who want to innovate their product or service in cooperation with a university or other research organisation can receive a subsidy of up to CZK 150,000 for their project. The aim of this support is to stimulate cooperation between the private sector and the research sector and to support companies' innovation activities. The research sphere mainly contributes knowledge and technologies for the transfer thereof to companies. Business entities and research organisations, by implementing smaller joint projects, test their ability to cooperate with each other and create a basis for long-term collaboration.

Funding for such a project is provided by the Central Bohemian Region. In the three calls held so far (in 2016, 2017 and 2018), it distributed a total of almost CZK 10 million and supported the cooperation of more than 80 companies from the Central Bohemian Region with research organisations, which most often came from Prague, but also hailed from other parts of the Czech Republic. The maps in the appendix illustrate the links between companies and research organisations under the projects supported in the two calls that have been closed.

The evaluation of the first year of the Central Bohemian Innovation Vouchers (which took place on a sample of 29 companies) showed, for example, that:

- In almost a third of cases, the joint projects of companies and knowledge providers that were supported established completely new cooperation on the part of companies. For companies, this was the first opportunity to try out mutual interaction and the services of higher-education institutions or research organisations.
- The most frequent partners for companies were Prague higher-education institutions (52% of companies, mainly with the Czech Technical University and the Czech University of Life Sciences) and research institutes of the Academy of Sciences (again, mostly also in Prague or its immediate vicinity). There is therefore a strong link to research organisations in Prague, which are natural partners for companies from the Central Bohemian Region.
- Companies most often believe (in 52% of cases) that the benefits of cooperation supported by an innovation voucher lie in the area of products offered to customers – e.g. the expansion of their product portfolio, the development of innovated products/services that will be more competitive on the market, etc. 18% of companies said that cooperation had helped to give them a firmer foothold on new markets (from a territorial or product perspective).
- 79% of companies that received an innovation voucher were very satisfied with the cooperation with a research organisation or higher-education institution, considered it problem-free, and observed that the whole process had exceeded their expectations. The remaining 21% of companies graded the cooperation with a mark of 2 (out of 5, with 1 the best and 5 the worst mark). No company was even partially dissatisfied with the cooperation.
- Three-quarters of companies did not perceive any barriers to cooperation with knowledge providers. Other companies most often singled out, as barriers, time delays and protracted negotiations on the part of the knowledge provider, the lack of time flexibility among researchers, low knowledge of the practical environment at companies, and the absence of formal mechanisms governing the parameters and course of cooperation between research organisations and companies.
- All of the respondents stated that non-implementation of the project would have somehow made their situation more difficult. 59% of respondents answered that they would definitely not have innovated/modified their product so quickly or even developed it at all. 27% of companies would not

have been able to respond quickly enough to market changes/demand. 14% of companies would have continued incur higher operating costs had the project not been implemented.

- The key objective of the innovation voucher tool is to make it easier for companies to establish initial contact with a knowledge provider and to gain experience by working together on smaller projects. Virtually all (97%) companies plan to continue collaborating with the research organisation with which they cooperated on the basis of the innovation voucher.
- One third of companies (9) collaborated with research organisations for the first time thanks to the innovation vouchers. One very positive finding is that all of these companies want to continue their collaboration and most (5 companies) are cooperating even more intensively or on a long-term basis. There was success not only in initiating new collaboration with researchers, but also in contributing to greater mutual understanding between companies and researchers.
- Roughly two thirds of companies spend more than CZK 200,000 on cooperation with research organisations. A third of them spend more than CZK 1 million. It also follows that companies are very well prepared financially for the continuation of the collaboration they have initiated with research organisations.

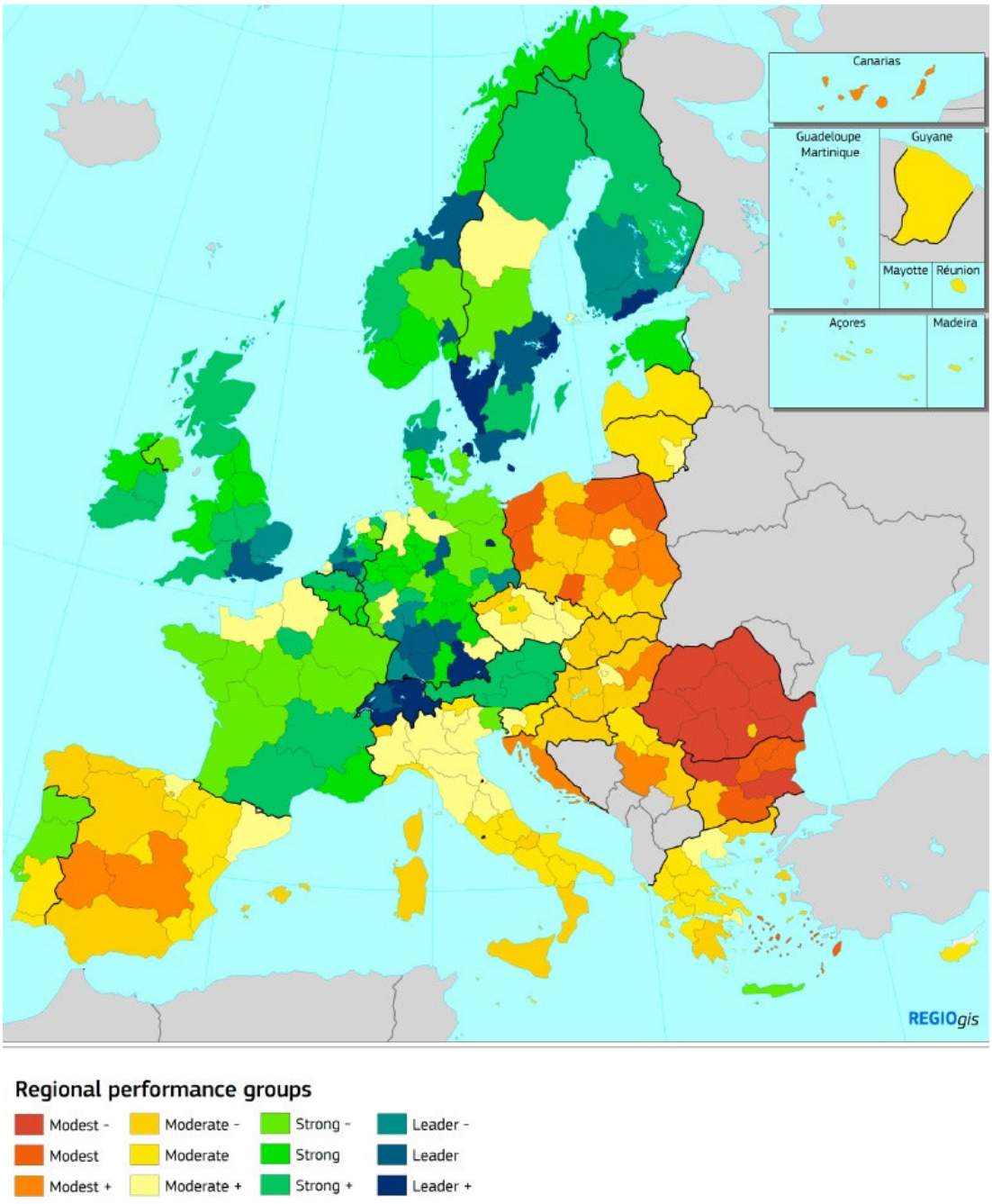
4.2 Comparison of the Overall Innovation Performance of the Central Bohemian Region and the EU

The innovativeness of the economy is often indirectly measured by the knowledge intensity indicator.[27] A need for more accurate measurements led to the emergence of various aggregate indicators that (according to their authors) are better at revealing information directly about the innovativeness of the economy. The most commonly used indicator is the Summary Innovation Index published by the European Commission,[28] and a branch thereof at regional level – the Regional Innovation Scoreboard. This measures EU regions at NUTS 2 level as a composite indicator of innovativeness (see the figure below). The indicator consists of a relatively large number of sub-indicators measuring sub-aspects of innovativeness in the segments of companies, research, human resources and the entire innovation ecosystem.

According to the Summary Innovation Index, the Central Bohemian Region belongs to a group of regions referred to as "moderate innovators", i.e. moderately innovative regions. These include most other regions in the Czech Republic (except Prague, which is a "strong innovator", and the Moravian-Silesian Region and the NUTS North-West region, which belong to a lower category), as well as most regions in Eastern and Southern Europe. In the last six years, the Central Bohemian Region has been hovering around 80% of the summary innovation performance reported as the EU average, and its performance has more or less stalled. A look at the individual pillars that make up the index paints a more specific picture.

[27] R&D expenditure relative to GDP or gross value added
[28] In the European Innovation Scoreboard

Figure 7: Summary Innovation Index in the regions of EU countries, 2019



Data source: Regional Innovation Scoreboard 2019

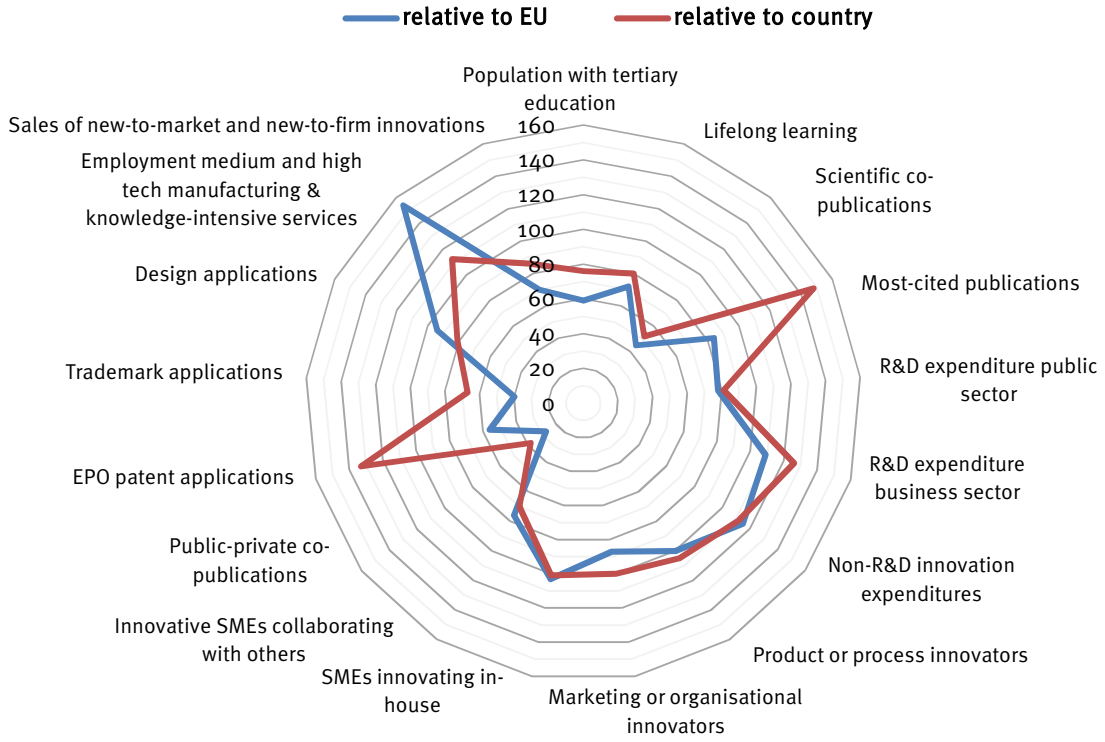
Those pillars (see the graph below) show, on the one hand, what the Summary Innovation Index is composed of, as well as the strengths and weaknesses of the region's innovation performance. According to the index, the Central Bohemian Region has above-average employment in knowledge-intensive activities.[29] Knowing the system to classify the technological intensity of industries, which is based on the simple classification of companies under NACE sectoral categories, it is very likely that the knowledge intensity of employment is not actually as high as the aggregate index data suggest.[30] This can also be

[29] Measured as employment in medium-high and high-tech manufacturing and knowledge-intensive services (KIS).

[30] For example, the entire NACE 26 division (manufacture of electronics) is included among the high-tech branches, even though it can reasonably be assumed that the activities of numerous companies in this branch in the Central Bohemian Region cannot be considered truly high-tech.

inferred from the situation at national level, where a similar paradox has been observed.[31] However, this conclusion can only be verified in a field survey among companies that reveals the true nature of their activities, the technological intensity and the true innovativeness of their business. The volume of R&D investments made by companies is also slightly above average.

