ERAWATCH COUNTRY REPORT 2010:

Czech Republic

ERAWATCH Network – Technology Centre ASCR

Lenka Hebakova and Ondrej Valenta

Acknowledgements and further information:

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Executive Summary

Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are at the heart of the EU 2020 Strategy replacing the Lisbon Strategy. The strategy among others aims to increase and improve investment in research and development, in particular in the private sector. To support the mutual learning process and the monitoring of Member States efforts, one task of JRC-IPTS within ERAWATCH is to produce analytical country reports. The main objective is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. In order to do so, the system analysis focuses on key processes relevant for system performance. The report is based on a synthesis of information from the ERAWATCH Research Inventory, Country Reports 2008 and 2009 and other important available information sources listed in References.

Along with the socioeconomic transformation of the country after 1990, the Czech research and development (R&D) system underwent a substantial size reduction. In recent years, the Czech Republic is slowly catching up with advanced European countries; however, the lag is still significant, especially in the field of R&D outcomes.

The Czech Republic has a strong public research system based on a developed network of public universities and research institutes. However, one of the main weaknesses of the public research sector can be seen in a low production of commercially applicable results related to the insufficiently motivating system of R&D evaluation. This problem is addressed by the R&D Reform (2008) and National Research, Development and Innovation Policy 2009-2015, which also include a new system of evaluation.

The Czech Republic's trailing behind highly developed European countries in most R&D indicators is addressed by a number of currently implemented strategic documents. Thus, R&D expenditures have been increasing as well as the number of researchers, students and graduates even though these figures have not reached the EU average yet.

The massive inflow of foreign direct investment into the business R&D sector during the past 10 years created conditions for the development of business R&D and knowledge intensive services. However, the low number of S&T graduates possibly leading to the lack of highly qualified labour force in technical fields of research in the future, is becoming a key challenge for the Czech R&D policy.

The main challenge for the Czech R&D systems lies in the interconnection between research, development and innovation processes related to the poor linkages between research and industry, which negatively affects the utilisation of R&D results in practice.

In order to improve research-industry co-operation, several programmes have been implemented in the past years. The Ministry of Industry and Trade played the main role in these initiatives, administering national as well as European programmes supporting the research-industry collaboration.

Recently prepared reforms, including the Reform of the R&D and Innovation system and the Reform of Tertiary Education address the main strengths and weaknesses of

the Czech R&D system. The R&D Reform substantially changes conditions across the fields of resource mobilisation (changes in financing), knowledge demand as well as knowledge production (new system of R&D evaluation).

EU Structural Funds 2007 – 2013 represent a unique chance for financing large R&D infrastructures as well as human resources for research and development in the Czech Republic. More emphasis is to be put especially on human resources mobilisation and ensuring the critical mass of human resources for the functioning of these newly built research infrastructures.

Knowledge Triangle

Generally speaking, some important aspects of the interaction between education, innovation and research policies still remain a challenge for the CR.

Within the research policy, new strategic / policy documents have been adopted recently and the reform steps are being fulfilled by the stakeholders accordingly. An interim evaluation of the policy priorities is just being provided by the Council for Research, Development and Innovation (CRDI). The newly established Technology Agency of the CR, aiming at support of the applied research, has improved the situation in the fragmentation of the Czech R&D funding. The R&D expenditures of the business sector are still not reaching the European average level and the effectiveness of the expenditures shall be increased in both private and public sectors.

In the framework of innovation policy, the National Innovation Policy 2005-2010 has been recently replaced by the National RDI Policy 2009-2015. Following the ideas of the European flagship initiative called Innovation Union, VERA (Czech advisory council for the ERA) has also introduced plans to change the CR system in view of ensuring stronger inter-linkages between the knowledge triangle policies. The Czech innovation environment is currently characterised by a high openness of the Czech economy linked to growing export volume and a high employment rate in medium high-tech and high-tech sectors, but also by a low share of high-tech industry and services in the total value added and slow structural adaptation of the labour force to the market needs.

Concerning education policy, the White Book on Tertiary Education was produced in 2008 as a basis for the tertiary education reform. Unfortunately, this document was not adopted by the Government and the following societal debate on this issue resulted in a controversy. This led to a situation where the reform is still not implemented. However, the numbers of Czech students and graduates have been increasing and the tradition of technical and natural sciences fields in universities is traditionally at a quite high level. Also financial resources from the Operational Programme Education for Competitiveness shall improve the situation and support the necessary reforms, the introduction of a new curriculum framework better responding to the needs of the labour market as well as a better inter-sectoral and international cooperation in universities.

Regarding the indirect impact of other policies on the development of the knowledge triangle, the tax incentives (one of the Government fiscal measures) introduced in 2005 should be mentioned. In 2005, 27% of all R&D active businesses used the tax relief. Since 2005, the number of companies drawing on indirect support to R&D increased to 35% of companies performing R&D activities. The total indirect support of R&D in 2009 reached almost CZK1b (€40m) and the tax deductible ran to CZK4.7b (approx. €190m).

Main recent policy changes as well as strengths and weaknesses of the relevant knowledge triangle policies are listed in the following table.

Effectiveness of knowledge triangle policies

	Recent policy changes	Assessment of strengths and weaknesses
Research policy	• Reform of RDI System • National RDI Policy • Technology Agency of the CR established • New methodology of RD results evaluation introduced • New programmes introduced mainly within the OPs 2007-13 • New Act on the Support of RDI	• S1 - newly introduced Reform and National RDI policy identified key priorities for the following years in the area of RDI • S2 - main basic as well as applied research funds providers are established and have their own national budget chapters (lower fragmentation of the RD financing) • W1 - low business RDI expenditures compared to the EU27 average • W2 - low effectivity of both public and private RD sources
Innovation policy	• National RDI Policy • OP Enterprise and Innovation funds (Innovation, Potential…) • VERA – Council for ERA established in 2010	• S1 - High openness of Czech economy linked to growing export volume • S2 - High employment rate in medium high-tech and high-tech sector • W1 - A low share of high-tech industry and services for value added generation • W2 - Slow structural adaptation of the labour force to the market needs
Education policy	• White Book on Tertiary Education • OP Education for Competitiveness	• S1 – University students and graduates share on population is increasing • S2 – traditionally high quality of technical and natural sciences disciplines on universities • W1 – still not realized Reform of the Tertiary Education planned from 2008
Other policies	• Tax incentives introduced in 2005	• S1 – Fiscal measures such as tax incentives introduced as indirect support to R&D • W1 – Global economic crisis leading to the cuts in RDI spending mainly in the business sector • W2 – not sufficient coordination and interaction of research, innovation and education policy

European Research Area

According to the opening statement of the *2020 Vision for ERA* by 2020, all players should benefit from:

- The "fifth freedom" across the ERA: free circulation of researchers, knowledge and technology;
- Attractive conditions for carrying out research and investing in R&D intensive sectors in Europe;
- Healthy Europe-wide scientific competition, together with the appropriate level of cooperation and coordination.

ERA Vision 2020 was translated into 15 strategic objectives, with relevant indicators and targets attached in order to monitor and evaluate progress.

In the table below, there is an assessment of the national policies/measures supporting the strategic ERA objectives – derived from the ERA 2020 Vision.

Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	• Issue reflected in National RDI Policy and in the Reform as a high priority; • OP Education for Competitiveness and OP Human Resources and Employment support measures;	• Labour market for researchers still suffers from lack of researchers mainly in the S&T fields • Post-graduate education has been classified as preparation for research career, but only 1/3 of PhD graduates choose the research career • Number of university graduates and researchers has been increasing but there is still a significant lack of R&D personnel and graduates in S&T fields, both at universities and in the business sector • International mobility is considered as the main challenge for improvement.
2	Increase public support for research	• GERD and GOVERD increasing in the last decade.	• Secured and increasing long term institutional and project-based funding of R&D (increasing GBAORD) but insufficient horizontal coordination between R&D and innovation policy.
3	Increase European coordination and integration of research funding	• VERA (Council for ERA – advisory board of the CRDI) established in 2010 to deal with these issues including the formulation of the Czech position on the FP8 priorities. • TA CR (Technology Agency of the CR) established in 2009 replacing the high number of providers of the applied research project based funding on the national level.	• One of the main weaknesses of the Czech R&D remains the low level of the public R&D expenditures, even though increasing in a long-term horizon.

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
4	Enhance research capacity across Europe	• Strengthening of the Czech research infrastructure is supported from OP RDI • CR is a member of excellent European research infra-structures and participates in 11 ESFRI Roadmap projects • Czech position papers concerning FP8 priorities created	• CR is involved in the ERA-NET projects as well as in the FPs projects but the Czech participation is not very outstanding and international cooperation within national projects is still not a common practice.
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	• OP RDI Priority Axis 1 + 2: support to centres of excellence and regional R&D centres.	• There is a number of projects supporting the development of research infrastructures from the Structural Funds, but there is question remaining on the sufficient number of researchers for these new infrastructures.
6	Strengthen research institutions, including notably universities	• Institutes of the ASCR have become autonomous / independent public research institutions including the financial responsibility.	• Universities are quite autonomous in the Czech Republic, including the field of research. Anyway, new methodology on evaluation of research results shall be introduced to lead the research providers to excellence.
7	Improve framework conditions for private investment in R&D	• OP Enterprise and Innovation support • MIT national support measures – Tandem, Tip, Trvalá Prosperita • Tax incentives introduced in 2005	• Private sector is still more purchasing the knowledge from abroad and financing the low cost labour cost in the CR, more than support the RDI qualified HR in the Czech Republic.
8	Promote public-private cooperation and knowledge transfer	• OP RDI Priority Axis 3 aiming at support of the commercialisation of research results including the technology transfer offices. • Issue addressed in the national RDI policy as a priority • EF-TRANS project creating methodology for the knowledge and technology transfer offices.	• Existence of R&D programmes supporting research-industry co-operation and industrial R&D with the aim to lead research towards practical outcomes but a low level of services provided by organisations ensuring technology & knowledge transfer into practice. Insufficient supply of mediation services provided to innovative companies and unfavourable conditions for setting up academic spin-offs. Low support to inter-sectoral (private-public-university sector) mobility of researchers.

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
9	Enhance knowledge circulation across Europe and beyond	• VERA: formulation of the Czech priorities within the FP8; • Issue addressed in the national RDI policy as a priority • FP7 Cooperation – international teams common projects	• National and European funding enabled the development of science parks, incubators, TTOs, but also qualified human resources for the big research infrastructures including for TTOs are still a challenge.
10	Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world	• FP7 Cooperation – international teams common projects • Czech participation in Eureka, COST, FP7 etc.	• Low success rate in the international research programmes compared to national ones leading to a low participation of Czech teams in the international activities in the field of research.
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	• National RDI Policy and Reform	• Coordination of the knowledge triangle policies in the CR is not sufficient yet, nevertheless the common research and innovation policy is a first step towards improvement.
12	Develop and sustain excellence and overall quality of European research	• OP RDI Priority Axis 1 – Centres of Excellence • New Methodology for Evaluation of Research Results and its interconnection with institutional funding	• Several new centres of excellence are being supported through the SF in the Czech Republic. PROs and Universities shall be financed according to their research results from 2011.
13	Promote structural change and specialisation towards a more knowledge - intensive economy	• Government Office established "National Economic Council" – group of experts dealing with the issues of necessary reform and structural changes steps.	• Reform of the Tertiary Education and Research Systems shall be finished ASAP including the measures aimed at increasing the effectiveness of R&D expenditures.
14	Mobilise research to address major societal challenges and contribute to sustainable development	• Priorities of the Applied Research 2009-2011 replaced in 2009 the Long Term Principal Directions – addressing the societal challenges.	• Societal challenges shall be included in the research programmes priorities to be addressed by researchers (CSF, TACR).
15	Build mutual trust between science and society and strengthen scientific evidence for policy making	• TTOs support both from national and SF sources • VERA – supporting the scientific evidence for policy making.	• Policy documents mention the issue, but still a gap between science and society remains significant. More popularisation and medialisation steps are needed.

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1 Introduction

The main objective of the ERAWATCH Analytical Country Reports 2010 is to characterise and assess the evolution of the national policy mixes in the perspective of the Lisbon goals and of the 2020, post-Lisbon Strategy. The assessment will focus on the national R&D investments targets, the efficiency and effectiveness of national policies and investments into R&D, the articulation between research, education and innovation, and on the realisation and better governance of ERA. In doing this, the 15 objectives of the ERA 2020 are articulated.

The report builds on the 2009 report streamlining the structure and updating the 2009 policy assessment in the domains of human resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. The information related to the four ERA pillars covered in the 2009 report is also updated and it is extended in order to cover all six ERA pillars and address the corresponding objectives derived from ERA 2020 Vision.