Graph 35: Pillars of the Summary Innovation Index in the Central Bohemian Region, 2019



Data source: Regional Innovation Scoreboard 2019

Conversely, the region reports very sub-par performance in patent activity, higher education (there are significant differences in the region between areas closer to Prague and rural/peripheral areas), and non-public R&D expenditure (where regional investments made in research centres under the Operational Programme Research and Development for Innovation in recent years have yet to be manifested due to data time lags[32]). Performance is also below average in terms of the joint scientific publications of the public and private sector, indicating minimum joint activity in long-term research projects geared more towards basic research.

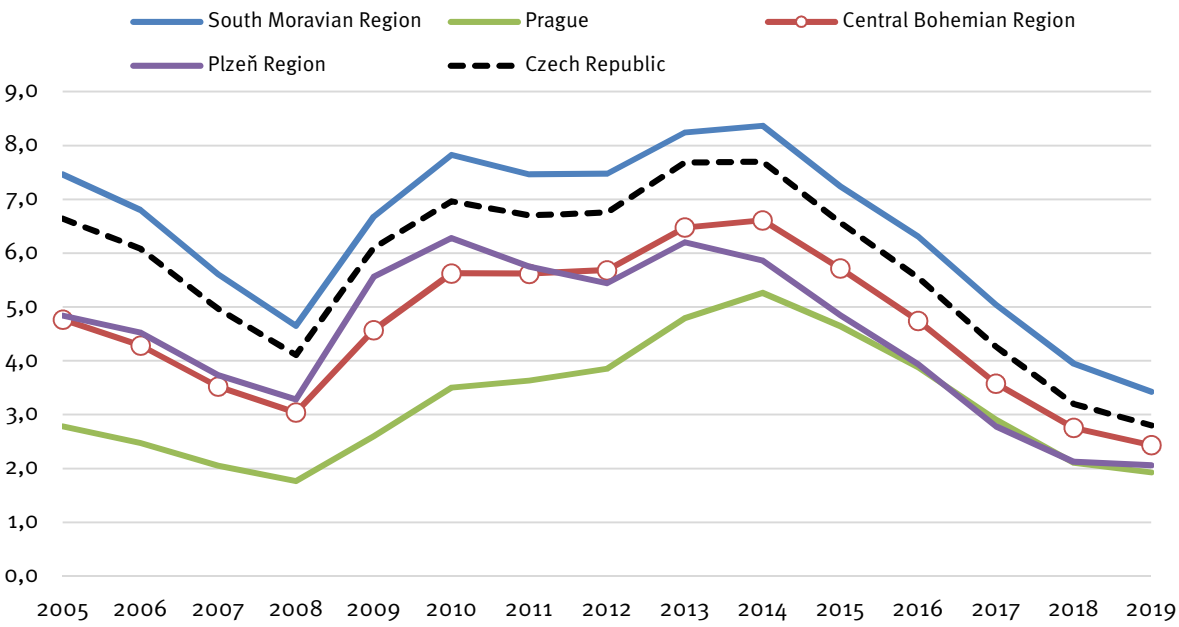
5. People and the Labour Market

Skilled, creative and enterprising people are essential for a functioning innovation ecosystem. They pave the way for the ability to develop innovative solutions for products and services. The availability of a workforce on the labour market for a wide range of different job positions is also important. The Central Bohemian Region is in an unusual position, in that it has a very wide network of secondary schools, but higher education is naturally concentrated in Prague. There are only a handful of private universities and autonomous faculties in the region. The main source of key skilled human resources for innovation and

[31] The Czech Republic ranks highly in the share of employment in high- and medium-high-tech industries for the EU as a whole. In reality, however, companies belonging this category for statistical purposes actually specialise in less knowledge-intensive activities with lower value added. Many of them are branches of foreign companies with limited decision-making autonomy, where long-term objectives and access to global markets depend on other parts of the group. Although the situation is gradually changing and improving, such companies still do not form a large share of the economy (Innovation Capacity Mapping 2014+, Technology Agency).
[32] ELI Beamlines, Biocev, HiLase and others

research is Prague and its university environment, where most students from Central Bohemia go. Therefore, mutual cooperation between the two regions is important. In particular, it is vital to ensure that as many graduates as possible return and find employment in the region.

Graph 36: Unemployment (%) in selected regions of the Czech Republic, 2005–2019



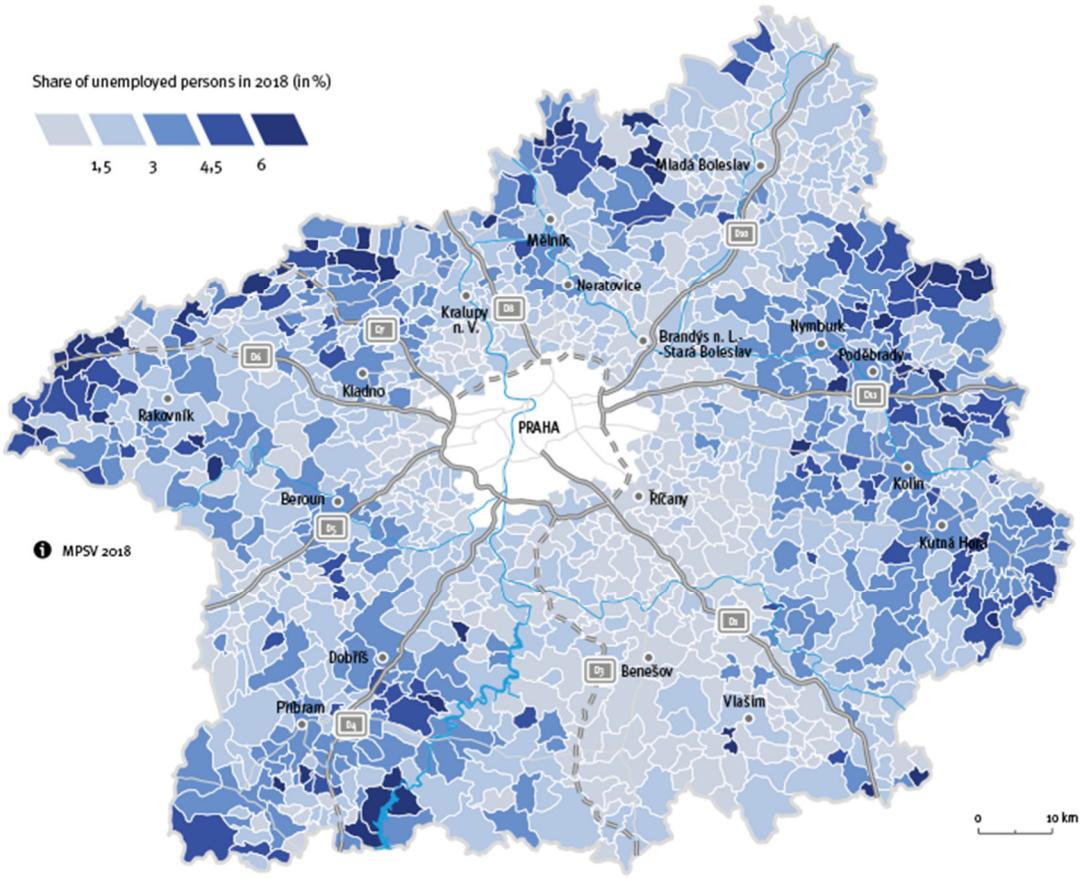
Note: this indicator is calculated as the proportion of available job-seekers aged 15-64 relative to the entire population of that age.

Data source: Ministry of Labour and Social Affairs (2020)

Unemployment trends in the Central Bohemian Region mirror the national average and the stages of economic cycles, which are mostly driven by global developments and certain institutional milestones – EU accession and increased FDI inflows ushered in a stage in which there was a quantitative decline in unemployment, which was subsequently increased again by the economic crisis and has declined steadily since 2014. The unemployment rate reported for the Czech Republic and the Central Bohemian Region is currently the lowest in Europe. It is below the natural unemployment rate conducive to the normal circulation of employees in jobs. In some parts of the region (the hinterland of Prague, the Benešov area, and the Mladá Boleslav area), unemployment has reached very low values below 2%, making it very difficult to find any available workers on the labour market.

The unemployment rate in the Central Bohemian Region has long been 1-2 percentage points lower than the average for the Czech Republic as a whole and is well below the level of unemployment averaged by the EU-28 countries. This indicates a strong regional economy and a well-functioning labour market. The unemployment rate in the Central Bohemian Region, at 2%, is currently one of the lowest anywhere in the EU.

Figure 8: Share of unemployed persons in the Central Bohemian Region, 2018 (annual average)



Note: According to methodology in force as of 1 January 2013, the unemployment rate is calculated as the proportion of available job-seekers aged 15-64 relative to the entire population of that age.

Data source: Ministry of Labour and Social Affairs (2019)

However, unemployment differs considerably from one part of the Central Bohemian Region to another and reflects the level of development and the economic strength of individual locations within the region. There are very few unemployed people in the ring of municipalities around Prague. In the districts of Praha-východ (Prague-East) and Praha-západ (Prague-West), the unemployment rate has long been around 2%. This low figure is due to the proximity of Prague as a strong economic centre, where many people commute to work, and also due to the highly favourable economic and social structure of municipalities in the hinterland of Prague.

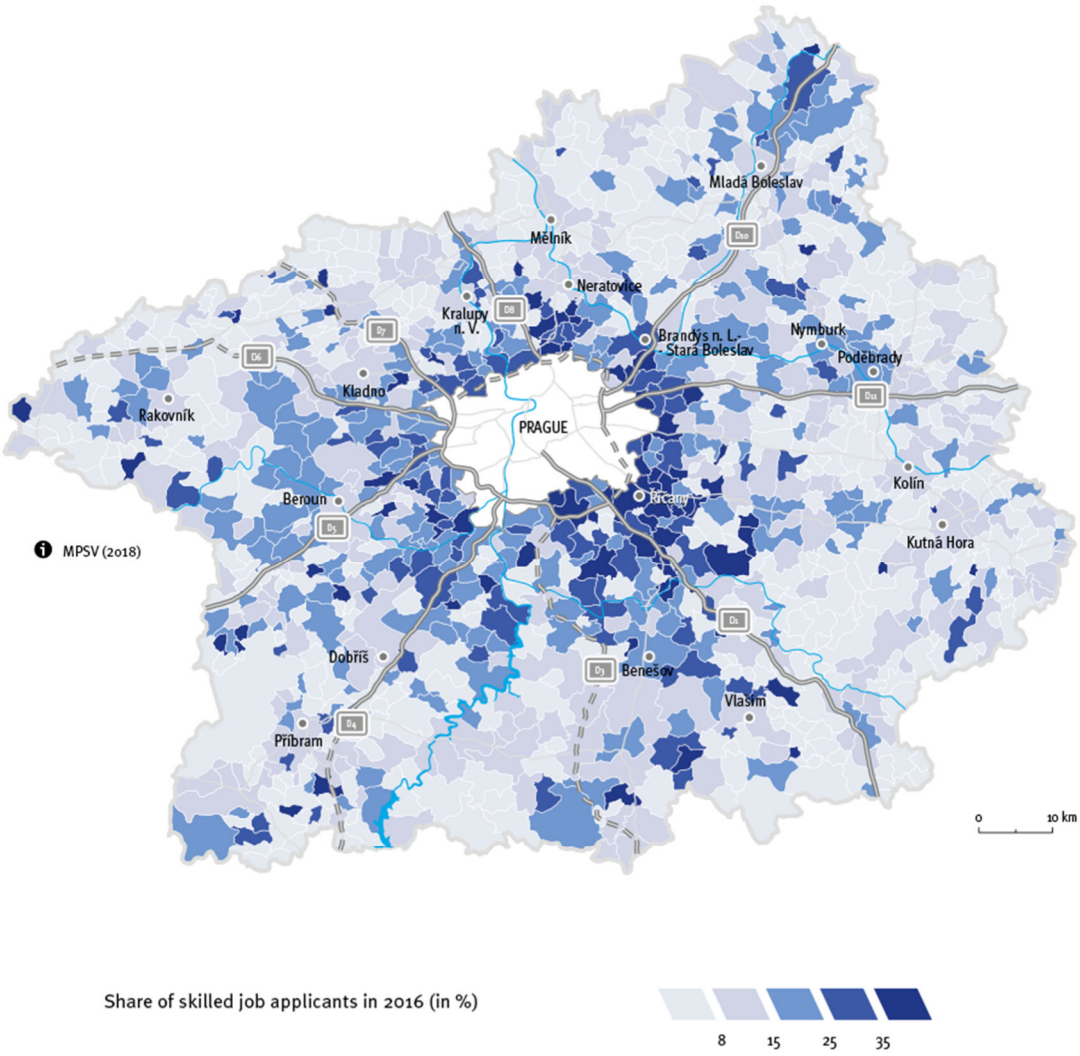
Conversely, in peripheral areas on the edges of the Central Bohemian Region's administrative borders, there are municipalities where the share of the unemployed is close to or exceeds 10%. Besides the Prague suburbs, the surroundings of Mladá Boleslav also report the quite specific developments of a very low unemployment rate with relatively high incomes. In this case, the reason is the strong concentration of economic activities linked to Škoda Auto. Despite the fact that Mladá Boleslav is quite a small town by Czech standards, it the number of job opportunities it generates exceeds even the level of some regional capitals.

For sophisticated economic activities, especially those based on research, development and innovation, the total available workforce on the labour market is not as important as the accessibility of highly skilled professionals and specialists.

A skilled workforce, which includes managers, specialists, and technical and professional workers, is concentrated in the region, especially around Prague. Available people on the labour market seeking these

jobs make up more than 50% of all job-seekers in municipalities in the vicinity of Prague. This indicates that people in these locations are highly skilled. The process of suburbanisation over the last 20 years has concentrated a large proportion of young educated people with high human and social capital in the hinterland of Prague. They offer development potential primarily in relation to research, development and innovation activities. Young, educated and creative people make up a large part of the total population here.

Figure 9: Concentration of skilled labour in the suburban zone of Prague, 2018



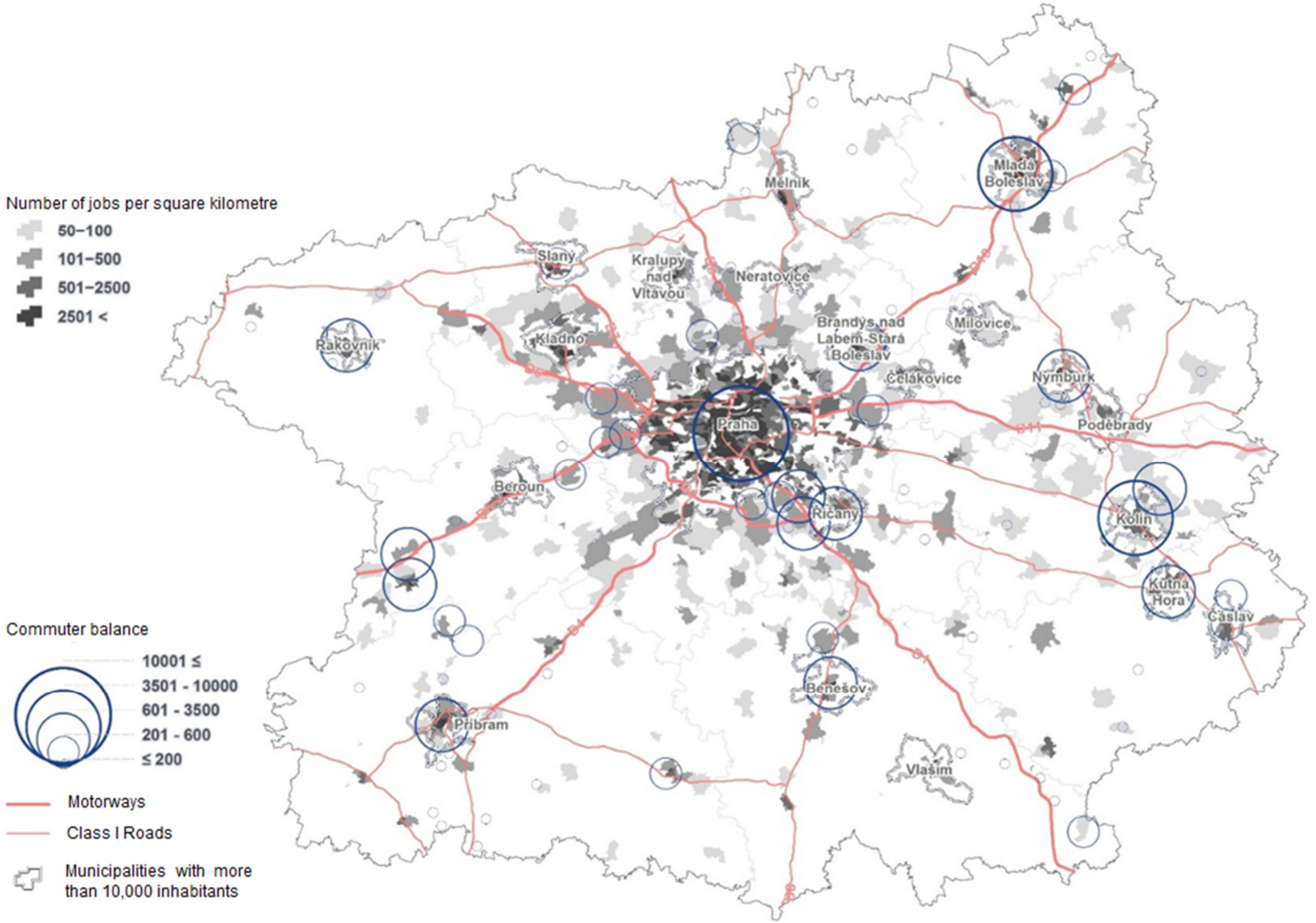
Share of applicants in ISCO 1-3 groups (managers, professionals, technicians and associate professionals) per total number of job applicants.

Data source: Czech Statistical Office

There is also an increased concentration of highly skilled labour in smaller regional centres and their surroundings. Typical examples include Mladá Boleslav, Poděbrady and Benešov. Although the concentration of skilled people here is not as high as in the suburban zone around Prague, these towns and their surroundings have become very attractive for investment in manufacturing sectors that require skilled workers.

It is mainly in these parts of the Central Bohemian Region that potential for the development of economic activities with high value added and based on innovation and research is at its highest. The development of quality transport and data infrastructure indicates that the conditions in place for the development of other parts of the Central Bohemian Region – where the share of talented, qualified and educated people has not yet reported long-term growth – will also improve.

Figure 10: Commuting centres in the Central Bohemian Region, 2011



Note: The number of jobs is calculated as the number of gainfully employed inhabitants + the number of commuters – the number of commuters in a given microdistrict (basic unit of settlement). The commuter balance is calculated as a municipality's number of inbound commuters – the number of outbound commuters, and shows whether the municipality is a commuting centre. Data source: Cartographically modified by the authors based on data from the Czech Statistical Office (2016), Nemeškal, Svoboda, Ouředníček (2015), Svoboda (2016).

6. Main Innovation System Actors in the Region

6.1 Business Innovation Infrastructure

The following chapter provides an overview of entities in the "innovation infrastructure", i.e. support organisations intended to facilitate companies' innovation activities and cooperation in research, and to encourage new business activities. This list encompasses entities both in Prague and in the Central Bohemian Region, as their activities are often intertwined and a number of entities from Prague provide services and even business premises to companies from the Central Bohemian Region. They include business incubators, science and technology centres, technology centres and coworking centres. In Central Bohemia and Prague, there are 64 innovation infrastructure entities (see Figure 11) of varying specialisation and focus and playing different roles in the regional innovation ecosystem. Table 14 of the appendix presents the profiles of individual entities, accompanied by their addresses and websites.

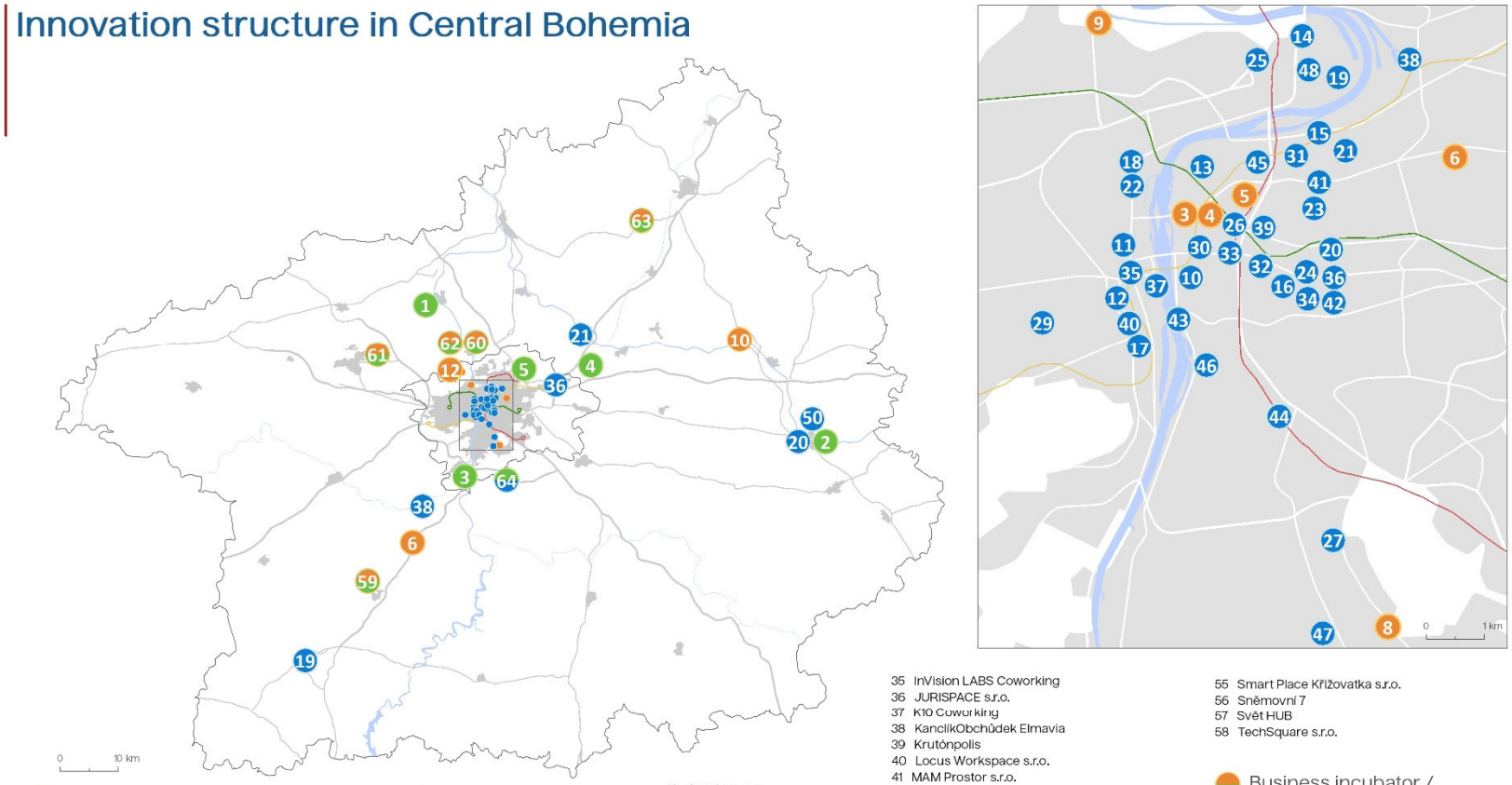
In Prague, coworking centres account for the largest share of the total 48 entities. Most of them are concentrated in the centre and in the inner city, enabling them to capitalise on a readily accessible location within the metropolis and on the proximity of a large number of other services, companies and infrastructure. Coworking centres often focus on a certain type of start-up or freelancer, from the point of view of their line of business and, for example, in terms of their specific needs, such as mothers on maternity leave.

Most of the 16 entities located in the Central Bohemian Region are concentrated in the immediate or close vicinity of Prague, which is a natural centre for the Central Bohemian Region. In some cases, these entities are directly linked to research organisations or academic institutions based in Prague. The different age of innovation infrastructure entities in the region also explains the different levels of development in their activities. In some cases, these are organisations that have only recently been established and are just starting their activities. This reflects, for instance, their occupancy and the portfolio of services that they have offered so far.