Given the latest developments, the 2010 Country Report has a stronger focus on the link between research and innovation, reflecting the increased focus of innovation in the policy agenda. The report is not aimed to cover innovation per se, but rather the **'interlinkage'** between research and innovation, in terms of their wider governance and policy mix.

2 Performance of the national research and innovation system and assessment of recent policy changes

The aim of this chapter is to assess the performance of the national research system, the **'interlinkages'** between research and innovation systems, in terms of their wider governance and policy and the changes that have occurred in 2009 and 2010 in national policy mixes in the perspective of the Lisbon goals. The analysis builds upon elements in the ERAWATCH Country Report 2009, by updating and extending the 2009 policy assessment in the domains of resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. Each section identifies the main societal challenges addressed by the national research and innovation system and assesses the policy measures that address these challenges. The relevant objectives derived from ERA 2020 Vision are articulated in the assessment.

2.1 Structure of the national research and innovation system and its governance

This section gives the main characteristics of the structure of the national research and innovation system, in terms of their wider governance.

The Czech Republic is a small European country (10,506,813 inhabitants in 2009) with only 2% of the total European Union (EU) population. In 2009, GDP per capita was 18,900b in the CR, which corresponds to 80% (in purchasing power standards -

PPS) of the EU27 average. Unemployment rate was 6.7% versus 8.9% in the EU27 average (Eurostat, 2010).

The Czech research and development (R&D) system is a centralised one. Private investment in R&D is dominated by foreign-controlled companies, largely from within the EU (approx. 40% of BERD in automotive industry – NACE 29 - where a significant part is financed by German companies such as Škoda-Volkswagen or Siemens). The public R&D sector is characterized by a traditionally strong position of the Czech Academy of Sciences (ASCR - focused mainly on basic research), similar to most post-Communist countries. Compared to the EU15, far less research is thus conducted in the sectors of higher and tertiary education.

The Czech research and development (R&D) system underwent a radical transformation along with the post-Communist economic and social transformation of the 1990s. The key changes were linked with the new measures in public spending of the early 1990s which resulted in the restructuring of the Academy of Sciences, as well as in the reduction of the number of the former sectoral applied research institutes controlled by individual ministries (they were either privatised or shut down). At the same time the business sector - which was constituted of public enterprises - underwent large-scale privatisation and, during this process, lost much of their R&D capacity in a rather short-sighted effort to quickly reduce costs. The consequences of these processes are still being felt at present, especially in the context of the absence of applied research institutes to act as partners for the business sector.

In the Czech Republic, trends in R&D expenditures have been fairly positive over time with total gross expenditure on R&D (GERD) increasing since 1995 (with the exception of year 2007/2008). In 2009, R&D investment exceeded €2.24b[1], and the share of total R&D expenditures in the Gross Domestic Product (GDP) increased from 1.21% in 2000 to 1.53% in 2009 (compared to 2.01% in the EU27). Most of the increase in recent years is due to the private sector, strongly linked with the growing attractiveness of the country for foreign direct investment, including in R&D.

Public R&D expenditures have been on the increase since 2002. Total R&D public expenditures in 2009 are €985m which corresponds to 0.67% of the GDP (slightly above the EU27 average). Although the new Government established in August 2010 introduced reductions of public spending for the upcoming years in most of the areas because of the economic crisis to balance the national budget, RDI and education are two of the very few areas where no significant financial cuts are planned.

Main actors and institutions in research governance

Competences of particular governmental bodies (ministries) in the Czech Republic are defined by the Competence Act. In addition, competences in research, development and innovation policy are given by the Act No. 130/2002 Coll., on the support of research and development from public funds.

The following three main governmental bodies play the chief role in the research and innovation governance:

- Council for Research, Development and Innovation (CRDI) is an expert and advisory Government body for research, development and innovation. At the political level, the Council plays the main strategic and coordinating role in the research and innovation governance system.

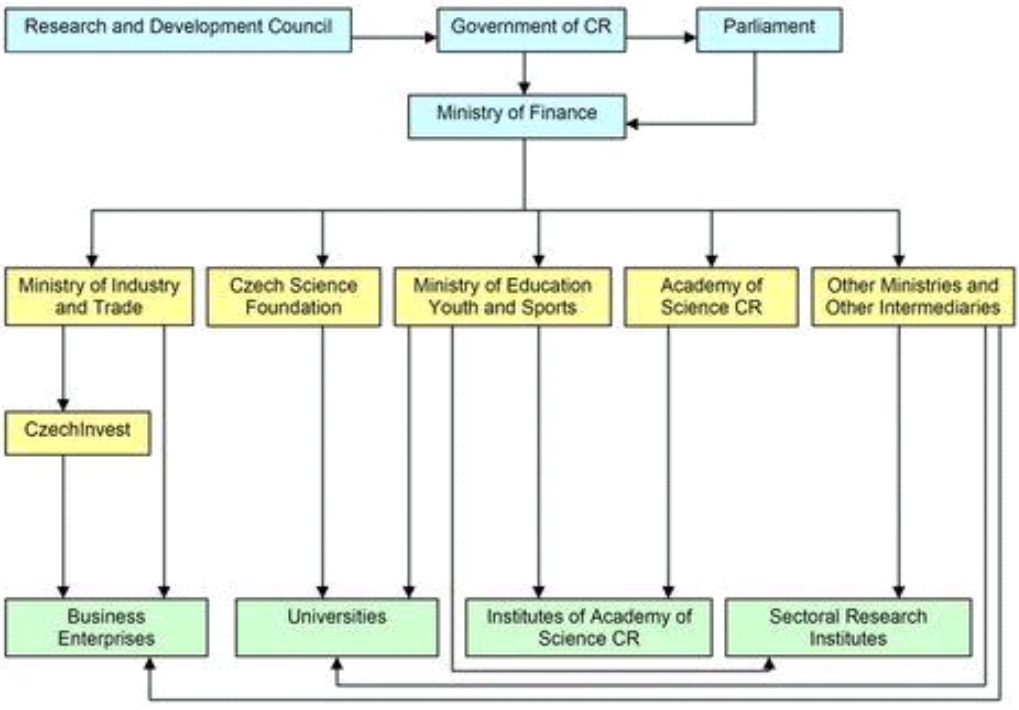
[1] 1 EUR = 24.66 CZK

- Ministry of Education, Youth and Sports (MEYS) is a central administrative authority responsible for research and development, although (based on the amendment of the Act No. 130/2002 Coll. approved in July 2009) "with the exception of areas that are covered by the Council for Research, Development and Innovation". By this amendment MEYS has lost its position of strategy maker in science and technology policy and this role has been taken over by the CRDI.
- Ministry of Industry and Trade (MIT) is responsible for industrial research and development and for innovation in the business sector. The ministry prepares and implements programmes of industrial research and manages the EU Structural Funds-funded Operational Programme Enterprise and Innovation.

In addition to MEYS and MIT, there are five other ministries responsible for preparation and implementation of research, development and innovation concepts: Ministry of Health, Ministry of Agriculture, Ministry of Culture, Ministry of Defence and Ministry of Interior. These ministries provide support from their own budgetary chapters and also establish and operate their sectoral research institutes. Also the Technology Agency of the Czech Republic (TA CR) was established in 2009. TA aims at implementing applied research programmes. Some of the public research institutes have begun to split their activities between the applied and basic research area.

The following figure shows the governance structure of the Czech research system at the national level:

Figure 1: Overview of Czech Republic's research system governance structure



Source: ERAWATCH Research Inventory

The institutional role of regions in research governance

At the NUTS III level the Czech Republic consists of 14 regions that have their own elected regional councils with their own budgets and responsibilities stipulated by

law. Regional authorities do not have any legally binding responsibilities in the field of RDI - the Czech innovation policy is performed mainly at the national level and the role of regional governments is limited to coordination and execution of regional development policies. Some regions have begun to realize the need to ensure their prosperity based on a sustainable and competitive economy. However, there are significant differences between particular Czech regions in terms of policy and budget support for the RDI policy. In some regions (e.g. South Moravia) the regional governments play a significant role in catalysing Structural Funds-funded projects in the field of research, development and innovation. The role of the regional authority as the main policy body dealing with innovation has been in several cases substituted or complemented by the capital cities of the regions (e.g. Pilsen Region). Generally, the position of regions in performing innovation policy is very weak in the Czech Republic as the regional municipal level was re-established in 2001 and their budgets and competencies are limited.

More information on the regional aspects of the RDI governance in the CR is provided on the Regional Innovation Monitor website.

Main research performer groups

The largest R&D performer in the Czech Republic is the business sector spending 60% of GERD even though the share has been decreasing from 2006 (65.1%) in favour of the public sector. The government sector comes second with 21.4%, followed by the higher and tertiary education sector with 18.1% and private non-profit sector with only 0.5% share in GERD in 2009.

2.2 Resource mobilisation

This section assesses progress towards national R&D targets, with particular focus on private R&D, recent policy measures and governance changes and the status of key existing measures, taking into account recent government budget data. The need for adequate human resources for R&D has been identified as a key challenge since the launch of the Lisbon Strategy in 2000. Hence, the assessment includes also the human resources for R&D. Main assessment criteria are the degree of compliance with national targets and the coherence between the policy objectives and the policy mix.

2.2.1 Resource provision for research activities

The 2nd ERA objective “to increase the public support for research” has been a high priority of the foreign administrative as well as the new right-wing Government established in August 2010. The total R&D (GERD) as well as public RDI investments have been continuously increasing over the last decade (see also chapter 2.1), with the exception of 2008, where the current economic crisis had a negative impact mainly on the business sector investments.

This priority has also been included in the new National RDI Policy 2009-2015 approved by the Government on 8 June 2009 – it replaces the previous National Research and Development Policy of the Czech Republic for 2004–2008 and the National Innovation Policy 2005–2010. For the first time in its history the Czech Republic has one single multi-annual policy document for research, development and innovation. The new policy is based on the Green and White Paper on the RDI System of the CR, attachments to the policy, analysing the system, its strengths and weaknesses and settling RDI national priorities.

The National R&D and Innovation Policy 2009-2015 builds on the ERA objectives and consists of nine main objectives and their respective implementation actions:

1. Establish a strategic management of R&D and innovation at all levels based on systematic impact assessment of the National Policy objectives fulfilment as well as in depth analyses of R&D and innovation system as such;
2. Target the public support to R&D and innovation in line with demands of sustainable development;
3. Increase efficiency of the public support to R&D;
4. Utilize the R&D results in innovation processes and enhance the co-operation between public and private sector in research, development and innovation;
5. Intensify the Czech Republic's involvement in the international R&D and innovation co-operation;
6. Provide qualified human resources for R&D and innovation;
7. Create an environment stimulating R&D and innovation in the Czech Republic;
8. Ensure the compatibility and linkages of the National Policy with other sectoral policies;
9. Ensure consistent evaluation of the R&D and innovation system.

Since the National RDI Policy was designed before the recent financial crises and subsequent recession fully affected the Czech economy, it does not reflect several new aspects of the environment, in which the innovation policy is implemented. The most important changes in innovation policy directions after the economic recession result from strict budget constrains. Although the Government referred to research, development and innovation as a national priority and assumed an increase of public investment in R&D by 8% annually before the recession, the budget for R&D has been stagnating since 2008. This change has influenced especially the political will to implement deep reforms of the research, development, and innovation governance system, which started in 2008 together with reform efforts in the area of tertiary education and education in general.

On July 14, 2009, the Government approved the amended Act no. 130/2002 on the Support of Research and Development from Public Resources, a key act concerning research and development in the Czech Republic. The new Act no. 211/2009 embodies a number of institutional reforms previously approved in the Reform of the System of Research, Development and Innovation in the Czech Republic. It also established the Technology Agency of the CR. On November 18, 2009, the Government also published Resolution no. 397/2009 concerning the information system of research, experimental development and innovation.

In the Czech R&D system, three main modes of public funding are applied: institutional funding, project-based funding and fiscal incentives. Institutional and project-based funding are almost balanced (see below).

In 2009, the institutional funding amounts to CZK11b (€447m) representing 54% of the total Government budget appropriations or outlays on R&D (GBAORD). The largest shares of institutional funding are distributed between the Ministry of Education, Youth and Sports (which provides this type of funding to universities) and the Academy of Sciences (which allocates the funding to its public research institutes). To the end of 2010, the major part of institutional funding is provided

based on medium-term (usually 6 years) research proposals with concrete objectives (so-called research intentions). This system of institutional funding will be replaced by a new, result-based, system from 2011. This systemic change which was initiated by the Reform of the System of Research, Development and Innovation has become a hot topic of public debate within the research community and policy makers. The main controversial questions consist in what results will be counted, how to compare various research fields and how to convert research results into institutional financing. Answering these questions is currently the most important task assigned to the Council for Research, Development and Innovation.

The second pillar of the Czech R&D funding system is the project-based funding which amounts to CZK9.5b (€386m - 46% of the total GBAORD) in 2009. The Ministry of Education, Youth and Sports represents the biggest provider of project-based funding in the Czech Republic (28% of the total project-based funding). The major part is provided within the framework of research programmes whereby MEYS organises thematic calls on the topics defined under the National Research Programme II (set of programmes adopted by the Government focused on financing research priorities in the Czech Republic). The recipients are mostly universities and other public research organisations. The Ministry of Industry and Trade is the second biggest provider of project-based funding (26% of the total project-based funding). Through its programmes MIT promotes industrial research projects, either carried out by businesses themselves, or by consortia of business and academic partners.

A major part of project-based funding of fundamental research is allocated through the Czech Science Foundation (CSF) which represents the third main provider of project-based funding (16% of the total project-based funding). Based on the Reform of the System of Research, Development and Innovation, the newly established Technology Agency of the Czech Republic (TACR) will become an integral part of the Czech R&D funding system in the near future. The idea is to have one main funding agency for fundamental research (CSF) and one agency for industrial research (Technology Agency). At this time the Technology Agency allocates almost CZK1b (approx. €40m) annually to industrial research projects and it is expected that this amount will gradually increase in connection with reducing the number of budget chapters which will be absorbed by the Technology Agency.

In addition to direct R&D funding, a tax incentives scheme for in-house R&D was introduced in 2005. These tax incentives are in the shape of a tax deductible amount representing 100% of costs expended on the implementation of R&D projects (without any direct support).

In 2005, 434 businesses used the tax relief which was almost 27% of all R&D active businesses. Since 2005, the number of companies drawing on indirect support to R&D increased to 618 in 2009, i.e. 35% of companies performing R&D activities. The total indirect support of R&D in 2009 reached almost CZK1b (€40m) and the tax deductible ran to CZK4.7b (approx. €190m). The highest share of R&D active firms, which used the indirect support, was in the group of small enterprises up to 50 employees (42%) (CZSO, 2010).

Public support of innovation activities carried out by the business sector and support for the building of new research infrastructure are set by the National Strategic Reference Framework of the Czech Republic 2007 – 2013 as objectives of three Operational Programmes for EU Structural Funds – OP Enterprise and Innovation (OP EI) promoting innovation in business sector, OP Research and Development for Innovation (OP RDI) focused on strengthening the R&D infrastructure at universities

and research institutions, and OP Education for Competitiveness (OP EC) aimed at overall improvement of human resources for R&D and innovation.

The OP RDI and OP EC fall under the competence of the Ministry of Education, Youth and Sports. Compared to the annual national public R&D budget of approximately €1b/year (2010), the SF allocations clearly represent an important boost to the Czech R&D system. Their impact is likely to be even more pronounced than the actual figures suggest because most of the Czech public R&D capacities are concentrated in Prague (roughly 60% of research labour force) while the bulk of the SF funding will be channelled to the Convergence regions.

The OP R&D for Innovation, financed by the ERDF, consists of 4 priority axes, all of which are relevant for research and innovation policy: Priority 1 - European Centres of Excellence - allocation for the priority axis is €806m, i.e. one third of the OP budget; Priority 2 - Regional R&D Centres - allocation for the priority axis is €806m, i.e. one third of the OP budget; Priority 3 - Commercialisation and popularisation - allocation for the priority axis is €250m, i.e. 10% of the OP budget; and Priority 4 - Infrastructure for Tertiary Education linked with R&D - allocation for the priority axis is €487m, i.e. 20% of the OP budget.

The OP Education for Competitiveness, financed by the ESF, focuses on tertiary education, developing human resources for R&D and supporting the setting up of high-quality research teams, partnerships and networking activities. In concrete terms these activities will be supported mainly through the Priority Axis 2 - Tertiary Education and R&D.

In addition, the OP Enterprise and Innovation (OP EI - managed by the Ministry of Industry and Trade) shall provide part of its budget of €3b for R&D-relevant activities, specifically for building R&D capacities in the business sector (Priority 4 – Innovation – 22% of the total of this OP) and for joint activities in the field of innovation and R&D among businesses and public R&D organisations (Priority 5 – Environment for Innovation and Cooperation – 38% of the total of this OP).

Finally, some of the allocation from the Operational Programme Prague - Competitiveness in the framework of the "Competitiveness and Employment" objective will also be allocated to R&D activities. This concerns some of the activities planned under Priority 3 - Innovation and Enterprise. This priority has an allocation of €53.6m for the period 2007-2013 which equals 22.8% of the total budget of the OP. The supported activities will be, among others, the following ones: development of innovation infrastructures (science parks, incubators, innovation centres, and centres of excellence); creation of partner links between public research institutions and companies; development of innovation capacities of enterprises; support for creation of technology-based firms and SMEs in the field of ICT. The total allocation for Prague from both ERDF and ESF equals €420m for period 2007 - 2013.

Czech participation in the EU Framework Programme is regularly monitored by the National Contact Point – Technology Centre AS CR – and reports are published on a regular basis within the publication Analysis of the Existing State of R&D in the Czech Republic. According to the latest report (from 2009) covering Czech participation in FP6 and FP7 Czech participants still have one of the lowest participation rates in the EU. In the case of FP6 it scores 21st out of 27 (ahead of Lithuania, Latvia, Slovakia, Bulgaria, Poland and Romania) when measured by the number of participations per million inhabitants. When measured by the amount of funds contracted per one researcher, the Czech Republic's score is among the worst in the EU (20th out of 27, ahead of Portugal, Latvia, Bulgaria, Lithuania, Poland,

Slovakia and Romania). On the more positive side, Czech participation between the 5th and 6th Framework Programme increased substantially (in financial terms it doubled).

A broader impact of the Framework Programme on the Czech R&D policy impact is relatively strong at the level of national policy making - e.g. the Czech Republic works on its own national road map of research infrastructures, an initiative inspired by the Roadmap of the European Strategy Forum on Research Infrastructures (ESFRI); also the national thematic priorities formulated in the Priorities of the Applied RDI (former Long-Term Principal Research Directions- DZSV) indicate an influence of the thematic priorities of FP6. EU FPs in the broader context of building the ERA are also reflected in the new National RDI Policy 2009-2015.

Following the Lund declaration, Grand Challenges and the Innovation Union – EU 2020 Strategy flagship initiative – aiming at re-focusing RDI policy on the societal challenges, there has been some progress in the CR on the national level. The CR has recently adopted a document called Reform of the System of Research, Development and Innovation to foster excellence, reinforce cooperation between universities, research and business, implement joint programming, enhance cross-boarder cooperation and adjust national funding procedures accordingly.

Also the share of *technical* graduates in the *total* active population is much higher than the EU27 average (CR: 35%, EU27: 18%). When compared to the current share of *technical* graduates it means that this is not a very positive trend concerning technical tertiary education in the CR. Increasing motivation to study technical and natural sciences fields remains one of the challenges of the Czech education system – as stated also in the White Paper of the Tertiary Education created in 2008. A tax incentives scheme for in-house R&D was introduced in 2005 (see above).

2.2.2 Evolution of national policy mix geared towards the national R&D investment targets

The European Innovation Scoreboard has produced an analysis based on the INNO-barometer 2009 survey of innovating firms in the EU27 which was conducted in April 2009. The survey data indicates that 23% of innovative firms in Europe had decreased their innovation expenditures as a direct result of the economic downturn, and that 29% of firms expected their 2009 innovation expenditures to be lower than in 2008. This showed a marked transition from the period 2006-08 where only 9% of firms had decreased innovation expenditures.

The total BERD of the Czech Republic is CZK25.4b (approx. €1b) in 2009, which is 60% of GERD. This share corresponds to the EU27 average but some of the EU15 reached almost 75%. Business expenditures on R&D (BERD) are far below the EU27 average (the share on GDP remains approx. 80% of the EU27 average in 2008). On the positive side, the total R&D expenditures in the business sector have been increasing by 13% a year since 2000, moreover in 2005 and 2006 BERD increased by 20% a year. Total expenditure in the business sector doubled between 2000 and 2006. From 2007, the business expenditures have been decreasing, which might be partly caused by the negative impact of the global economical crisis.

In the ERAWATCH Policy Mix Report 2009 six policy mix routes have been identified to stimulate R&D investment. Based on this report, the following paragraphs summarise the R&D investment tools in the Czech Republic, their latest development and impact.

There are some instruments in place to foster private R&D in the Czech Republic. Particularly there is a Economic Growth Strategy (2005-2013) prepared in November 2005 that specifies the need to support commercial sources of financing, such as private equity and venture capital. Programmes operated by the Ministry of Industry and Trade support the creation of companies and their development by granting credits and bank guarantees. However, there is no programme focusing on financing early stage development of innovative and start-up companies by venture capital (e.g. through a programme on a venture capital fund). There is still a need to support start-ups and development of new and technology-based companies through creating financial tools facilitating SMEs access to pre-seed and seed capital. New technology-based companies are however supported by grants and subsidized loans within the OP Enterprise and Innovation. Traditional indirect tools of public support for R&D and innovation include tax incentives and public procurement (see also Chapter 2.1).

Stimulation of existing R&D performers to increase their investment in R&D has been provided by the following programmes of the Ministry of Industry and Trade: TANDEM, TIP and Trvalá prosperita. Furthermore, enterprises in the Czech Republic can use a series of measures to promote R&D, which are included in particular in the existing OP Enterprise and Innovation. This OP contains 7 priority axes which are specified through the programmes indicated (support areas). Under the priority axis called Innovation two programmes exist:

- INOVACE - contributing to the implementation of the development of innovative projects based on R&D and supporting the projects for the protection of intellectual property rights.
- POTENCIAL - aiming at strengthening the capacity of corporate R&D in connection with production activities of firms. It supports in particular the creation and development of technology centres and in-house R&D departments.

Despite the fact that business R&D expenditures in the CR are at a low level and the Czech companies are spending their innovation expenses on purchasing external know-how, only the programme IMPULS launched by the Ministry of Industry and Trade directly addresses this issue. The programme supported 151 companies (48 from Czech Republic) with total budget of about €636m. Programmes for indirect support of private-public co-operation (KLASTRY, PROSPERITA), which terminated in 2006, have been carried over to the new programming period. Another programme of direct support, called “TIP”, is currently being prepared by the Ministry of Industry and Trade (for 2009 - 2017).

A lack of cooperation between universities and companies in the area of R&D is a significant weakness, which is indicated by a low proportion of business sector resources spent on financing R&D carried out at universities. This issue is partially addressed in the Spoluprace (Cooperation) programme aiming at promoting the emergence and development of cooperative sector clusters - clusters and technology platforms.

In the Operational Programme R&D for Innovation is currently the most important tool to increase the capacities in the Czech public R&D sector by supporting new research infrastructures. Moreover, the Operational programme Education for Competitiveness (2007 - 2013), contains a priority axis called Tertiary education, research and development. The financial allocation for this priority axis is €688.5m.

The allocation of financial means in the form of institutional support is not yet sufficiently tied to the evaluation of research work. It results not only in lower number of scientific publications and their citations, lower number of patents, new technologies, products and services, as well as lower motivation of researchers to carry out high-quality research. Methodology used for the evaluation of research results has been a very controversial issue in the CR from its very beginning (2008) and a compromise must be found in the near future within the research community and stakeholders. In the first half of 2011, results from the International Audit of the Czech RDI System project are expected to be the background document for the reforms in the research results evaluation.

Policies to promote education in the Czech Republic are the responsibility of the Ministry of Education, Youth and Sports. Reform of tertiary education has been recently quite an issue in the CR. It represents a change that will lead to increase of the competitiveness of universities and strengthening the role of universities as the main source of innovation to ensure social cohesion. One aspect of the tertiary education reform is also the reinforcing of research and development importance carried out at universities.

The need for greater collaboration between public and private R&D sectors has become an increasingly topical issue, especially since the preparation of the Economic Growth Strategy, National Innovation Policy in 2005 as well as the National RDI Policy in 2009. Although the practical policies react to this trend and cover the issues of public-private co-operation, their impact on knowledge circulation between these sectors is still quite weak. A first interim evaluation of the National RDI Policy 2009-2015 will show the effectiveness of close interaction between research and innovation policy measures including the support of SMEs, technology transfer, international research cooperation, research infrastructures, human resources development, mobility, popularisation of technical and natural research fields, etc.

2.2.3 Providing qualified human resources

The number of R&D personnel and researchers has been increasing recently in the Czech Republic. Even though the increase rate of R&D personnel is significantly higher than in other European countries, the Czech Republic is still below the EU27 average. In 2008, the total number of researchers in FTE (full time equivalent) per 1000 labour force reached 89% of the EU27 average and about 43% in comparison with Finland or Sweden.