Facilities offering the services of a science and technology park (STP) and/or a business incubator also require that the incubated companies or the companies using technical and R&D equipment and the services provided to them via the STP be headquartered there. In all, 81 companies employing 983 workers are headquartered at innovation infrastructure entities in the Central Bohemian Region alone.[33] The extent to which individual facilities' capacity is utilised varies. At those that are just starting their activities in particular, there are still relatively large spare capacities. However, the capacity of some facilities has already been completely or is nearly exhausted.

[33] The data comes from an internal survey conducted by the Central Bohemian Innovation Centre in June 2017

Figure 11: Innovation infrastructure in Central Bohemia, 2017



6.2 Innovation Landscape Support and Intermediate Bodies

In the Central Bohemian Region, there are several entities that specialise in the support and mediation of contacts between innovative companies, scientific and research organisations, and other local development actors. They include Star Cluster, the Central Bohemian Innovation Centre, the Agency for Business and Innovation, the regional branch of CzechInvest, CzechTrade and the Chamber of Commerce.

The *Central Bohemian Innovation Centre* supports research, development and innovation in the Central Bohemian Region. It forms partnerships and establishes new cooperation between companies and academia. It contributes to the growth and development of small and medium-sized innovative companies in particular. It also strengthens the competitiveness of the Central Bohemian region within the Czech and global economy. In the field of education, it concentrates mainly on working with talented students in the technical and natural sciences. It helps to implement innovative solutions and technologies in Central Bohemian municipalities.

CzechInvest, the business and investment support agency, is an organisation partly funded from the public purse. It is subordinate to the Ministry of Industry and Trade. It negotiates domestic and foreign investments in the Czech Republic that are related to production, strategic services and technology centres. It supports small, medium-sized and start-up innovative enterprises, business infrastructure and innovations. At its Prague and Central Bohemia regional offices, it helps companies that are interested in making investments in the region.

CzechTrade offers Czech exporters readily accessible information and assistance services provided by professionals in the Czech Republic and, especially, at foreign offices. The most significant value added delivered by cooperation with *CzechTrade* lies in the expertise and long-standing experience of the agency's foreign representatives. This results in proven savings of time and costs and the mitigation of risks associated with international trade. CzechTrade also has a regional branch in the Central Bohemian Region.

The Business and Innovation Agency is an organisation partly funded from the public purse. It is subordinate to the Ministry of Industry and Trade. It plays the role of an intermediate body for the subsidy schemes under the Operational Programme Enterprise and Innovation for Competitiveness, through which business projects in the manufacturing industry and related services can be co-financed. It provides its services in the region via the regional branch of CzechInvest.

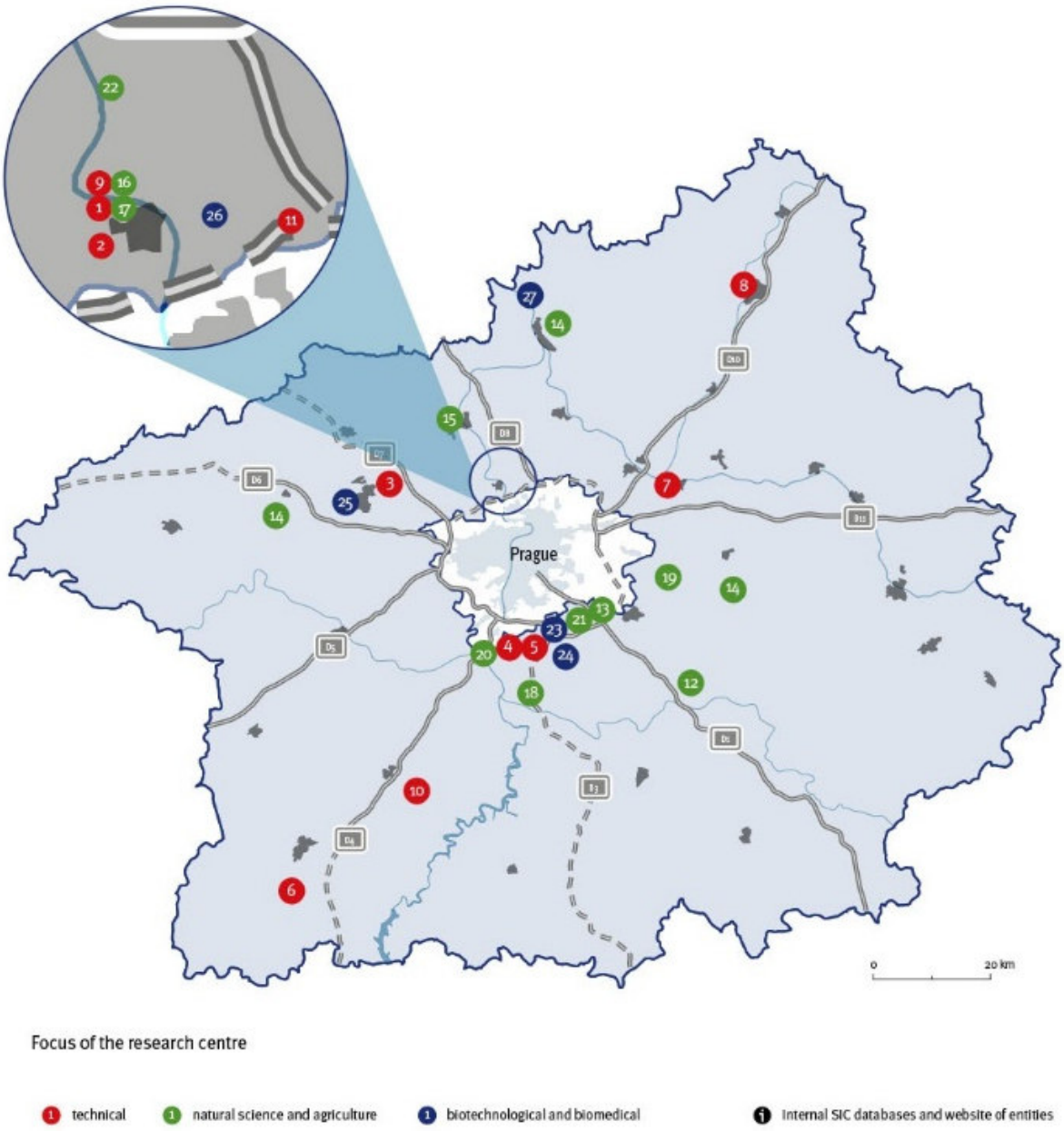
The *Chamber of Commerce of the Czech Republic* is the most important representative of the business sphere. It draws together 15,000 members organised in 68 regional chambers and in 110 industry associations. Regional chambers provide support to enterprises mainly in the form of advisory and consulting services on issues related to business activities, the issuance of certified statements of selected government agendas, the support of training, assistance in entering foreign markets, etc. It provides its services in the region through the Regional Chamber of Commerce of Central Bohemia.

Star Cluster is a science and technology cluster of international stature. It helps innovative companies to grow through incubation and spin-off processes, by providing services with high value added, and by providing quality office and development space and other equipment. It creates a working environment that stimulates innovation and entrepreneurship based on the knowledge economy. It stimulates exchanges of knowledge and technology between its members, partners, universities and businesses.

6.3 Research Organisations

The public research segment in the Central Bohemian Region is described in detail in Chapter 3.1. All public and private research organisations in the region are listed on the map and in the summary table, where there is also a basic profile and a description of the services they offer.

Figure 12: Research organisations and centres in the Central Bohemian Region, 2019



Data source: Central Bohemian Innovation Centre – internal database

Table 11: Research organisations in the Central Bohemian Region

No.	Name	Address	Web page	Number Employees
1	Research Centre Rez The company's main mission is to conduct research and development in the energy field, in particular nuclear. It has a research and experimental infrastructure that includes research nuclear reactors. The centre also focuses on sustainable energy in the SUSEN project as well as researching and modelling the behaviour of materials and components under normal and extreme conditions.	Hlavní 130, 250 68 Husinec-Řež	www.cvrez.cz	303
2	Centre of Vehicles for Sustainable Mobility The research centre focuses on new solutions for piston engines for vehicles and powertrains, including both electric and hybrid, and their control with regard to efficiency, environmental friendliness and mobility value.	Přílepská 1920, 252 63 Roztoky	www.cvum.eu	
3	University Centre for Energy Efficient Buildings The CTU's Centre of Energy Efficient Buildings is a research institute striving for the sustainable development of the construction industry. It offers research and expert services for the construction of new and the renovation of existing buildings to make them energy efficient, comfortable, and environmentally friendly.	Třinecká 1024, 273 43 Buštěhrad	www.uceeb.cz	220
4	Institute of Physics AS CR, ELI Beamlines ELI Beamlines is a laser user infrastructure that implements research and applied projects involving the interaction between light and matter with an intensity that is almost 10 times greater than the currently achieved values. ELI offers the use of laser technology for testing new materials in engineering, nanotechnology, and medical diagnostics and technology.	Za Radnicí 835, 252 41 Dolní Břežany	www.eli-beams.eu	315
5	Institute of Physics AS CR, HiLASE HILASE focuses on the experimental development of a new generation of lasers with high energy pulse or high frequency repetition that are more compact and stable than the devices currently available. It offers contract and cooperative research services as well as expert measurements and customization.	Za Radnicí 828, 252 41 Dolní Břežany	www.hilase.cz	80
6	National Institute for Nuclear, Chemical and Biological Protection Research focusing on the identification and quantification of radioactive, chemical and biological substances, assessing their effect on humans and the environment. Testing and expertise in chemical, biological and radioactive substances.	Kamenná 71, 262 31 Milín	www.sujchbo.cz	57
7	SVUM a.s. A research centre in metallic materials, plastics and their testing in accredited laboratories. It offers equipment and services for strength, fatigue, metallography and corrosion testing.	Tovární 2053, 250 88 Čelákovice	www.svum.cz	52
8	ŠKODA AUTO University It focuses on education, offering unique bachelor's and master's programmes that combine economic education with a high-quality base of technical disciplines. It has its own internal grant agency that promotes the research potential of its staff.	Na Karmeli 1457, 293 01 Ml.Boleslav	www.savs.cz	120
9	ÚJV Řež, a. s. The institute offers project and engineering services, support for the safe and effective operation of nuclear and classic power plants, the chemistry of the combustion cycle and the management of nuclear and other specific waste. In the field of healthcare, it focuses on the research, development, distribution and production of radiopharmaceuticals.	Hlavní 130, 250 68 Husinec-Řež	www.ujv.cz	350
10	Institute of Thermomechanics of the CAS, Aerodynamic Laboratory in Nový Knín The Institute conducts interdisciplinary basic research in the following areas: fluid dynamics, thermodynamics, dynamics of mechanical systems, solid mechanics, interactions of fluids and solids, environmental aerodynamics, biomechanics, mechatronics, electrophysics, electrical machines, drives and electronics and material diagnostics.	Jatecká 511, 262 03 Nový Knín	www.it.cas.cz	236
11	Research Institute of Geodesy, Topography and Cartography The institute focuses on basic and applied research in geodesy and geodynamics, the surveying and cadastre of real estates, the development and testing of new methodologies, procedures and programme resources, and providing expert consultations in various fields.	Ústecká 98, 250 66 Zdiby	www.vugtk.cz	58
12	Astronomical Institute AS CR The institute is the country's leading scientific institution in the fields of astronomy, astrophysics and cosmic physics. It studies the origin, evolution and physical properties of stars and star systems, unusual and exotic objects in space, the dynamics of natural and artificial objects in the solar system, interplanetary matter and Earth's atmosphere.	Fričova 298, 251 65 Ondřejov	www.asu.cas.cz	154
13	Institute of Biotechnology CAS The Institute of Botany focuses on science and research in all the fields of botany, ranging from classical taxonomy, biosystematics and plant evolution, to selected groups of fungi, ecology, ecophysiology, phytogeography and vegetation mapping and dendrochronology, wood anatomy, and karyological and population genetic studies.	Zámek 1, 252 43 Průhonice	www.ibot.cas.cz	300
14	Czech University of Life Sciences Czech University of Life Sciences was established in 1906 and in 1995 changed its name to the present one. It consists of 5 faculties and 2 institutes that carry out multiple study programmes in the fields of agriculture, forestry and also in the related technical and economic disciplines.	Kamýcká 129, 165 00 Praha 6 – Suchdol	www.czu.cz	1180
15	Technopark Kralupy of The University of Chemistry and Technology Technopark Kralupy is part of The University of Chemistry and Technology, Prague. It is a scientific research institute focusing on building chemistry and other related fields. Technopark possess the top laboratory equipment allowing to take on even the most demanding challenges in the field of R&D.	Žižkova 7, 278 01 Kralupy nad Vltavou	www.technopark-kralupy.cz	20
16	Institute of Inorganic Chemistry AS CR It engages in basic and applied research in inorganic chemistry and fields straddling the border between inorganic chemistry with material sciences and other fields.	Řež 130, 250 68 Husinec	www.iic.cas.cz	86
17	Nuclear Physics Institute of the CAS The main focus is research in nuclear physics and other related fields and the use of methods of nuclear physics in multidisciplinary branches of science and research.	Řež 130, 250 68 Husinec	www.ujf.cas.cz	300
18	Institute of Forest Ecosystem Research Institute of Forest Ecosystem Research, Ltd., is an independent, private research organization. The core activity of the company is carrying out applied and basic research projects on forestry, forests and natural environment.	Čs.armády 655, 254 01 Jílové u Prahy	www.ifer.cz	20
19	Research Centre SELTON Applied research in the field of agricultural crop breeding, mainly concerning the study of genetic diversity and the precise identification of initial breeding materials.	Kolodějská 24, 250 84 Sibřina	www.selton.cz	12
20	Forestry and Game Management Research Institute It focuses on basic and applied research and development in forest and game management and other related fields. It also provides expert and advisory services for the public administration and forest owners, as well as publishing and training services.	Strnady 136, 252 02 Jíloviště	www.vulhm.cz	100
21	The Silva Tarouca Research Institute for Landscape and Ornamental Gardening The institute's fields of research include the ecology of forests and the landscape, the study of long-term changes and the land-use evolution, solutions for vegetation in urban and agricultural areas, the monitoring of pollutants, research on the spread of new plant diseases, the analysis of the use of biomass as an alternative energy source and DNA analysis.	Květnové nám. 391, 252 43 Průhonice	www.vukoz.cz	150
22	Bee Research Institute at Dol It is engaged in research, development and education in apiculture and bee products. In addition to research, the institute also engages in development and production. It also organises seminars and courses for bee-keepers, pupils and students.	Dol 94, 252 66 Máslovice-Libčice nad Vl.	www.beedol.cz	40
23	Biotechnology and Biomedicine Center of the CAS and Charles University in Vestec BIOCEV is a joint project with the goal of providing a research centre of excellence in biotechnology and biomedicine. The newly built knowledge base, together with BIOCEV's singular infrastructure, provide biotechnology companies unique collaboration opportunities through contracted research and staff training in advanced biotechnological methods.	Průmyslová 595, 252 42 Vestec	www.biocev.eu	416
24	Institute of Biotechnology of the CAS The activities of the institute are focused on excellent basic research in molecular biology with prospective transfer of biotechnological methods and tools to human medicine or other important areas of human activity.	Průmyslová 595, 252 42 Vestec	www.ibt.cas.cz	115
25	CTU, The Faculty of Biomedical Engineering The faculty focuses on research and training of experts in medical technology, thereby preparing biomedical technicians, engineers, and ICT specialists. The faculty has equipment for providing experimental teaching and research in 30 laboratories, including some that simulate the conditions of both emergency and intensive care departments in hospitals.	Nám. Sítná 3105, 272 01 Kladno	www.fbmi.cvut.cz	310
26	National Institute of Mental Health NIMH is quickly becoming a reference centre in the field of mental health in the Czech Republic. The applied research activities focus on the development and testing of new methods of diagnostics and treatment, including the synthesis and R&D of new drugs, the development of new medical equipment and technologies for mental health.	Topolová 748, 250 67 Klecany	www.nudz.cz	280
27	Institute of Animal Physiology and Genetics AS CR The main activity of the institute is studying the properties of domestic, wild and laboratory animals. The tasks being currently addressed range from highly biomedical to biodiversity-oriented topics. The research focuses on mammalian cloning, assisted reproduction and cell cycle regulation.	Rumburská 89, 277 21 Liběchov	www.iapg.cas.cz	195