Lack of a highly skilled workforce for R&D and its adequate financial assessment is one of the barriers in the area of R&D. The share of labour costs on R&D expenditure is low, which corresponds to low salaries of researchers, amounting to the level of 30% of EU15 countries. As a result of low salaries, scientific work loses social prestige and leads the exodus of excellent researcher abroad (brain-drain). This also creates barriers not only to the influx of researchers from other countries (brain gain) but also to the return of elite Czech scientists from their stays abroad. One of the policy objectives of the RDI system reform is thus aimed at providing enough qualified human resources for R&D in both public and private sectors.

The highest share of researchers (in FTE) is in the business sector (51% in 2009) and the number has been recently increasing. Nevertheless, the number of researchers in the business sector in the Czech Republic equals 75% of the EU27 average. The shares show that the business sector is more undersized in the area of qualified human resources than other research-performing sectors in the Czech

Republic. The number of researchers in the government sector decreased from 36% in 1995 to 22% in 2009. This was related to strengthening other sectors at the expense of the previously dominant Academy of Sciences. The highest increase in the number of researchers has been recorded in the higher and tertiary education sector with a share of researchers amounting to 27% in 2009. Nevertheless it still corresponds to 80% of the EU27 average. The lack of researchers at universities can negatively influence the quality of tertiary education, mainly preparing future researchers and excellent experts for high-tech industrial branches. Of all sectors, the share of researchers in the fields of technical sciences has been significantly decreasing.

The number of *all* university graduates (including PhD) in the Czech Republic has been growing more rapidly than in other European countries but it is still significantly lower than the EU27 average. The Czech Republic (as well as most European countries) has not reached the level of one PhD graduate per 1000 inhabitants in the age of 25 - 34 years yet (EUROSTAT, 2010). The share of *technical* graduates in the *total* active population is much higher than the EU27 average (CR: 35%, EU27: 18%). When compared to the current share of *technical* students it means not a very positive trend concerning technical tertiary education in the CR. Increasing the motivation to study technical and natural sciences fields remains one of the challenges of the Czech education system.

Even though postgraduate education can be classified as a preparation for the research career, only one third of the Czech PhD graduates decide for research and two thirds for other careers. The main reason for choosing a career in research lies in creativity and innovation potential of the work. Only a very low share of research personnel with PhDs prefer the research career because of good employment conditions (10%) and because of good financial conditions (3%) (Czech Statistical Office, 2008).

Human resources policies with relevance for R&D are currently represented within educational policy as measures to increase the attractiveness of research careers and research as such. Apart from several smaller local initiatives, the most prominent among these is the Česká hlava (Czech Head) project which awards an annual prize to distinguished Czech scientists for their life-long achievement in R&D. From 2008, The Council for Research and Development also organises an annual award to distinguished scientists - Prize of the Chairman of R&D Council. In the tertiary education sphere, attention will be paid to the adaptation of curricula to the needs of knowledge society, with emphasis on the development of progressive disciplines and R&D for strengthening competitiveness of the Czech economy. It is necessary to support personnel capacity of the tertiary education and to establish an incentive system for young staff starting their professional career in the field of R&D.

2.3 *Knowledge demand*

This section focuses on structure of knowledge demand drivers and analysis of recent policy changes.

In 2009, about one third of BERD was realised in the medium high-tech sector, about 22% of BERD was spent in the high-tech sector and less than 9% of BERD was spent in medium low-tech a low-tech sectors. The share of high-tech services was

about 22% of BERD. The share of the high-tech sector in BERD has been growing in the last years; however, the share of high-tech services shows a moderate decrease.

Over the last few years, more than 22% of total business R&D expenditures (BERD) has been realised in the automotive industry (NACE 34), but expenditures in this branch have recently increased more slowly than the total R&D expenditures. Very high R&D expenditures have been also recorded in the NACE 24 branch – Chemical industry (almost 15% of BERD in 2009). R&D expenditures in this branch also grew significantly and their average annual increase over the last 5 years has reached almost 6%, and between 2005 and 2006 R&D expenditures have more than tripled. The biggest share of the NACE 24 expenditures are recorded in the NACE 24.4 branch: Pharmaceuticals (86% of the NACE 24 branch).

Current GBAORD percentage shares of socioeconomic objectives (NABS) reflect the allocation of public support of R&D described above. The biggest share recently (2000 – 2009) falls on the Non-Oriented Research (NABS 11) with 26.8% in 2009, on Research financed from general university funds (GUF – NABS 10) with 25.6% and on Industrial production and technology (NABS 7) with 12.4%. Other NABS shares are smaller than 8%. When comparing the GBAORD division with the EU27 average, the biggest share (30.3%) lies in Research financed from general university funds (GUF – NABS 10), then in Non-Oriented Research (NABS 11 - 17.1%), in Defence (NABS 13 - 13.2%, in comparison with 3.1% of the Czech Republic) and Industrial production, and technology (NABS 7 – 10.4%) (Eurostat, 2010).

At the European level, ERA-NET projects were considered as very successful and useful instruments for the coordination of national research programmes. Czech participation in these projects was not very outstanding, from the total number of 1,044 participants only 16 were from the Czech Republic. If we take into account projects themselves, Czech teams participated only in 14 projects from the total of 106. As the reason of the Czech low participation we can see the lack of interest from the eligible participants (ministries and science foundations mainly) and also financing of joint ERA-NET calls (hard to find right instruments how to contribute to transnational joint research).

Structure of knowledge demand drivers

Processes for identifying drivers of knowledge demand (e.g. foresight and planning exercises, expert groups, technology assessment) have been launched in the Czech Republic. Since 2000, foresight exercises have been periodically used for identifying the thematic orientation of National Research Programmes (NRP) for public funding of research.

The use of ad-hoc groups of experts for development and/or consultations during the preparation of strategic documents is relatively common in the CR. The Priorities of Applied Research, Development and Innovation for 2009-2011 setting up strategic thematic orientation of research in the CR were elaborated by working groups of experts. Expert groups were also involved in preparation of the White Paper on Tertiary Education and White Paper on R&D and Innovation, which can be considered as background documents for the upcoming reform of tertiary education and the National research, development and innovation policy 2009-2015 adopted in 2009.

The knowledge demand drivers exist also in the private sector. Dominant sectors of the Czech economy (as to value added) are automotive industry and industries related to production of vehicles (e.g. rubber-making industry or production of

plastics); at the same time, also engineering industry has had a significant share on value added. Dynamic has been the growth of electrical and optical branches of industry as well as ICT.

R&D specialization patterns and expenditures correspond to the above-summarized specialization of the Czech economy to some extent. The highest share of R&D expenditures has been registered in the automotive and related industries, followed by electrical and optical industries. Significant are R&D expenditures also in (petro) chemical and pharmaceutical industry. The majority of companies performing R&D in the Czech Republic is however foreign-owned; this has certain implications and limits to deeper cooperation in R&D between the private and public sector.

Research efforts to address major societal challenges

The Government is the key driver of societal knowledge demand. The share of the government sector in GERD (GOVERD) was 21.4% and the share of higher and tertiary education sector (HERD) was 18.1% in 2009. The non-government non-profit sector share reached less than 1%. The institutional (non-targeted) support of research is still slightly prevailing in comparison with the targeted (project-based) support of research.

Long-term thematic orientation of the societal knowledge demand is specified by the Priorities of the Applied RDI 2009-2011, which were approved by the Government in 2008 and provide a framework for defining priorities in research with assets for economy, competitiveness and sustainable development of society and reflect the traditional orientation of research and industry in the CR. R&D programmes should be based on these priorities.

The share of basic research in total R&D expenditures (GERD) is quite high (almost 31% in 2009), which is more than in most of the EU15 and also EU27 countries. Share of basic research in GERD has increased slightly in the last years. Share of applied research is a little bit lower than the share of the basic research (24% in 2009; EU27 countries as well as the USA and Japan are in the opposite situation) and has been decreasing since 2003. Share of experimental development in total R&D expenditures amounted to 45% of GERD in the Czech Republic.

2.4 *Knowledge production*

The production of scientific and technological knowledge is the core function that a research system must fulfil. While different aspects may be included in the analysis of this function, the assessment provided in this section focuses on the following dimensions: quality of the knowledge production, the exploitability of the knowledge creation and policy measures aiming to improve the knowledge creation.

2.4.1 Quality and excellence of knowledge production

Knowledge production in the Czech Republic is strongly concentrated into the public sector represented mainly by the Academy of Sciences (consisting of 53 research institutes) and 25 public and 39 private universities. Unlike in advanced EU countries, higher share of research activities is performed within the Academy (predominantly dealing with the basic research), while Czech universities are less research-oriented and more focused on education. The currently prepared and discussed Reform on Tertiary Education is an important step to deal with this issue.

There are excellent research teams and individual researchers producing worldwide comparable results in both basic and applied R&D. Within the EU Framework Programmes, 3 centres of excellence were supported in the Czech Republic – at the Faculty of Electrical Engineering of the Czech Technical University in Prague, at the Institute of Theoretical and Applied Mechanics and at the Institute of Experimental Medicine (both latter institutes belong to the Academy of Sciences).

There is also a list of large supported projects within the OP RDI – Priority Axis 1: Centres of Excellence and Priority Axis 2: Regional R&D Centres (see also Chapter 2.2.1 of this report). The Ministry has already accepted 29 projects for financing the research centres including one big project called "Sustainable Power Engineering" in the Central Bohemian Region. In the area of support to centres of excellence, there are 9 project proposals chosen by the Czech Managing Authority for the financial support. 5 of these 9 projects are financially big and are still to be agreed by the Commission in a very near future. The 5 big centres of excellence are the following: Biotechnological and Biomedical Centre of the ASCR and the Charles University; CEITEC – Central European Technology Institute of the Masaryk University in Brno; IT4Innovations Centre of Excellence of the Technical University in Ostrava; ELI: Extreme Light Infrastructure of the Institute of Physics ASCR; and International Centre for Clinical Research (ICRC) of the Faculty Hospital of St. Anna in Brno.

The biggest number of proposals in these two priorities was from the South Moravian and Moravian-Silesian regions. The amount of this area of support is CZK17b for the European centres of excellence and CZK11b for the regional research centres.

The Czech Republic lags behind the EU15 countries in production of scientific publications (Czech Republic – 150 publications per 1000 researchers; EU27 – 179 publications per 1000 researchers in 2006). However, thanks to an increased growth of publication activity, it is slowly catching up with the EU27 average. During 2003 - 2006, the number of Czech publications increased by 25%, while in the EU15 countries only by 13% (CRDI, 2009).

In scientific citations, the lagging behind of Czech research is more significant. In 2006, the Czech Republic reached 457 citations of scientific publications per thousand researchers, i.e. substantially less than the EU15 average (953) (CZSO, 2008).

During previous years, a harmonisation of law in the field of protection of intellectual property rights has taken place in the Czech Republic. However, statistical data demonstrate a significantly lower patenting activity both in the private and public sectors in comparison with advanced countries. Although the number of Czech patent applications at the European Patent Office (EPO) increased four times over 1993 - 2004 (from 2.0 to 9.0 applications per million inhabitants), it has not reached even 8% of the EU27 average (111.0).

2.4.2 Policy aiming at improving the quality and excellence of knowledge production

In 2005, a new Law on Public Research Organisations was enacted which changed the legal status of public research organisations from January 2007. It increased their autonomy and legal and budgetary independence. The Reform of R&D and innovation system in the Czech Republic (2008) stipulates the need to simplify the evaluation of R&D outcomes, carried out by the Council for Research, Development and Innovation, in order to improve distribution of institutional R&D funding within the

state budget. One of the main objectives of the Reform is to change the current situation towards a real excellence in R&D, based on achieved results.

Within the Operational Programme Enterprise and Innovation (2007 - 2013), the issue of IPR is addressed by increasing the innovative capacity of companies (especially SMEs) and by using instruments for protection of intellectual property rights (Ministry of Industry and Trade, 2007). Universities and public research organisations are newly responsible for the IPR protection and commercialisation of their research outcomes. Within the Operational Programme Research and Development for Innovation (2007 - 2013), European Centres of Excellence as well as Regional R&D Centres, technology transfer units and commercialisation of R&D results are being supported. A limited number of European Centres of Excellence supported by the OP will facilitate co-operation between various research institutes in the Czech Republic and will enable their full connection to ERA and international research infrastructure, including European Strategic Forum on Research Infrastructures – ESFRI (e.g. ELI – Extreme Light Infrastructures).

2.5 Knowledge circulation

Tackling the challenges that European society faces in the 21st century will require a multi-disciplinary approach and coordinated efforts. Many debates and conferences, e.g. the Lund Declaration recognise that such complex issues cannot be solved by single institutions, technology sectors or MS acting alone. Hence strong interactions within the "knowledge triangle" (education, research and innovation) should be promoted at all levels. Moreover, in the context of increasing globalisation, cross-border flows of knowledge are becoming increasingly important. This section provides an assessment of the actions at national level aiming to allow an efficient flow of knowledge between different R&D actors and across borders.

2.5.1 Knowledge circulation between the universities, PROs and business sectors

Co-operation between public research (including universities) and businesses has been a long-lasting weakness of the Czech R&D system. Research-industry co-operation is still hampered by the public R&D system, which is still characterized by an ineffective system of R&D evaluation and low motivation of researchers. Very weak linkages between business and public research are reflected in a low share of private resources in GOVERD and HERD – in 2009, the business sector had 9.8% share in GOVERD (i.e. €49m) and only 1.1% share in HERD (i.e. €4m).

The importance of research-industry R&D co-operation is emphasised in most national strategic documents. It is addressed also by concrete measures of the National RDI Policy 2009-2015.

Nevertheless, there are only two national programmes supporting industrial R&D, which provide a direct support to private-public R&D collaboration between research institutes and private sector enterprises – the TANDEM and IMPULS programme, both administered by the Ministry of Industry and Trade (MIT).

The majority of science parks, business incubators, technology transfer and innovation centres in the Czech Republic are associated in the Science and Technology Park Association (SVTP). Currently, according to the SVTP database, there are 13 accredited science parks in the Czech Republic, 22 non-accredited parks and a further 13 parks being prepared.

During 2004 - 2006, a total of 16 science and technology parks, 20 incubators, and 11 centres of technology transfer were granted financial support from the PROSPERITA programme, launched by CzechInvest (an agency established by the Ministry of Industry and Trade). Currently, there are around 15 centres for technology transfer in the Czech Republic. The majority of these centres operate within universities or specialized intermediary organizations. The KLASTRY (Clusters) programme is aimed at creating formalised alliances among enterprises, higher education/research organizations and other entities (e.g. regional authorities).

The Priority Axis 3 of the OP RDI "Commercialisation and popularisation" is also very relevant for the improvement of the knowledge circulation. The objective is to support the use of research results by establishing technology transfer points and offices in research institutions, creation of instruments to fund the proof of concept stage for technologically-based projects, support popularisation of science and technology through creation of science learning centres and improving access to the research information and information about research results. The allocation for the priority axis is €250m, i.e. 10% of the OP budget. Recently, the first call for the Technology Transfer Offices Support Measure within this priority has been launched till the end of January 2011. The first TTOs from this call could be supported from the second half of 2011 / beginning of 2012.

In 2009, the MEYS has launched 7 "individual national projects" improving the system of tertiary education and RDI systems in the CR. These projects are financed through the OP Education for Competitiveness. One of these projects is called EF-TRANS. The project goal is to set up and bring into effect knowledge transfer between R&D (research and development) institutions and industry. A simple system of knowledge transfer is being created, with a special accent to: patent and licenses applications, intellectual property, spin-offs establishing, active cooperation between research institutions and industry.

2.5.2 Cross-border knowledge circulation

Considering the amount of subsidy as well as the number of projects, the most important initiative of international co-operation with participation of Czech research are the EU Framework Programmes. While participation of Czech universities is below the level of both EU15 and new member states, participation of Czech industry is relatively high. According to the total budget of industrial partners, the Czech Republic ranks first among the new member states (with a considerable lead) and 13th among the EU27 countries, with an exceptionally successful participation of Czech industry in the aeronautical research and global climate change research.

The Czech Republic is also a member of important international research organizations – e.g. European Organization for Nuclear Research, European Molecular Biology Organization, European Space Agency, European Southern Observatory, which enable Czech researchers and businesses to participate in top research activities within the most modern facilities and in developing special devices for these international organizations.

The Czech Republic is also quite active in the EUREKA programme – is involved in 214 projects (99 of them still running) out of 722 supported projects with an average support of €1.8m – this number includes also the Eurostars programme (common project of the Eureka and EU MS) aiming at a direct support of SMEs. Eureka is co-financed by the state budget – allocation for this programme has reached CZK100m (approx. €4m).

A massive foreign direct investments (FDI) inflow to the Czech Republic started in 1998 in the context of a launched investment incentives scheme. FDI positively influenced technology, knowledge, know-how and best practice spill-over into Czech companies resulting in a growth of their competitiveness and innovation performance. The impact of FDI on Czech R&D may be also seen in an increasing interest of foreign companies in a systematic co-operation with Czech research institutions, especially with universities and public research institutes. The share of foreign R&D expenditures in BERD in the Czech Republic increased substantially from less than 20% in 1995 to nearly 50% in 2009. This trend clearly illustrates the dynamic role of FDI in the Czech business R&D sector.

The level of inter-sectoral as well as international mobility of Czech researchers and technology oriented staff is still quite low in the CR. Academic and business sphere largely function in parallel, side-by-side. Existing policy measures have been concentrated mainly on international staff mobility. New measures introduced mainly within OP Education for Competitiveness may improve this situation in the future.

2.5.3 Main societal challenges

Following the Lund declaration, Grand Challenges and the Innovation Union – EU 2020 Strategy flagship initiative – aiming at re-focusing RDI policy on the societal challenges, there has been some progress in the CR on the national level. The CR has recently adopted a document called Reform of the System of Research, Development and Innovation to foster excellence, reinforce cooperation between universities, research and business, implement joint programming, enhance cross-boarder cooperation and adjust national funding procedures accordingly.

The societal challenges are reflected in the Priorities of Applied Research, Development and Innovation for 2009-2011, but still no specific research fields have been prioritised for the inter-sectoral and cross-boarder knowledge circulation. However, there are several recent activities reflecting the need of such cooperation and setting up the prioritised research fields. Namely the newly established Czech Council for the ERA (VERA) has defined priorities of the CR within the 8th Framework Programme (FP8) to enhance the cross-boarder cooperation. Also a CRDI project named AKCENT aiming at analyses and creation of background documents for realisation and update of the National RDI Policy 2009-2015 is being realized from 2010. To promote the inter-sectoral cooperation, prioritised fields of research shall be identified in the framework of the National RDI Policy implementation, namely with a significant contribution of the Map of Excellence currently being created also within the AKCENT project.

2.6 *Overall assessment*

Reform of the RTDI system together with FP7 and the new period of drawing support from the EU Structural Funds through Operational Programmes represent a great opportunity for the Czech R&D system as such. Reform is also supported by the new National RDI Policy and Priorities of Applied Research, Development and Innovation for 2009-2011 (2009). Anyway, a big risk is a low human resources mobilisation for the knowledge economy that can negatively affect the new research infrastructures needs as well as innovative SMEs. New research projects shall primarily support excellence instead of average research teams and more emphasis shall be put on the stimulation of the private sector to invest in R&D.

Concrete main policy opportunities and main policy-related risks are described in the table below. They are based on the relevant chapters of ERAWATCH Country Report 2009 as well as on the text of the Reform including its annex called "Green paper on Research, Development and Innovation" (Technology Centre AS CR, 2008).

Table 1: Summary of main policy related opportunities and risks

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	• Reform of R&D and innovation system adopted by the Government in April 2008; • National RDI Policy 2009-2015 adopted by the Government in 2009; • EU measures for R&D mainly within Structural Funds 2007 – 2013 and Framework Programme 7 for R&D.	• Low mobilisation of human resources for the knowledge economy that can critically affect the newly developed R&D infrastructure needs as well as innovative SMEs; • Not enough motivated private sector to support R&D and knowledge based economy; • Persisting brain drain of researchers based on bad conditions in R&D; • Not efficient use of European and national funding based on an evaluation leading to supporting average research teams instead of excellence.
Knowledge demand	• Reform of RDI shall lead to reduction of fragmentation of the public R&D support; • Development of medium high-tech and high-tech industry and sector of services leading to an increased demand for knowledge by business ; • New method of evaluation and monitoring of R&D results leading to a more effective contribution of research to the knowledge based economy.	• Public research not flexible enough to produce research results based on the knowledge demand; • Industrial policy measures supporting extensive business development and not reflecting fully the needs of a knowledge based economy; • Lack of qualified human resources to meet goals of applied research.
Knowledge production	• Increased autonomy of public research institutes should lead to a more efficient utilisation of public resources; • Emphasis on the applicability of new knowledge included in the Reform of R&D System; • High priority given to excellence through the OP R&D for Innovation; • Addressing the issue of IPR (within the National Innovation Policy and the OP Entrepreneurship and Innovation) should improve the performance of Czech R&D, particularly in terms of patent production.	• Continuing generic support to all R&D disciplines present in the Czech Republic disregarding excellent disciplines, institutes, teams and national thematic R&D priorities; • Potential rigidity of the new evaluation system disregarding differences among individual research disciplines; • Low interconnection between universities and external bodies (including industry) could lead to mismatches between university research and needs of the society.
Knowledge circulation	• Utilisation of Structural Funds for building top quality innovation infrastructure and environment stimulating research-industry knowledge circulation as well as setting up academic spin-offs; • Improvement of tax conditions stimulating business sector to order R&D at public research organizations and universities;	• Questionable sustainability of new R&D infrastructure after termination of public support (in case of insufficient links to industry and private funding); • Continuing separation of public and private sector R&D aggravates by a low horizontal mobility of human

Domain	Main policy opportunities	Main policy-related risks
	• Enhancement of Czech research participation in ERA and ensuring sufficient linkages to international R&D; • New legislation improving conditions for immigration of researchers.	resources; • Decrease of attractiveness of the Czech Republic for foreign R&D investment (also related to the lack of HRST, especially S&T graduates).

Table 2: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
The expenditures on R&D are still not satisfactory when compared to EU average as well as the ERA objectives.	All relevant policy documents describing this barrier. The current economic crisis may represent a barrier to further increase expenditure on R&D; however the budgetary cuts are much more significant in other than RDI fields.
The low number of researchers.	The current OPs represent the opportunity for more attractive R&D environment. Building a modern research capacity may attract new researchers, or it may encourage the return of qualified researchers from abroad. OP also offers the possibility of development of research in universities. Failure of appropriate conditions for researchers, structure of disciplines at universities and small horizontal mobility of researchers and students do not encourage the increase of researchers' number.
The low proportion of research in high technology intensive sectors.	The policy mix is more focused on stimulating further development R&D investment in R&D performing firms. Shift of companies to a higher technological sophistication and high-tech sectors.
A small number of domestic companies engaged in R&D.	Current policies may not be sufficient to encourage enterprises which do not perform R&D to become involved in research. Inovace and Prosperita programmes represent the opportunity to increase the number of firms conducting R&D.
Weak linkages between academic research and business sector.	Current programmes (Tandem, Impuls, Spoluprace) represent an opportunity to strengthen cooperation between academia and industry. Low absorption capacity of the business sector and insufficient interest of SMEs for R&D results are the risks.
Low commercialization of R&D output.	The Operational Programme Research and Development for Innovation (2007-2013), to be used for drawing financing from the EU Structural Funds, should support establishment of technology transfer offices within research institutes as well as the process of commercialisation of R&D outcomes itself (mainly the Priority Axis 3 calls).

3 Interactions between national policies and the European Research Area

3.1 Towards a European labour market for researchers

The Communication Better careers and more mobility: A European Partnership for Researchers proposed by EC in May 2008 aims to accelerate progress in four key areas: Open recruitment and portability of grants; Meeting the social security and supplementary pension needs of mobile researchers; Providing attractive employment and working conditions; Enhancing the training, skills and experience of researchers.

The Commission has also launched concrete initiatives, such as dedicated information services for researchers, in particular through the activities grouped under the name of EURAXESS – Researchers in Motion. Based on the assessment of the national situation in the four key dimensions detailed above, this section will conclude if national policy efforts are supporting a balanced 'brain circulation', with outward mobility levels matching inward mobility levels. High levels of outward mobility coupled with low levels of inward mobility often signal an unattractive national labour market for researchers and unsuitable research infrastructures. This may trigger, despite the policy efforts supporting the mobility the 'brain drain' rather than brain circulation.

3.1.1 Stocks and mobility flows of researchers

According to Eurostat data, the number of researchers has been steadily growing since 2001, both in the overall sense and in the business sector. As the tables below indicate, the pace of the growth was faster than in the EU 27. Nevertheless, the percentage of researchers in the active population was still lower in 2008.

In comparison with the new EU Member states, Czech Republic ranks second according to this indicator (with Slovenia being first).