1 technical | 1 natural science and agriculture | 1 biotechnological and biomedical

Data source: Central Bohemian Innovation Centre – internally developed survey

7. Innovation in Public Space

More than in other regions, in the Central Bohemian Region public space plays an important role in the development of an innovative environment and qualitative changes. There are considerable differences between the metropolitan area of Prague and the peripheral parts of the region, and internal barriers are created in the sustainable (organic) development of the region. There is also a north-south divide. Most of the big companies that make up the largest economic output are in the northern half of the region, as are the most fertile areas with the best conditions for agriculture. The southern part of the region is characterised by extraordinary natural conditions, and is well suited to tourism and the development of services that are not physically dependent on the presence of customers. As there are more than 1,100 municipalities, mostly with populations below 3,000, this places extraordinary demands on infrastructure, which is currently insufficient. In the future, it is not entirely realistic to create good living conditions in all such municipalities in all parts of the region.

In all areas of life in this part of the country, the profound influence of Prague and Central Bohemia is evident and has mutually positive and negative effects. Prague's plans for transport, health care, social affairs, education and other areas are increasingly influencing the broader environs around Prague. Cooperation between actors of change in the various areas is therefore very important. The development of the innovative environment also relies heavily on the cooperation of individual actors within the region – representatives of municipalities, public administration in general, NGOs, companies, research organisations and schools (these last two types of dialogue partners are viewed as key drivers of innovation and qualitative change in the longer term).

Innovation driven by the public interest

The current interpretation of applied research and its importance for innovation, which is based solely on the notion of "market-driven innovation" underpinned by new technologies emerging at companies, is contrasted by a different view of innovation that is opening up – innovation "driven by regulation" and sought by "public space", i.e. in the public interest. These are mainly qualitative changes that are associated with EU strategies and national strategies implemented through legislation and with the support of subsidy schemes. In the context of the Czech Republic and Central Bohemia, these are primarily changes associated with the low-carbon economy, population ageing, and environmental protection measures. A similar trend is evident in other countries around the world, where public institutions are more involved in research and innovation activities. This takes place through the award of contracts for new products or through grant schemes aimed at "smart" solutions. This tendency can be seen, for example, in relation to smart cities, where cities are involved in innovation activities. These smart cities thus become test sites for innovative solutions to social and environmental challenges.

Smart city / smart region

In the last ten years, the Czech Republic has witnessed significant growth in municipalities' activities originally focused on energy savings in public space in large agglomerations and referred to as "smart cities". Gradually, the concept began to spread to smaller municipalities. Innovative solutions are developed in energy, transport, the expansion of IT technologies, public administration, and construction, where interest is gradually extending from energy-efficient buildings to "smart" houses. New technological possibilities are emerging in health care, education, and social affairs. The importance of creative branches and culture in public space is growing.

In 2016 and 2017, the Central Bohemian Innovation Centre conducted two surveys on smart cities. They included questions on innovations that had been implemented or were planned. The 2017 survey was particularly detailed.

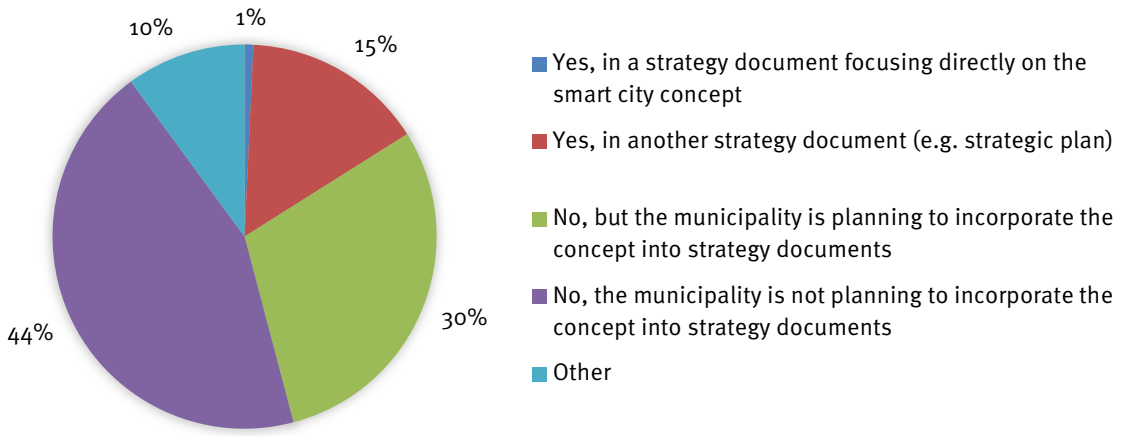
At 1 January 2017, the Central Bohemian Region had a population of 1,338,982. There were 377 municipalities with a population of up to 300 inhabitants, with a total of 66,305 people living in them. In number, these municipalities make up 33% of all municipalities in the region, but account for only 5% of the population. There were 233 municipalities in the category of 301-500 inhabitants, where a total of

91,424 people were living, i.e. they accounted for 20% of all municipalities and 7% of the population. There were 278 municipalities in the category of 501-1,000 inhabitants, where a total of 194,896 were living, i.e. they represented 24% of all municipalities and 15% of the population. There were 183 municipalities in the category of 1,001-3,000 inhabitants, where a total of 291,427 people were living. These municipalities made up 16% of all municipalities in the region and 22% of the population. There were 73 municipalities with a population of 3,001 or more inhabitants, with a total of 694,930 people living them. These municipalities make up just 6% of the total number of municipalities in the region, but account for 52% of the population. Therefore, only a quarter of the population (26%) lived in municipalities with up to 1,000 inhabitants, which account for 78% of the total number.

The questionnaire survey was conducted among 290 municipalities and towns representing 642,000 or almost 50% of all inhabitants in the Central Bohemian Region. In the category of up to 300 inhabitants, 90 municipalities participated in the survey, in the category 301-500 inhabitants, there were 50 participating municipalities, and in the category 501-1,000 inhabitants, there were 60 municipalities. Fifty-five municipalities and cities participated in the category of 1,001-3,000 inhabitants, while there were 35 participating towns in the category of over 3,000 inhabitants.

The questions focused on municipal administration and strategic planning, transport and mobility, the environment and energy, support for business and social services, and communication technologies. The survey showed that only 1% of municipalities and towns that participated have a strategy document centred directly on the smart city concept, 15% of municipalities and towns have drawn up this concept as part of another strategy document, and 30% of municipalities and towns are still at the planning stage of incorporating their smart city concept into strategy documents. The larger the municipality, the greater the knowledge of and readiness for a strategic approach.

Graph 37: The smart city concept in municipalities' strategy documents



Data source: internally developed by reference to an online survey

In general, however, the application of innovative approaches to solving problems of public space is still in its infancy. It is mostly being implemented in the field of energy savings, with most interest focusing on environmental protection and, to a lesser extent, transport. Elsewhere in the world, the smart city trend is developed and its expansion is accelerating as the technology advances. Smart city principles and trends are not necessarily limited to a city as such, and can be applied just as well outside large cities, i.e. in the "smart countryside". [34] Innovative solutions relating to the "smart countryside" are an example of

[34] See, for example, the Central Bohemian Innovation Centre's study "Design Option Paper on the Strategic Intervention of a Smart City – Start-up City Tel Aviv, 2017".

innovations driven by regulation and public space, which have great potential for further development in the Central Bohemian Region.

eGovernment

As far as innovations in public administration itself – eGovernment – are concerned, statistics currently monitor its use only at national level, i.e. as the number of outputs provided through CzechPoint (the register of criminal records, the property register, the commercial and trade register, etc.) and electronic declarations submitted for financial administration (value added tax, road tax, conveyancing tax, and personal and corporate tax returns). The use of CzechPoint is generally growing, with more than 2.1 million outputs for the whole of the Czech Republic in 2016. The installation of data boxes is growing relatively fast (from 34,000 in 2014 to 54,000 in 2016), but this is an area that is not sufficiently used. In terms of electronic returns submitted to the financial administration, between 2014 and 2016 the number of VAT filings increased the most in number (from 1.5 to 2.1 million filings). In all the categories monitored, the number of filings increased between two- and fourfold.