Table 3: Overall number of researchers (% of active population)*

	2001	2002	2003	2004	2005	2006	2007	2008	index 2008/2006
Czech Republic	0.29	0.29	0.31	0.32	0.47	0.51	0.54	0.57	1.12
EU27	0.52	0.53	0.55	0.57	0.59	0.61	0.61	0.63	1.03

Source: Eurostat

Table 4: Number of researchers in the business enterprise sector (% of active population)*

	2001	2002	2003	2004	2005	2006	2007	2008	index 2008/2006
Czech Republic	0.11	0.12	0.13	0.14	0.20	0.21	0.24	0.25	1.19
EU27	0.25	0.25	0.26	0.26	0.27	0.28	0.28	0.29	1.04

Source: Eurostat

* Figures for EU 27 are Eurostat estimates; Since 2006, the methodology of registering researchers in the Czech statistics changed

When divided into sectors, Czech researchers are concentrated in research organizations within public sector by a slight majority (ca 55 %). The remaining 45% is active in private business sector.

Table 5: Number of researchers (FTE)

	2006	2007	2008
Total Business Enterprise Researchers	11,053	12,230	13,253
Total Government Researchers	6,800	6,915	7,084
Total Higher Education Researchers	8,352	8,664	9,358
Total Researchers	**26,267**	**27,878**	**29,785**

Source: DG Research Regional Key Figures Database (based on integrated Eurostat/OECD data)

Similar development trends can be observed in terms of the number of all university graduates (including PhD) in the Czech Republic; the counts have been growing

more rapidly than in other European countries but are still significantly lower than the EU27 average. The Czech Republic (as well as the majority of European countries) has not yet reached the level of one PhD graduate per 1000 inhabitants in the age of 25 – 34 years. Even though the postgraduate education can be classified as a preparation for the research career, approximately only one third of the Czech PhD graduates decide for research and two thirds for other careers. The main reason for choosing career in research lies in creativity and innovation potential of the work. Only a very low share of research personnel with PhD prefers the research career because of good employment conditions (10%) and because of good financial conditions (3%) (CZSO, 2008).

Inward and outward flows of researchers are hard to assess as limited statistical data is available. Conclusions can be drawn from partial (and thus non-representative) qualitative studies such as the ones provided by the Research Institute of Labour and Social Affairs in 2007 (RILSA, 2008). The results are as follows: the estimated share of foreigners employed in R&D is less than 1% of the total number of researchers in the Czech Republic; two-thirds of them are of a Slovak nationality. As to the outflow, about one half of post-graduate researchers intend to work abroad (especially in Anglo-Saxon countries); one third of the total sample already undertook specific steps to achieve that. The most important reasons were to gain international prospects and experience, higher income and better opportunity for a research career. About one third of the likely-moving-out was willing to take a job below achieved qualification.

On the demand side, there is still a lack of R&D personnel in the following fields: technical and natural sciences, ICT, and medicine (Vavreckova 2009).

The Czech Republic is involved in the majority of European programmes to support the ERA (researchers and students/graduates/post-doc mobility) such as Socrates Erasmus for university students or the Leonardo da Vinci programme for university teachers. National programmes as tools for stimulating the in and outward mobility of researchers are also available, e.g. *Programme for human resources development intended for talented MA and PhD students*. Since 2009, the national *Programme for support of bilateral mobility of students and university teachers and researchers* has been implemented by MEYS; financial resources from Operational Programmes Research and Development for Innovations and Education for Competitiveness will also be used.

3.1.2 Providing attractive employment and working conditions

Although the position of a scientist or researcher is acknowledged very positively in the Czech society, the quality of working conditions and attractiveness in terms of salary level is generally not attractive. The level of salaries of researchers in the Czech Republic is slightly higher than the average salary in the country; that does not really attract young graduates to choose the research career – it is definitely one of the significant discouraging factors. Within public research institutions, public tables of salary levels are respected; additional financial sources can be distributed to researchers within realized projects.

Moreover, according to the Czech Statistical Office (www.czso.cz), the average salary of the employees in the S&T fields in 2008 reached 75% of the salary of highly qualified staff in other fields.

Table 6: Average monthly gross wages in selected sectors (in CZK)

Average monthly gross wages	2004	2007	index 2007/2004
Total	**17,006**	**20,360**	**1.20**
Agriculture, hunting and forestry	12,841	15,749	1.23
Mining and quarrying	21,203	25,736	1.21
Manufacturing	16,560	19,941	1.20
Electricity, gas, steam and hot water supply	24,759	31,362	1.27
Wholesale trade and commission trade, except of motor vehicles and motorcycles	21,354	25,056	1.17
Hotels and restaurants	9,855	11,354	1.15
Air transport	42,677	58,449	1.37
Supporting and auxiliary transport activities; activities of travel agencies	19,612	23,867	1.22
Financial intermediation	34,857	41,055	1.18
Renting of machinery and equipment and of personal and household goods	20,507	23,285	1.14
Computer and related activities	32,039	39,481	1.23
Research and development	**19,851**	**24,612**	**1.24**
Public administration and defence; compulsory social security	20,527	24,645	1.20
Education	15,969	19,340	1.21
Health and social work	16,163	18,944	1.17
Other community, social and personal service activities	14,232	17,050	1.20

Source: www.czso.cz

Salaries in R&D sector in the Czech Republic are lower also when compared to west European countries – it is the higher income, which is one of the most significant pull-factors of outward mobility. According to the Report of the ERA Expert Group from 2008 called “Realising a Single market for Researchers”, the Czech employees in the field of R&D in average reach a salary of approx. €1,630 and the European average is approx. €3,160 which is almost twice as much.

These shortcomings of the R&D sector were in recent years addressed by several active employment policy tools in the Czech Republic, although they were not primarily directed at improving the attractiveness of R&D sector as such. These measures were e.g. promotion of part-time employment of women, then a financial aid in maternity leave with a possibility to keep a part time job etc. More specifically, research and academic careers in the Czech Republic have become women-friendly in the context of reconciliation between work and family life; nevertheless, it also has certain gender limits when considering high research positions for women. In general, there is no special promotion of women in the research career; the Czech Republic is traditionally one of the countries with a relatively high share of women on the labour market as 91.5% of employed women are employed on the full-time basis in comparison with the EU27 average of 68.6% of employed women (the latter figure being further lower for EU15 countries where a higher percentage of women take advantage of part-time employment).

Enhancement of the attractiveness of R&D positions is addressed mainly in the Operational Programme Education for Competitiveness, drawing financial aid from the EU Structural Funds. Within its Priority axis 2 (Tertiary education, research and development), selected supported activities concerning R&D employment are the following:

- Support of training and fellowships for researchers in private industrial subjects including the support of inter-sectoral mobility;
- Support to creation of quality R&D teams and their consequent development;
- Enhancement of international R&D cooperation.

As far as the information is available, the Charter for Researchers was signed by the Academy of Sciences (which consists of 53 different research institutes) and by a private research organization, Aeronautical Research and Test Institute.

3.1.3 Open recruitment and portability of grants

The Czech Republic's legislative rules provide a relatively open access for foreign researchers to be employed at academic positions, especially in case of EU citizens. Participants from the "third countries" can take part in a project of the Ministry of Labour and Social Affairs called Selection of Qualified Foreign Workers, which has been running since 2003. Qualified workers are given the opportunity to apply for permanent residence within a shorter period, after one and a half years (highly qualified workers category) or two and a half years (standard category of qualified workers) of uninterrupted stay and work (as compared to the current standard period of 5 years). The project targets to attract qualified workers mainly from the third world countries (post-soviet, Asian or Latin American countries) as well as from the United States, Japan or Israel.

Standardisation of PhD programmes as well as university research issues in the country is being currently solved within the reform of tertiary education based on the debate corresponding to challenges identified in the White Paper on Tertiary Education which was adopted on January 26, 2009 by the Government. Ministry of Education did prepare two principal documents:

- Proposal of new *law on tertiary education* in the Czech Republic;
- Proposal of new *law on financial support of students* (in cooperation with Ministry of Finance and Ministry of Labour and Social Affairs).

National programmes as tools for stimulating the inward and outward mobility of researchers are used to improve the current situation, for example the *Programme for human resources development intended for talented MA and PhD students*. Since 2009, a national *Programme for support of bilateral mobility of students and university teachers and researchers* has been funded by MEYS and financial resources from Operational Programmes Research and Development for Innovations and Education for Competitiveness will also be used.

Support of mobility of researchers from third countries to Europe is then provided by a transposition of the Council Directive 2005/71/ES on special procedure for accepting nationals of third countries for purposes of science and research. The Czech Republic also respects Regulation 1408/71 and 1612/68 on social benefits of European citizens even though they do not have permanent residency in the CR.

To simplify the movement of researchers within Europe, the European Commission established a network of mobility centres. These centres provide information for researchers on vacant jobs and administrative processes, necessary for work and stay in the EU Member States. The Czech Mobility Centre was created with the Czech Academy of Sciences and started activity on January 1, 2005. It provides help and expert information for foreign research workers, who are interested in working in

the Czech Republic and also Czech research workers, who are interested in working abroad.

Overall, for the last decade, international cooperation in R&D has been heavily promoted in the Czech Republic, especially after entering the EU structures. The Czech Republic has been connected to various systems of international advertising of research vacancies, including the European Researcher's Mobility Portal.

3.1.4 Meeting the social security and supplementary pension needs of mobile researchers

Incoming foreign researchers are obliged to respect the same legal and tax regulations as any other type of a foreign worker. In other words, no special treatment for international researchers exists in the Czech Republic. Foreign workers enumerated in the Pension Insurance Act have to participate in pension insurance, provided they meet the conditions stipulated by the Act. Most persons become participants in insurance by law, without having to sign up.

As far as the information is available, no tax incentives to facilitate the participations in supplementary pension schemes exist in the Czech Republic.

As to incoming researchers from third countries, the above-mentioned programme Selection of Qualified Foreign Workers is the most suitable and tailored for those individuals intending to stay permanently in the Czech Republic. The EU directive on Scientific Visa Package was transposed into the Czech Foreigner's law (Act n. 379) in December 2007. Since this date, the Scientific Visa is in place and can be applied for.

3.1.5 Enhancing the training, skills and experience of European researchers

Greater degree of standardization of Czech and foreign PhD programmes are secured by the above-mentioned laws arising from the White paper on tertiary Education (Section 3.1.3). According to the new law, Higher education institutions can provide – either free of charge, or subject to payment training in an internationally recognised training course aimed at increasing professional knowledge and skills of students or graduates from a foreign higher education institution. Detailed conditions of the course are then specified by internal regulations. At the same time, higher education institutions can issue certificates to course participants in order to prove the completion of such a course. Higher education institutions may award to successful graduates of the course an internationally recognised degree.

The new law also modifies the bilateral agreements and provision of scholarships provided by the Ministry of Education. The new law stipulates that the scholarships are awarded by the Ministry taking into account obligations under international treaties binding on the Czech Republic. The Ministry can award such scholarships and bursaries also to citizens of the Czech Republic studying at higher education institutions abroad.

Also, since August 2009, the Ministry of Education is now active in a project *National qualification framework for tertiary education* aiming at finding the most efficient structural measures in order to become compatible with the competence framework in the European higher-education area.

3.2 *Research infrastructures*

Research infrastructures (RIs) are a key instrument in the creation of new knowledge and, by implication, innovation, in bringing together a wide diversity of stakeholders, helping to create a new research environment in which researchers have shared access to scientific facilities. Recently, most EU countries have begun to identify their future national RI needs, budgets and priorities in the so called National Roadmaps for Research Infrastructures. These strategic documents also set out a strategic view on how to guarantee and maintain access to research facilities. Although some countries invest heavily in RIs, none can provide all the required state-of-the-art facilities on a national basis. Several large RIs have already been created in Europe. While optimising the use and development of existing RIs remains important, new infrastructures are needed to respond to the latest research needs and challenges. European Strategic Forum for Research Infrastructures (ESFRI) was established in April 2002 to support a coherent approach to policy-making on RIs in Europe and to act as an incubator for international negotiations on concrete initiatives. This section assesses the research infrastructures national landscape, focusing on the national RI roadmap and national participation in ESFRI.

3.2.1 National Research Infrastructures roadmap

The Roadmap for Large Research, Development and Innovation Infrastructures in the Czech Republic was approved by the Government in March 2010 as a strategic document for development of large infrastructures for research, development and innovation.

The goal of the Czech Republic in respect to ESFRI Roadmap projects is to have a node or a measuring station in the case of distributed infrastructures or to build a regional partner facility in the case of single sited research infrastructures. Strengthening of the Czech research infrastructure will be supported by means of the Operation programme Research and Development for Innovations administered by the Ministry of Education, Youth and Sports. Two main priority axes are entirely devoted to support of research infrastructure: Priority axis 1 – European Centres of Excellence, which is focused on establishment of large research infrastructure of a European significance and Priority axis 2 – Regional Centres for research and development, from which research infrastructures for especially industrial research are supported.

3.2.2 National participation in the *ESFRI roadmap*. Updates 2009-2010

Currently, the Czech Republic is a member of inter-governmental European research infrastructures. Besides the participation in ESFRI system, Czech Republic also has own national large research infrastructures; the prevailing areas of their specialization is material sciences and engineering (6 existing facilities – e.g. the Institute of plasma physics is housing the COMPASS-D and the Institute of physics is housing the PALS – Prague Asterix Laser System), energetics (2) and social sciences and humanities (2).

Furthermore, the Czech Republic participates in developing e-infrastructure within the GÉANT network (the Czech part is named CESNET – Czech NREN Operator). The Czech research institutes also participate in the following European research infrastructures: European Organization for Nuclear Research – CERN (since 1991), Joint Institute for Nuclear Research Dubna – JINR DUBNA, European Fusion Development Agreement – EFDA, Multidisciplinary Synchrotron Light Laboratory

ELETTRA, European Space Agency – ESA, European Southern Observatory – ESO (since 2007), European Synchrotron Radiation Facility – ESRF (since 1999), Institut Laue-Langevin – ILL 20/20 project (since 1998) and PIERRE AUGER Cosmic Ray Observatory.

Moreover, the Czech Republic has been participating in various projects of ESFRI Roadmap projects. These are: Council of European Social Science Data Archives – CESSDA, Common Language Resource and Technology Infrastructure – CLARIN, European Advanced Translation Research Infrastructure in Medicine – EATRIS, Extreme Light Infrastructure – ELI, Feasibility Study for a European Virtual User Office – ESRF-up, European High Power Laser Energy Research – HiPER, Integrated Carbon Observation System – ICOS, The European infrastructure for phenotyping and archiving of model mammalian genomes – INFRAFRONTIER, Integrated Structural Biology Infrastructure for Europe – INSTRUCT, Jules Horowitz Reactor Project – JHR and Survey of Health, Ageing and Retirement in Europe – SHARE.

Approximately €700m was allocated in the call for proposals of large projects in the Priority axis 1 and 2 within the Operational Programme Research and Development for Innovations at the end of 2009. These proposals included an obligation to have a partnership with the ESFRI infrastructure. The following projects were registered by the deadline of the call:

ELI – Extreme Light Infrastructure: project aiming at creation of an excellent large laser infrastructure in the Czech Republic. It is the only ESFRI Roadmap project, which is to have its base in the Czech Republic.

BIOCEV – Biotech & Biomed Research Centre: the goal is to create an excellent biotechnology and biomedicine centre.

CEITEC – Central European Institute of Technology: the aim is to establish a sustainable “engine” generating innovation capacity in biosciences, biomedicine and advanced materials and technologies.

IT4Innovation: The project follows one of the long-term research priorities in the Czech Republic with the aim of creating an information society. The specific goal is to create a supercomputer for both academy and industry needs.

Sustainable energetic: The project aims at establishing a research institute focusing on R&D of safe and efficient technologies for energy production at sustainability basis as well as for medical purposes.

CVEVL – Centre for Research of Energetic Exploitation of the Lithosphere: A specialized research institute is to be created with focus on utilization of geothermal energy as a source of clean water.

ICRC – International Clinical Research Centre: the focus of this centre is the cardiovascular and neurological research with anticipated spill over effects to oncology etc.

CERIT – Centre for Educational Research and Innovation in Informatics: The aim is to create an excellence centre in the area of education, R&D of advanced modelling and simulations.

3.3 *Strengthening research institutions*

The ERA green paper highlights the importance of excellent research institutions engaged in effective public-private cooperation and partnerships, forming the core of research and innovation 'clusters', mostly specialised in interdisciplinary areas and attracting a critical mass of human and financial resources. The Universities/ research institutions should be embedded in the social and economic life where they are based, while competing and cooperating across Europe and beyond. This section gives an overview of the main features of the national higher education system, assessing its research performance, the level of academic autonomy achieved so far, dominant governing and funding models.

3.3.1 Quality of National Higher Education System

Higher and tertiary education sector in the Czech Republic consists currently of 26 public and 45 private institutions providing tertiary education. Although the number of private universities has undertaken a rapid growth since 2009, the number of enrolled students in private universities is rather low in comparison to those in public universities.

Table 7: Number of universities

	2001	2002	2003	2004	2005	2006	2007	2008
Public	24	24	24	25	25	25	26	26
Private	17	27	28	36	39	38	42	45
State	4	4	4	2	2	2	2	-

Source: www.czso.cz

Table 8: Number of university students

	2007		2008	
	total	females	total	females
Public	303,244	53.2%	319,615	54.1 %
Private	40,939	60.2%	50,659	60.2 %

Source: www.czso.cz

Since 1990s, universities have been increasing their scientific output (measured by publications). The average annual growth of HERD (16%) during 2000 – 2006 is however still much lower than the EU15 average but it recently exceeded the growth in business, government as well as private non-profit sector. The leading science areas receiving the most substantial part of HERD are technical sciences, followed by natural sciences.

Table 9: Higher education expenses on R&D activities

HERD (in mil. €)	2000	2001	2002	2003	2004	2005	2006	2007	2008
Natural sciences	53.6	55.2	53.0	41.5	46.4	60.3	82.5	78.0	96.2
Technical sciences	57.6	69.7	75.0	83.2	83.7	102.1	108.3	138.3	131.8
Medical sciences	17.8	19.9	21.0	30.6	33.9	59.3	63.0	75.2	64.2
Agricultural sciences	10.9	14.0	14.6	16.1	18.7	17.2	18.7	24.7	25.0

SSH	13.7	22.4	25.0	29.5	28.8	43.1	50.8	57.5	53.8

Source: www.czso.cz

There is a steady pace of growth also as to postgraduate students. All of them have been registered in public universities as private universities have no PhD programmes.

Table 10: Number of PhD students

Number of PhD students	2007		2008	
	total	females	total	females
	21,592	39.5%	22,071	40.9%

Source: www.czso.cz

3.3.2 Academic autonomy

University management has undergone major changes in the last 15 years, evolving from a centralised model to the self-governing (autonomous) management. The biggest weakness of the current universities' management is a low participation of other actors, mainly from industry, in the university management boards. This is one of the reasons why universities currently do not properly fulfil their third role. Improvement is expected after the tertiary education reform based on the White Paper of Tertiary Education which has been under a large discussion of the expert public.

The aim of the White Paper of Tertiary Education is to stabilize an open system of autonomous institutions of tertiary education. Concerning the management of universities, it proposes the following management structure:

- The Council for Tertiary Education (RTV): RTV should be conceptual, coordinating and an Advisory Board appointed by the Government to ensure balanced strategic influence on the development of all parts of the sector of tertiary education.
- The Management Board of universities: This body will be a tool for monitoring and influencing the basic steps of strategic institutions.
- Academic Senate of universities: The Senate plays a significant role in the negotiation and approval (not creating) the internal rules of the institution and including the budget and control issues.
- The Scientific Council: The Council should pay particular attention to the long-term focus of R&D and the overall strategy of the institution (including cooperation with the practice).
- The influence of external actors will be felt especially at the strategic level and the level of control and evaluation. The external actors certainly include not only representatives of regional public administration or business, as well as representatives of research institutions, workers in the field of culture, non-profit sector workers, but also graduates of the institution.

The White Paper of Tertiary Education is currently being transformed into a new Act on tertiary education.

3.3.3 Academic funding

Research at the universities is generally funded from institutional public funds (the provider is the Ministry of Education) and targeted public funds (Czech Science Foundation – GACR). Tertiary education is financed through a normative public financing of education and financial support to students. The amount of the financial support to university R&D is provided in the table in Section 3.3.1. The public support to university R&D funds nearly 91% of the total university R&D activities.

Table 11: Sources of university R&D (in million of CZK)

Sources of university R&D	2006	2007	2008
Private	55	67	57
Public	7,166	8,387	8,256
Foreign	354	411	394
Own income	344	294	383

Source: www.czso.cz

Lack of private R&D funds (0.7% of the university funding in 2007 and 0.6% in 2008) is a significant problem in the field of higher education in the CR. This fact leads to an insufficient fulfilment of universities' third role and to the cooperation with the private sector.

The above-mentioned measures within the White Paper of Tertiary Education and their translation into the Act of Tertiary Education address these shortcomings in the third role of universities. This reform is based on two key pillars. The first pillar is a new and more liberal system of higher education (a change in the decision-making and supervisory powers of the university authorities).

The White Paper of Tertiary Education also proposes tuition fees paid by students. Tuition fees shall guarantee the improvement of tertiary education quality and can also be used to better match the fields of study to labour market needs. Tuition fees must however be accompanied by a system of student loans, which allow students to defer payment of tuition fees up to earning a career after graduating. The aim is that a socio-economic background of students should play a minimum, ideally no role in their accessibility to tertiary education.

Also the funding system is expected to change considerably. Today's funding scheme to the universities is as follows:

Table 12: Structure of public funding of R&D at HEIs (in thousands of CZK)

Structure of public funding of R&D at HEIs		2010	2011
Targeted funding		937,603	904,756
Institutional funding	Development of research organizations	1,335,488	2,623,825
	Research intentions	1,973,497	1,695,757
Total		**4,246,588**	**5,224,338**

Source: www.vyzkum.cz

From 2011 a higher share of the institutional funding based on evaluation of R&D results ("Development of research organizations") will be put in place, together with the decline of financing through research intentions.

3.4 Knowledge transfer

The importance of knowledge dissemination and exploitation in boosting competitiveness and contributing to the effectiveness of public research has been increasingly recognised by EC and EU Member States. Following the publication of the ERA Green Paper in April 2007, the EC Communication "Improving knowledge transfer between research institutions and industry across Europe" was issued, highlighting the importance of the effective knowledge transfer between those who do research, particularly HEIs and PROs, and those who transform it into products and services, namely the industry/SMEs.

Several Member States have taken initiatives to promote and facilitate knowledge transfer (for instance new laws, IPR regimes, guidelines or model contracts) and many others are planning to intensify their efforts in this direction. However, these initiatives are often designed with a national perspective, and fail to address the tran-snational dimension of knowledge transfer. This section will assess the national policy efforts aimed to promote the national and trans-national public-private knowledge transfer.

3.4.1 Intellectual Property Policies

Knowledge transfer and intellectual property rights issues have been one of the most significant challenges in the Czech R&D and innovation system for a long period, both in the public and private sector. During those years, harmonisation of law in the field of protection of intellectual property rights has taken place in the Czech Republic. However, statistical data demonstrate a significantly lower patenting activity both in the private and public sectors in comparison with advanced countries. The main reasons may lie in a low awareness of intellectual property rights (IPR) issues as well as in the high input costs needed for processing patent applications abroad (EPO).

The support for the protection of intellectual property rights became one of the priorities in the area of innovation, which form part of the Operational Programme Enterprise and Innovations for the programming period of 2007 – 2013 and more specifically, in the programme INOVACE (Innovation). The programme contributes to the implementation of the development of innovative projects based on R&D and allows subside the use of protection of intangible assets in the form of patents, utility models, industrial designs and trade marks. Allocation of funds for the last call was approximately €70.6m.

IPR issues are addressed also in the National Policy of Research, Development and Innovation in the Czech Republic for 2009 – 2015, where IPR is given an attention. Within the Priority axis 3 of the Operational Programme R&D for Innovation, formulation of strategies at the research institution level for knowledge transfers will be supported. Also operation of various bodies providing advisory services in IPR will be supported.

Some of the major universities and especially those oriented on technical and material sciences have been active in establishing a knowledge and technology transfer offices.

3.4.2 Other policy measures aiming to promote public-private knowledge transfer

Spin-offs

In the Czech Republic, venture capital schemes and business angels are nearly nonexistent, basically as a result of the above-mentioned low level of knowledge and technology transfer as well as limited awareness and quality of IPR.

The National Policy sets measures also for support the creation of spin-offs from the universities. Within the Priority Axis 3 of the Operational Programme R&D for Innovation, the support to strategies setting out the regulations and rules of the knowledge and technology transfer at a certain research institute also contain the formulation of principles of establishing spin-offs, based on the utilization of R&D results achieved at these institutes. The goal of the National Policy is also to include the extent of commercialization of R&D results and establishing spin-off companies into the overall method of evaluation of R&D results.

Inter-sectoral mobility

Along with the rather difficult process of knowledge transfer in the Czech Republic goes the inter-sectoral mobility of researchers. The practice that a researcher of a public research institution would gain a fellowship at a private research organization (and vice versa) is certainly not usual.

Promoting research institutions - SME interactions

In recent years, the Czech Republic has started being active in promoting and supporting cooperation of private and public bodies in R&D, especially between SMEs and public research institutions. The situation has been as if the two worlds (public and private) have lived separately. The new efforts strive to overcome these barriers.