In the survey discussed above, in relation to "smart" municipal administration, or eGovernment, the Central Bohemian Region's respondents were asked about their use of the electronic registry, the publication of their detailed electronic budget on the municipal portal, participatory systems (the harvesting of citizens' ideas and comments), access to electronic forms for individual agendas, the public accessibility the contracts register, mobile communication with the clients of municipal authorities, an electronic questionnaire of citizens' satisfaction, the electronic registration of public procurement candidates, etc. Municipalities are most experienced in the use of electronic registries (70%), and 51% of them stated that they implement (or have implemented) projects aimed at publishing detailed electronic budgets on their websites. 44% of municipalities and towns had implemented (or are implementing) projects aimed at creating participatory systems. Interest in electronic communication with citizens is gradually growing. It is more common in larger cities, less so in small municipalities. There are municipalities that do not yet have a website.

Spatial development, education and health as examples of innovative approaches

At present, there is no known systematic overview of the use of innovative approaches in public space in the Central Bohemian Region. However, there are a number of examples that demonstrate the relevance of applied research to such innovations.

An example is the use of the TD 0100549 project under the Omega programme run by the Technology Agency, where employees from Charles University worked with the municipality of Dolní Břežany to prepare a forecast of population trends in this municipality near Prague up to 2030. This resulted in methodology that made it possible to demarcate the functional territory of the Prague metropolitan area for the application of ITIin the use of European Structural and Investment Funds in the 2014+ programming period.

Another example is services for seniors prepared by staff from the Czech Technical University's University Centre for Energy-Efficient Buildings in Buštěhrad. These are solutions aimed at increasing the quality, availability and efficiency of services offered to seniors in their home environment. The first innovation is an electronic platform for the unification of data, services and issues relating to the health and social management of services. The second solution is a services marketplace. This is a combination of an information portal, an e-shop with the option of finding and requesting online services, and a portal for evaluating services. The third planned new solution is a modular emergency care solution that combines technologies for emergency units, smart home elements, telemedicine equipment, alarms, and server solutions, and takes into account both formal and informal ways of coordinating care.

An education-related example is the streamlining of the administration of primary education in areas with a declining number of primary school pupils via cluster-based schools. For instance, in the Rakovník area there is the Primary and Nursery Cluster School Without Frontiers, which clusters Mšec Nursery and Primary School, Srbeč Nursery School, and Tuřany Nursery and Primary School. This is a unique project created in order to strengthen and stabilise the school district on the outskirts of Rakovník and Slaný (both municipalities with extended powers). The cluster school was set up to unify the quality of education in

the newly created school district (on the outskirts of the Rakovník municipality with extended powers), to stabilise the pupil capacities, and subsequently to improve conditions relating to long-term sustainability for the school authorities, including the optimisation of operating costs.

An example in the field of polytechnic education is the equipping of the above-mentioned with a centre for teaching DT and robotics and with school workshops (again, with the support of the Ministry of Education, Youth and Sports) and preparations for Industry 4.0 in a special academy specialising in this theme, not only as a space for pupils and students, but also as an training programme for teachers. The innovation of polytechnic and technical education includes the implementation of new technologies in teaching (3D printing and 3D design, Robotics for both tiers of primary school). This should be carried out in cooperation with school organisations from the outskirts of the Rakovník municipality with extended powers – Čistá Primary and Nursery School, Jesenice Primary and Nursery School, Mutějovice Primary School, Kolešovice Primary and Nursery School, Dubínek Nursery School, and Hředle Primary School.

Technical prerequisites for innovations in public space

The main technical prerequisites for innovation in public space include the providing ICT infrastructure, i.e. basic physical communication systems facilitating the interconnection of end users, data transmission and information transfer (i.e. a set of hardware features to ensure error-free communication and data transmission) make it possible to connect to the internet and other necessary specific data services.

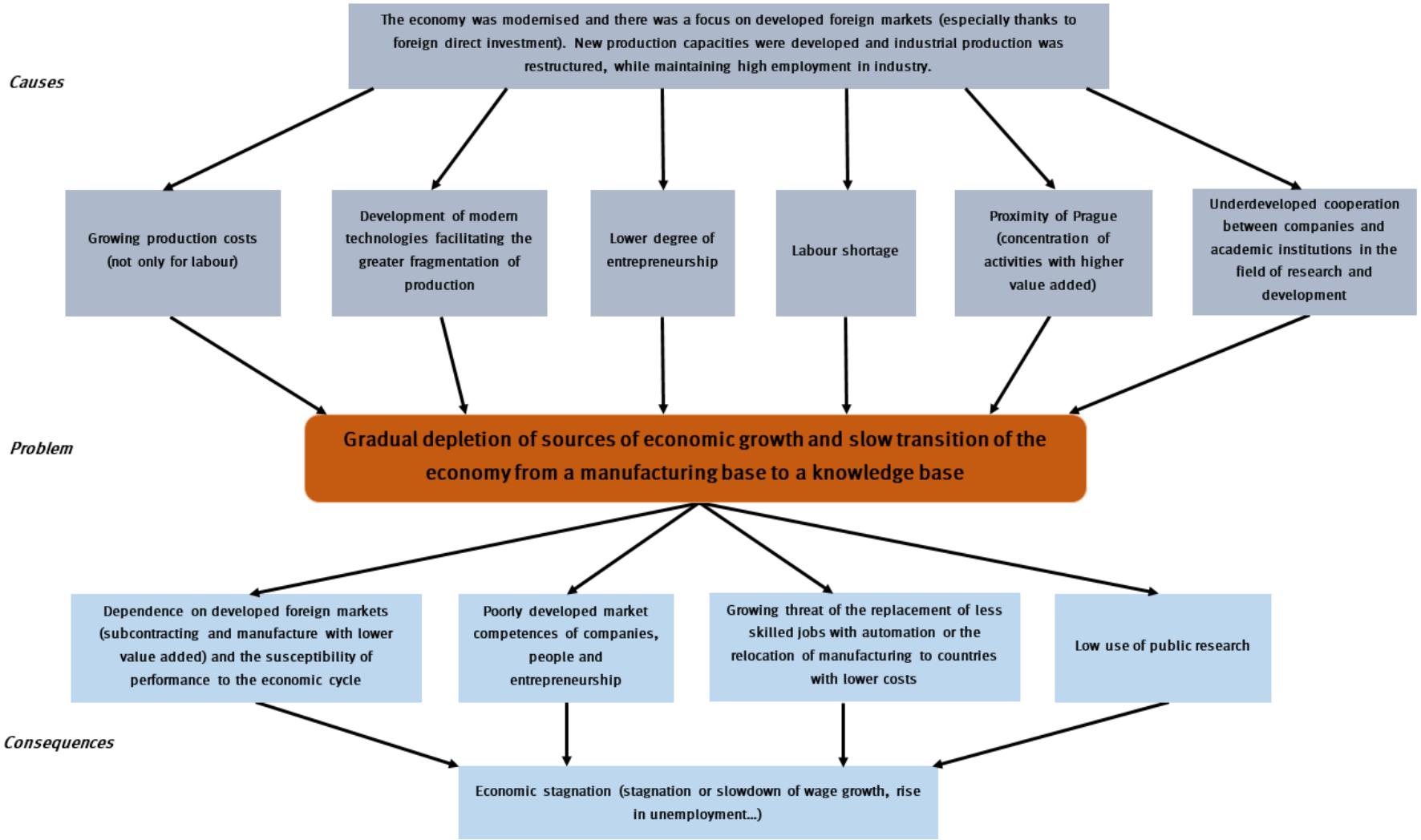
ICT infrastructure facilitates the virtualisation of the material world and communication over long distances with no need for physical transfer, i.e. the implementation of changes that, in the production area, are referred to as Industry 4.0, and society-wide as Society 4.0, in the area of eGovernment public administration.

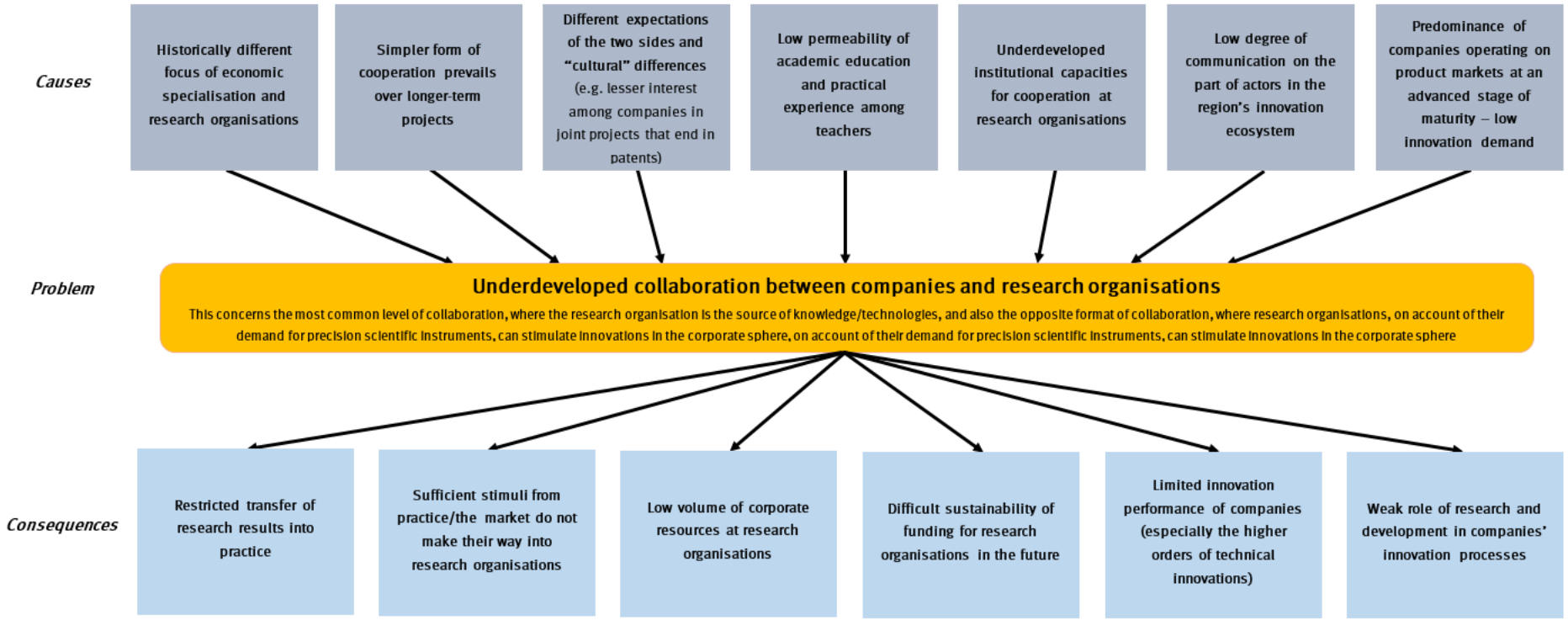
According to indicators drawn up by the Czech Statistical Office on the information society, the ICT infrastructure is currently insufficient. On a nationwide level, an international comparison singles out the Czech Republic as one of the countries with the highest mobile connection, but with the lowest use of services that require a connection with a speed higher than 100 Mb/s. The expansion of ICT infrastructure is hindered mainly by non-financial barriers associated with construction management and insufficient mapping of the situation. The use of services provided via the internet is spreading rapidly, both among the public and among companies, which creates a good opportunity for the "digitalisation" of the region's economy. The population, especially all age groups up to 54, makes widespread use of internet services. The lower the age and the higher the education, the more use there is. Most companies have an online presence, own a ".cz" domain, and have internet access. For the most part, these are connections with a speed higher than 254 kb/s, but not in the order of Mb/s. In terms of the extent to which the first tier of primary schools is equipped with computers and internet access, the Central Bohemian Region ranks tenth in the country. Similarly, ICT-based business is minimal here. The region has the second largest number of ICT experts, evidently company employees. Likewise, a high number of students studying informatics at universities come from the Central Bohemian Region. The extent to which households are equipped with information technologies and the use thereof is the second highest in the country.

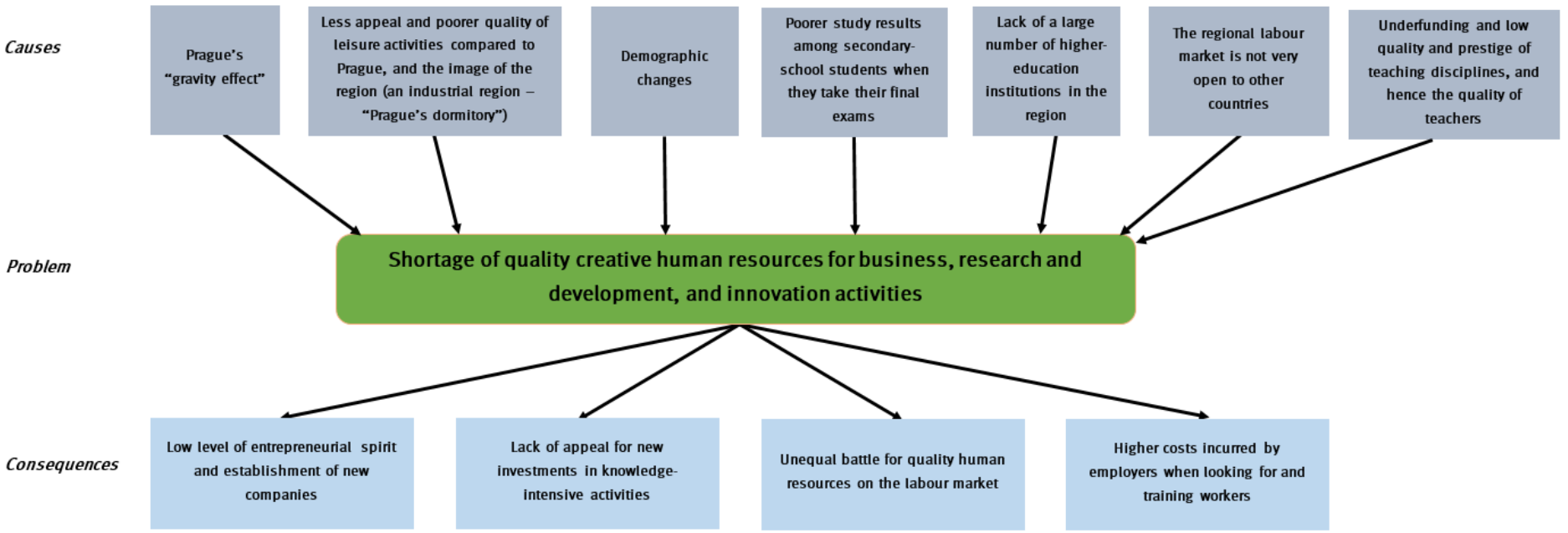
It follows from this information that, for the purposes of innovations in public space, a backdrop has been created for the region's inhabitants to be able to accept "digital" services. If information support and Act 194/2017 are applied, the physical infrastructure can quickly expand and conditions can be created for municipalities' innovation activities and other public services.

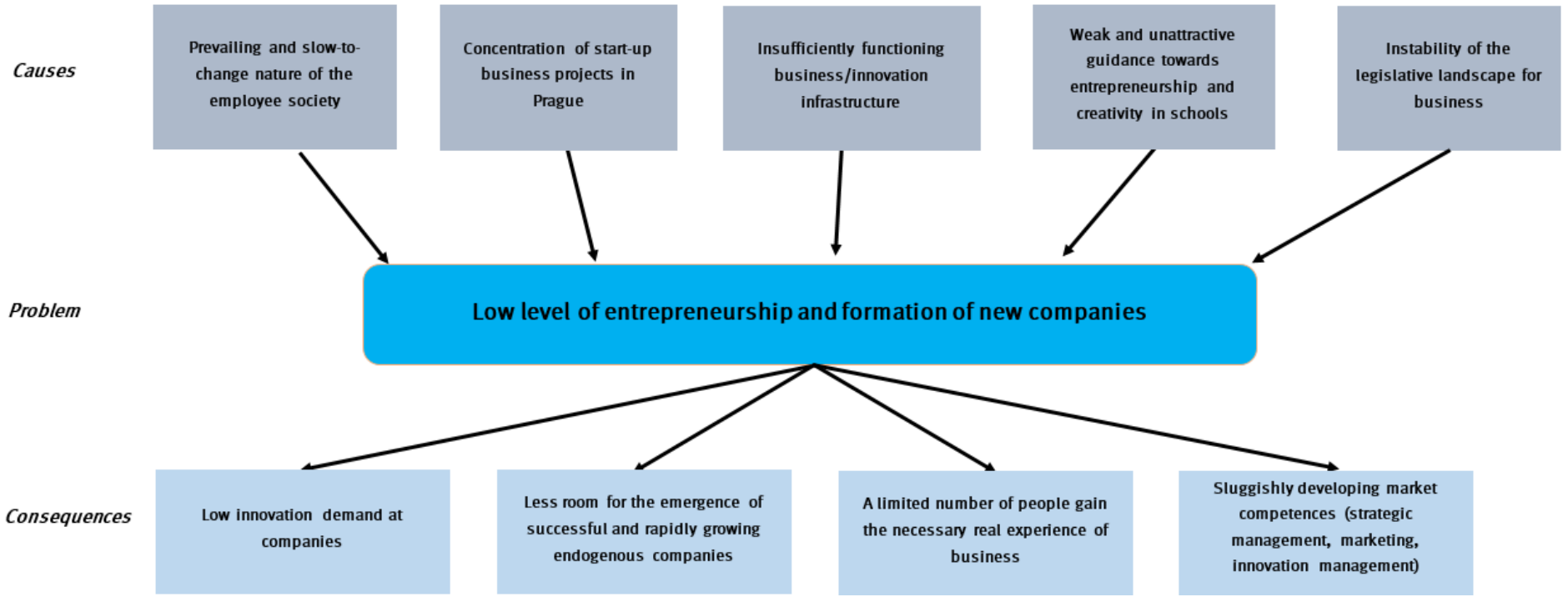
8. Appendices

8.1 Problem Analyses




Causes
Historically different focus of economic specialisation and research organisations
Simpler form of cooperation prevails over longer-term projects
Different expectations of the two sides and "cultural" differences (e.g. lesser interest among companies in joint projects that end in patents)
Low permeability of academic education and practical experience among teachers
Underdeveloped institutional capacities for cooperation at research organisations
Low degree of communication on the part of actors in the region's innovation ecosystem
Predominance of companies operating on product markets at an advanced stage of maturity – low innovation demand
Problem
Underdeveloped collaboration between companies and research organisations
This concerns the most common level of collaboration, where the research organisation is the source of knowledge/technologies, and also the opposite format of collaboration, where research organisations, on account of their demand for precision scientific instruments, can stimulate innovations in the corporate sphere, on account of their demand for precision scientific instruments, can stimulate innovations in the corporate sphere
Consequences
Restricted transfer of research results into practice
Sufficient stimuli from practice/the market do not make their way into research organisations
Low volume of corporate resources at research organisations
Difficult sustainability of funding for research organisations in the future
Limited innovation performance of companies (especially the higher orders of technical innovations)
Weak role of research and development in companies' innovation processes


Causes
Prague's "gravity effect"
Less appeal and poorer quality of leisure activities compared to Prague, and the image of the region (an industrial region – "Prague's dormitory")
Demographic changes
Poorer study results among secondary-school students when they take their final exams
Lack of a large number of higher-education institutions in the region
The regional labour market is not very open to other countries
Underfunding and low quality and prestige of teaching disciplines, and hence the quality of teachers
Problem
Shortage of quality creative human resources for business, research and development, and innovation activities
Consequences
Low level of entrepreneurial spirit and establishment of new companies
Lack of appeal for new investments in knowledge-intensive activities
Unequal battle for quality human resources on the labour market
Higher costs incurred by employers when looking for and training workers


Causes
Prevailing and slow-to-change nature of the employee society
Concentration of start-up business projects in Prague
Insufficiently functioning business/innovation infrastructure
Weak and unattractive guidance towards entrepreneurship and creativity in schools
Instability of the legislative landscape for business
Problem
Low level of entrepreneurship and formation of new companies
Consequences
Low innovation demand at companies
Less room for the emergence of successful and rapidly growing endogenous companies
A limited number of people gain the necessary real experience of business
Sluggishly developing market competences (strategic management, marketing, innovation management)

8.2 Appendices to the Analytical Section

Table 12: Number of small companies (0-49 employees) with five or more R&D personnel (FTE), 2005 and 2018

	2005		2018		Change 2005/2018	
	Number	National share	Number	National share	Number	National share
Prague	73	36.7%	85	23.0%	12	-13.6%
Central Bohemia	17	8.5%	37	10.0%	20	1.5%
South Bohemia	6	3.0%	13	3.5%	7	0.5%
Plzeň	7	3.5%	13	3.5%	6	0.0%
Karlovy Vary	1	0.5%	3	0.8%	2	0.3%
Ústí nad Labem	2	1.0%	9	2.4%	7	1.4%
Liberec	6	3.0%	14	3.8%	8	0.8%
Hradec Králové	6	3.0%	19	5.1%	13	2.1%
Pardubice	4	2.0%	14	3.8%	10	1.8%
Vysočina	4	2.0%	12	3.3%	8	1.2%
South Moravia	34	17.1%	71	19.2%	37	2.2%
Olomouc	9	4.5%	18	4.9%	9	0.4%
Zlín	13	6.5%	22	6.0%	9	-0.6%
Moravia-Silesia	17	8.5%	39	10.6%	22	2.0%
Czech Republic, total	**199**	**100.0%**	**369**	**100.0%**	**170**	

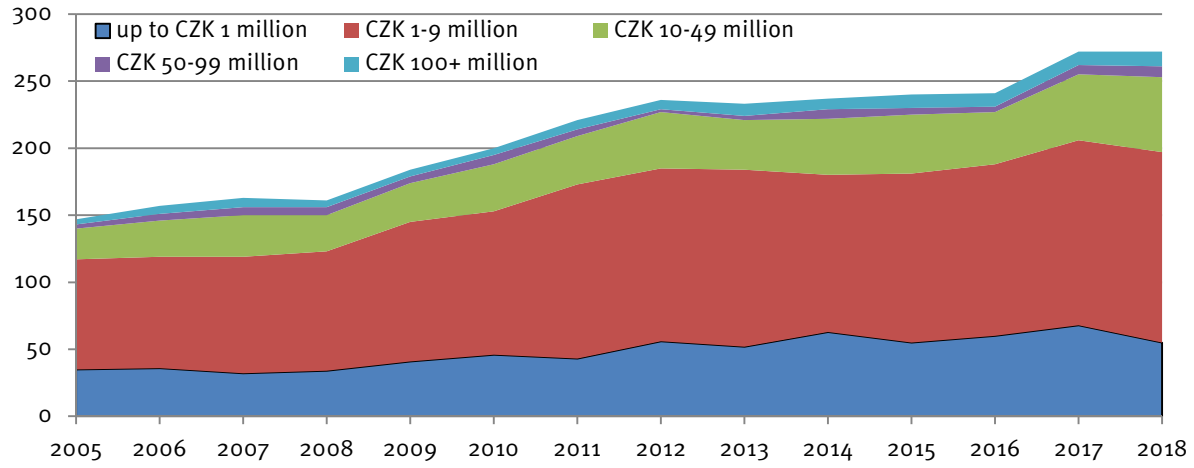
Data source: Czech Statistical Office – R&D Statistics

Table 13: R&D expenditure by ownership of companies in the Central Bohemian Region and in the Czech Republic (CZK millions), 2005–2018

	2005	2008	2012	2013	2014	2015	2016	2017	2018	18/05
Central Bohemian Region										
domestic	1,826	1,875	1,914	2,668	3,039	2,803	2,323	2,698	2,521	38%
foreign	1,713	2,676	3,689	5,652	5,263	5,663	6,337	8,547	10,395	507%
Czech Republic										
domestic	12,232	12,056	17,897	18,446	20,150	19,440	17,574	19,943	21,632	77%
foreign	9,954	16,673	20,331	23,067	26,831	28,707	31,406	36,867	42,022	322%
Central Bohemia/Czech Republic – share										
domestic	14.9%	15.6%	10.7%	14.5%	15.1%	14.4%	13.2%	13.5%	11.7%	-22%
foreign	17.2%	16.0%	18.1%	24.5%	19.6%	19.7%	20.2%	23.2%	24.7%	44%

Data source: Czech Statistical Office – R&D Statistics

Graph 38: Number of companies by amount of R&D expenditure in the Central Bohemian Region, 2005–2018



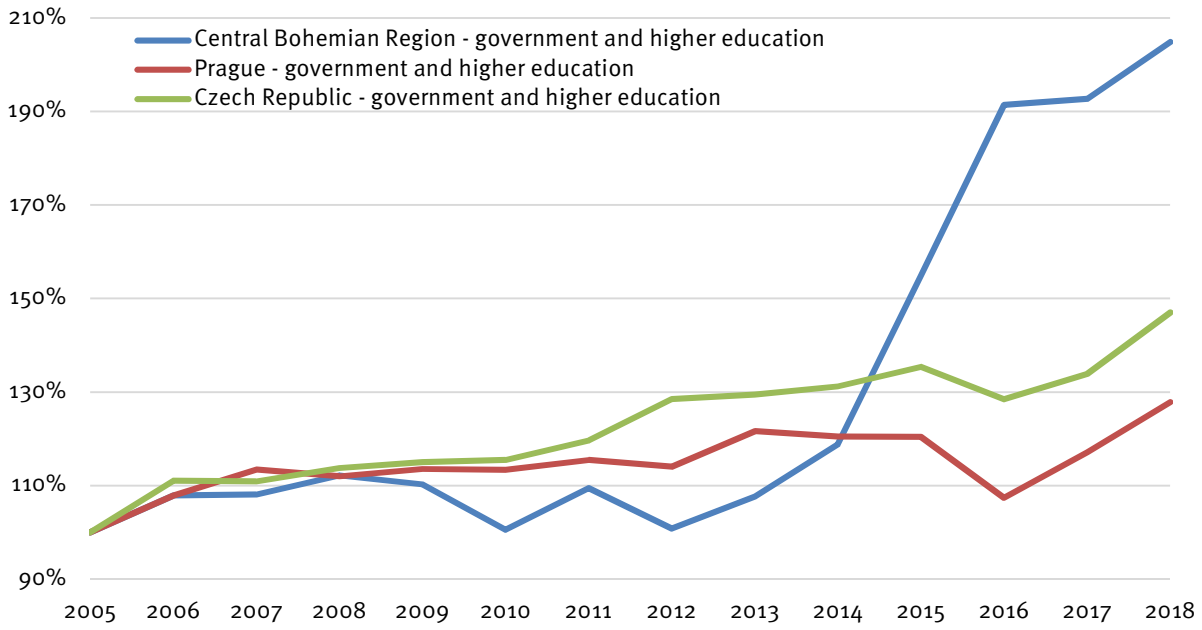
Data source: Czech Statistical Office – R&D Statistics

Table 14: Legal entities per working-age capita, by municipality with extended powers, 2018

Municipality with extended powers	Number of legal entities	Population aged 15-64	Number of legal entities per 100 inhabitants aged 15-64
Černošice	10,662	92,871	11.5
Říčany	4,311	44,403	9.7
Beroun	3,473	40,868	8.5
Brandýs n. L.-St. Boleslav	5,910	71,404	8.3
Příbram	3,575	45,132	7.9
Kladno	6,267	80,157	7.8
Poděbrady	1,481	19,377	7.6
Benešov	2,835	38,267	7.4
Mělník	2,041	28,311	7.2
Kutná Hora	2,197	31,816	6.9
Rakovník	2,386	35,583	6.7
Kolín	3,430	52,625	6.5
Kralupy nad Vltavou	1,348	20,736	6.5
Dobříš	936	14,514	6.4
Mnichovo Hradiště	732	11,352	6.4
Hořovice	1,234	19,221	6.4
Slaný	1,630	25,960	6.3
Mladá Boleslav	4,571	73,190	6.2
Český Brod	837	13,558	6.2
Nymburk	1,543	25,378	6.1
Vlašim	983	16,371	6.0
Lysá nad Labem	1042	17,626	5.9
Sedlčany	813	14,240	5.7
Votice	435	7,782	5.6
Čáslav	870	16,446	5.3
Neratovice	1,030	20,944	4.9
Central Bohemian Region	**61,652**	**878,132**	**7.0**

Data source: Czech Statistical Office

Graph 39: Employment in R&D in the government and higher-education sector in the Central Bohemian Region, Prague and on average in the Czech Republic, 2005–2018, 2005 = 100%



Data source: Czech Statistical Office

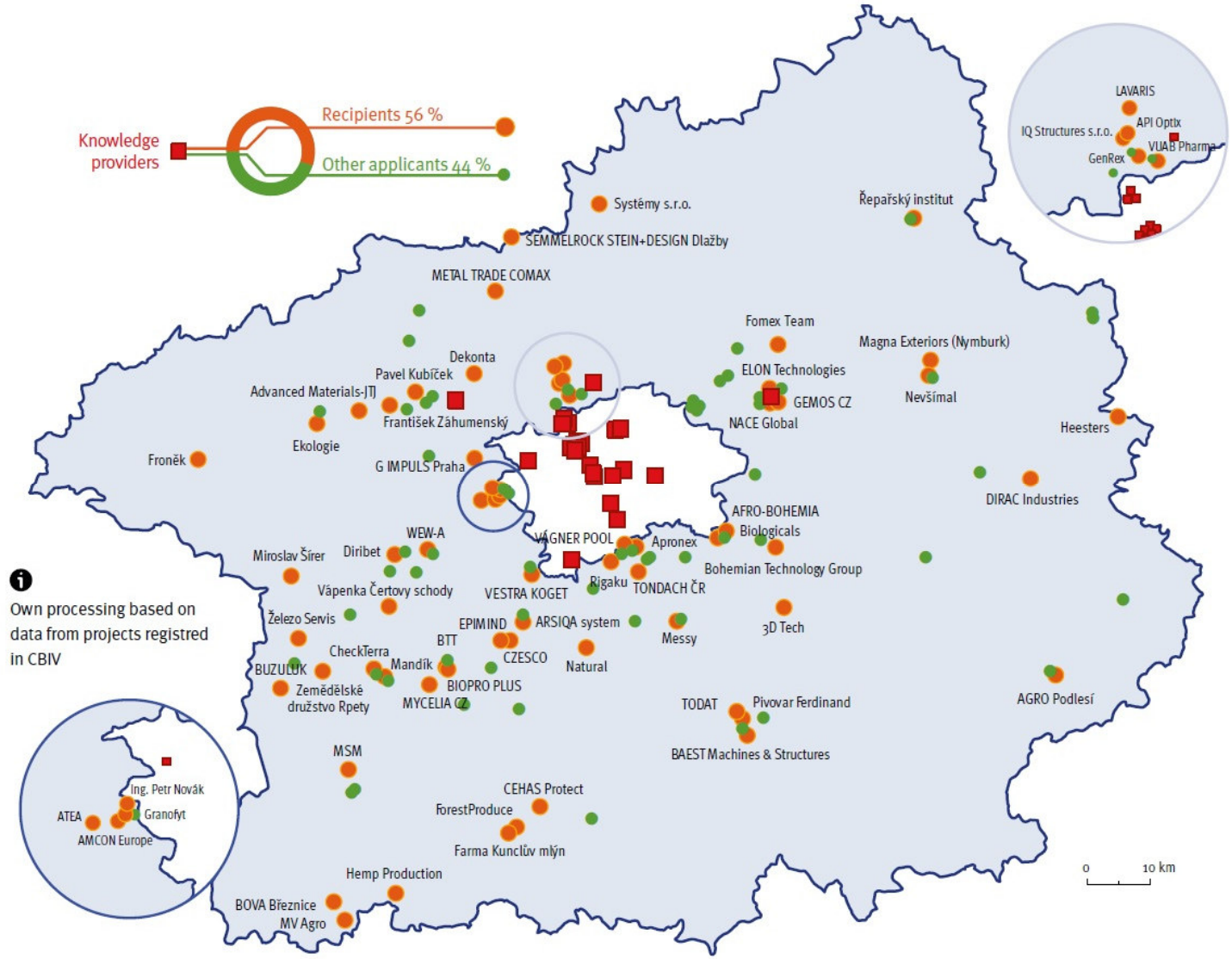
Table 15: Characteristics of innovation infrastructure entities in Central Bohemia

Name	Address	Website	Description
TECHNOPARK Kralupy (University of Chemistry and Technology)	Kralupy nad Vltavou, Žižkova 51/7, 278 01	www.technopark-kralupy.cz	The park provides applied research services in industrial chemistry and the possibility of testing in equipped chemical laboratories. It is a platform for collaboration between the University of Chemistry and Technology and the commercial sphere.
UVR Mníšek pod Brdy a.s.	Mníšek pod Brdy, ÚVR Mníšek pod Brdy 600, 252 10	www.uvr.cz	The park offers its facilities to significant partners in the field, together with their involvement in R&D activities in cooperation with universities and other research organisations in the Czech Republic and abroad. The STP's activities also focus on incubating new companies with innovation and research potential. UVR has many years' experience in these areas and collaborates with a number of leading Czech companies, institutions and institutes. URV aims to create a centre for R&D technologies in the field of environmental protection and the symbiosis of industrial production with the environment.
VTP Mstětice	Zeleneč, Mstětice 34, 250 91	www.eurosignal.eu	The park provides office space for research and development teams and companies with a wide range of support services.
CEROP Kolín	Kolín 2, Sokolská 1095, 280 02	www.cerop.eu	The incubator supports the development of incubated companies by mediating the transfer of technology between the research sphere and business entities through its own network of partner organisations.
Podnikatelský inkubátor Nymburk	Nymburk, Za Žoskou 2 506, 288 02	www.inkubator-nymburk.eu	The incubator offers innovative start-ups premises and support services for the development of their business, or offers established companies premises for their R&D activities.
Cowárna, z.s.	Komenského náměstí 389, 26101, Příbram 3	www.cowarna.cz	Cowárna is an inspiring space for work, collaboration, meetings and events. We create a shared workspace and an interconnected community, where experiences, ideas, thoughts and experiences intertwine. Our doors are open to freelancers, beginner students and independent professionals and experienced people from the field.
Coworking	Kutnohorská 40, 280 02 Kolín	www.coworkingkolin.cz	Coworking offers a shared office and a furnished meeting room.
CoWorking BoBr	Boleslavská 1384, Stará Boleslav	www.coworkingbobr.cz	In addition to offices, the coworking space also offers a meeting room, a library and a relaxation area.
KanclíkObchůdek Elmavia	5. Května 44, 252 29 Dobřichovice	www.elmavia.cz	A coworking space offering nine workstations and a relaxation area.
Prostor plus	Na Pustině 1068, 280 02 Kolín 2	www.prostor-plus.cz	We specialise in the provision of social services, education and regional development. Our vision is a prosperous client and the region in which we operate.
Park vědy Roztoky	Roztoky, Bořivojova 2 380, 252 63	www.pv-roztoky.cz	Rental of equipped laboratories and office space. Sharing of other specialised assistance services with VTP Roztoky.
Strojírenský vědeckotechnický park Buštěhrad	Buštěhrad, U Panelárny 136, 273 43	www.s-vtp.cz	The park provides technologically equipped premises and assistance services for start-up companies or for the prototyping, testing, design work and R&D activities of established companies. It mediates cooperation with research organisations.

Name	Address	Website	Description
VTP Roztoky	Roztoky, Přílepská 1 920, 252 63	www.vtp-roztoky.cz	Provision of equipped premises prepared for research into internal combustion engines, vehicles, gearboxes, electric transmissions and hybrids, fuel cells and high-speed machinery. Incubation programmes for start-ups.
VYRTYCH – Technologický park a inkubátor	Březno - Židněves 116, PSČ 294 06	www.vyrtych.cz	The park offers an environment for the development of young innovative companies and supports scientific activities in the region, with an emphasis on the actual marketing of innovative products.
Prague Innovation Centre (INNOCRYSTAL)	Hodkovice, Inovační 122, 252 41	www.innocrystal.com	The park offers space to accelerate the innovation potential of start-up projects and established companies.

Data source: Central Bohemian Innovation Centre – internally developed survey

Figure 12: Collaboration of companies and research organisations supported by Central Bohemian Innovation Vouchers, 2019



Data source: Central Bohemian Innovation Centre – own database

Innovation in the heart
Central Bohemia Region

Regional Innovation Strategy of the Central Bohemian Region (RIS3 Strategy)

Central Bohemian Innovation Centre, association

March 2020

CENTRAL BOHEMIAN INNOVATION CENTRE

Central Bohemia Region