The current set of measures puts greater emphasis on the technology transfer and co-operation between research institutes and private companies at the first place. In other words, the effort is to gain a more intensive inclusion of the private sector into joint public-private research projects. This shift is connected also with a sounder support to R&D in businesses and private enterprises, including SMEs. These measures are to increase the private expenditures on RDI and facilitate diffusion of new technologies in enterprises. The current set of support measures provides a sensible range of support to enterprises as well as to SMEs, however, there is no programme designed specifically for SMEs.

The support programmes are either financed from the Operational Programme Enterprise and Innovation (INNOVATION, POTENTIAL, COOPERATION and ICT and STRATEGIC SERVICES), or funded mainly from the national sources (IMPULS, TANDEM and TIP). All of the programmes are focused on support of industrial R&D and collaboration of enterprises (incl. SMEs) with research institutions.

Also, the Ministry of Education currently carries on a project EF-TRANS; its goal is to set up and bring into effect knowledge transfer between R&D (research and development) institutions and industry. A simple system of knowledge transfer is being created, with a special emphasis on patent and licenses applications, intellectual property, establishment of spin-offs, and active cooperation between research institutions and industry. The project ends in May 2012.

Involvement of private sectors in the governance bodies of HEIs and PROs

It has been only in recent years that the notion of modification of the structure of governance bodies of HEIs came into question. The reason behind it was to promote knowledge transfer between the HEIs and industry by adjusting education curricula and research and development agenda of HEIs so that they would respond more the current industry needs and demands.

These issues were addressed in the White Paper of Tertiary Education and consequent Act on Tertiary Education, which established an open system of autonomy of HEIs, with representatives of the relevant industries being allowed to their governing bodies (see Section 3.3.2).

The current situation at Czech HEIs is that the representatives of various private industrial companies are present in Scientific Boards (as external members) as well as on Boards of Trustees, which has an influence on long-term strategy of HEIs.

EU cohesion policy

Support to activities facilitating knowledge transfer (such as business incubators or science parks) was realised in the previous Operation Programme Industry and Enterprise (2004 – 2006). Currently, these types of institutions are supported particularly through programme "Potential" implemented by CzechInvest. This programme has allocation of approximately €333m and is a part of the Operational Programme Enterprise and Innovation. The main objective of the programme Potential is to support new or to increase existing capacity of enterprises for research, development and innovation activities, and at the same time to increase the number of enterprises carrying out own research, development and innovation.

3.5 *Cooperation, coordination and opening up national research programmes within ERA*

The articulation between the R&D Framework Programmes, the Structural Funds and the Competitiveness and Innovation Programme is still underdeveloped in terms of coordination, synergies, efficiency and simplification. The policy fragmentation at EU and national level and between EU and national policies can hinder the build of critical masses of research excellence, leads to the duplication of efforts, sub-optimal impacts of the different instruments and unnecessary administrative overheads. Differences between research selection procedures and criteria can also be an obstacle to the overall spread of excellence. This section assesses the effectiveness of national policy efforts aiming to improve the coordination of policies and policy instruments across the EU, all part of the drive to create an integrated ERA.

3.5.1 National participation in intergovernmental organisations and schemes

The research community in the Czech Republic considers it essential to maintain an intensive international cooperation and participation in intergovernmental organizations in research and development. The Czech Republic is a member of most of the intergovernmental organizations in ERA as well as the member of projects of large European infrastructures (ESFRI). This inclusion of Czech research and development is a very efficient means to further improve the quality of the Czech R&D towards efficiency.

Nevertheless, even though the policy documents declare the openness of the Czech research and development area, there are still no funding programmes in the Czech

Republic that allow a researcher to transfer a research grant to another country. For example, in the majority of cases, all research projects funded by national research programmes must be carried out in the Czech Republic. In general terms, reciprocity should be required in any international partnerships but there may be cases where it makes sense for national funding to be used outside the country without this requirement (e.g. need to access specialist skills, capacity building in a particular field, preparing the ground for future S&T partnerships and collaborations, etc.). In other words, international cooperation within a national research projects is still not a common practice.

In March 2010, the Ministry of Education established its advisory body for strategy- and recommendation-making of the Czech Republic within ERA. The aim is to create a central point, where relevant information and opinions of the main figures of R&D is concentrated and consequently proposed as a strategic position of the Czech Republic during formulation of R&D&I policies within ERA.

3.5.2 Bi- and multilateral agreements with other ERA countries

The involvement of Czech research teams in the bi- and multilateral agreements is rather low when compared to other EU 27 countries (in relation to FTE researchers or per million inhabitants). As to the participation of **7th Framework Programme**, Czech research teams have generally low response rate to the programme calls; nevertheless, their success rate is relatively high so far (21.6%).

Table 13: Participation in the 7th Framework Programme

Research Fields	7th Framework Programme	
	Number of participations	Total budget (mil. CZK)
Food, Agriculture and Fisheries, Biotechnology	3	0.53
Energy	1	0.10
Environment	4	0.44
Euratom	5	0.59
Health	6	1.64
Research for the benefit of SMEs	1	0.22
Information and Communication Technologies	3	3.38
Nanoscience, Nanotechnologies, Materials and New Production	5	0.23
Research Infrastructures	3	1.39
Science in Society	1	0.04
Transport	6	0.48
Space	2	0.32
Security	1	0.01
Socio-economic Sciences and Humanities	1	0

Source: Čadil, Pacvoň, 2008

According to the table above, Czech teams have participated mostly in transport, health and nanosciences. There is also relatively high participation in **Euratom**. Along with the level of participation goes the amount of the financial means provided through these projects (as approvable expenses).

One of the most significant reasons for lower participation of Czech researchers in the international schemes is that there is no coherent national strategy for Framework Programmes and other multilateral agreements. In turn, Czech researchers do not have clear linkage in terms of policy set priorities, strategy or motivations (FP as a part of evaluation) to participate in FPs.

On the other hand, 214 projects with a Czech partner have been carried out within **Eureka**. The current number of undergoing project is 99 (the number is a sum of projects within both Eureka and Eurostars). Eureka is co-financed also from the Czech national budget; the annual amount dedicated to this support is slightly over €4m. Czech research teams within these programmes cooperate with the neighbouring countries to the greatest extent, namely with institutions in Germany, Austria, Poland and Slovakia.

Altogether 257 projects were supported in the programme Eureka with the Czech public support of CZK1.153b (€46.8m). The total sum of approvable expenses reached CZK2.675b (€108.5m). The subjects supported are mainly private companies.

On the other hand, main Czech participants in programme **COST** are HEIs, institutes within the Academy of Sciences and private research organizations, as COST is focused more on support to basic research activities. The annual number of projects undertaken within this programme varies between 70 and 80, and the number of events with Czech participation is approximately 100 (per year). Since 1999 until now, 715 projects were supported within COST with the total amount of public support of CZK1.032b (€41.8m).

Table 14: Total budget of COST projects

Total budget	2008	2009	2010	2011*	2012*	2013*
COST	57,375	77,048	89,459	64,524	74,866	98,288

Source: Technology Centre 2010

The involvement of Czech research teams in inter-governmental research infrastructures as seen as highly strategic for the Czech research. For that reason, Czech research institutes cooperate and participate in numerous European research infrastructures, mainly in the field of aerospace and nuclear research. The most significant are as follows:

- European Organization for Nuclear Research – CERN (since 1991);
- Joint Institute for Nuclear Research Dubna – JINR DUBNA;
- European Fusion Development Agreement – EFDA;
- Multidisciplinary Synchrotron Light Laboratory ELETTRA
- European Space Agency – ESA;
- European Southern Observatory – ESO (since 2007);
- European Synchrotron Radiation Facility – ESRF (since 1999);
- Institut Laue-Langevin – ILL 20/20 project (since 1998);
- PIERRE AUGER Cosmic Ray Observatory.

3.5.3 Other instruments of cooperation and coordination between national R&D programmes

Participation in ERA-NETs

Czech policies approaching supporting the cooperation and participation in the European initiatives are very weak, as no coherent approach is in place (whereas PPP at national level are well recognized and supported from the public funds). The international R&D cooperation in European e.g. public-private partnerships or other initiatives thus results in several European projects with a Czech participation. The Czech Republics´ 21 research and state administration institutions participate in 14 active ERA-NETs financed by the FP7 (Source: Netwatch, 2010). There are 3 programmes in the CR to possibly finance ERA-NETs: OP EI: Potencial, Prosperity programme (MIT) and INGO programme (MEYS).

Participation in initiatives under Act. 185 of the Treaty of Lisbon

The Czech Republic was one of the countries most involvement in creation of programme EUROSTARS, which is a joint programme of Eureka and EU, and is dedicated especially for SMEs active in R&D. The statistic of Czech involvement is counted together with participation in Eureka programme (see above).

Also the European Metrology Research and Development Programme (EMRP) has Czech participation – altogether five institutions take part in projects within this programme; Czech Republic has also a member in the Management Board.

Participation in activities funded by European Science Foundation

Czech participation in activities undertaken through frameworks supported by the European Science Foundation (ESF) is not very successful. The reason is that COST

model started to cooperate closely with ESF; this resulted in modification of the COST model and COST started to be implemented into the ESF schemes. This caused undesirable effects on the Czech participation as this process of merging the two uncomplimentary models created rather confusing schemes.

Participation in European public-private partnerships

Currently, there are two projects under way with a Czech participation within the Joint Technology Initiative for Fuel Cells and Hydrogen. One project with a Czech participant is found also in Aeronautics and Air Transport (Clean Sky). Within ARTEMIS, focusing on ICT, 16 Czech research teams (9 from private companies, 6 from HEIs and one from the Academy of Sciences) take part in seven approved projects. As to ENIAC, three projects have been approved with the Czech participation.

Involvement in Joint Programming Initiatives

Based on the Green Paper on ERA, the European Commission initiated the establishment of several joint programming initiatives (JPIs) in 2008. In December 2008, the Council of EU approved four of these JPIs and the Czech Republic has representatives in management boards in all of the JPIs. These are:

- Neurodegenerative diseases (including Alzheimer's disease); a pilot JPI, in which the Czech Republic is represented by the Ministry of Education in cooperation with Czech Alzheimer society.
- Agriculture, Food security and Climate Change; the strategic agenda of this JPI has not been created yet.
- Cultural Heritage and Global Change: a new challenge for Europe; Czech Republic is represented by the Ministry of Culture.
- A Healthy Diet for a Healthy Life; the strategy of this JPI is also currently being formulated.

3.5.4 Opening up of national R&D programmes

Attracting researchers from abroad still keeps being a challenge. Concerning the environment for researchers from the EU27 countries, there are European and national researchers mobility schemes addressing the issue, which are of use in the CR (e.g. projects implemented by the newly established Czech Mobility Centre). However, the Czech research environment is among others characterized by low salaries (at 30% of the EU15 level) and low attractiveness of this employment in the society, which might discourage the researchers from abroad when choosing an EU country to work in.

National R&D programmes which are open to foreign individual researchers, but only to some extent: when working for a Czech research institution or when being a resident in the CR at the moment of application and realization of the research project. National programmes are not open to foreign research teams from a foreign research institution. More on the mobility schemes is also mentioned in the Chapter 3.6.2.

Nevertheless, increasing the attractiveness of research in the society as well as increasing the number of researchers are identified in recent strategic documents (reform, policy). OPs represent an opportunity to attract new researchers (graduates as well as researchers from abroad) in the big research infrastructures currently

being built from the OP RDI. Some measures addressing the issue are also present in the OP Education for Competitiveness and OP Human Resources and Employment.

3.6 *International science and technology cooperation*

In 2008, the European Commission proposed the Strategic European Framework for International Science and Technology Cooperation to strengthen science and technology cooperation with non-EU countries. The strategy identifies general principles which should underpin European cooperation with the rest of the world and proposed specific orientations for action to: 1) strengthen the international dimension of ERA through FPs and to foster strategic cooperation with key third countries through geographic and thematic targeting; 2) improve the framework conditions for international cooperation in S&T and for the promotion of European technologies worldwide. Having in view these aspects, the following section analyses how national policy measures reflect the need to strengthen the international cooperation in S&T.

3.6.1 International cooperation

The Czech Republic's international R&D cooperation with third countries is to a large extent carried out through bilateral agreements. The main science fields of the cooperation are material sciences, ICT, biotechnologies, sustainable technologies and engineering sciences. On the basis of bilateral schemes, the Czech Republic cooperates with India, Israel, South Korea, Russia, Argentina, China, and the United States.

3.6.2 Mobility schemes for researchers from third countries

As stated in Chapter 3.1.3, support of mobility of researchers from third countries to Europe is provided by a transposition of the Council Directive 2005/71/ES on special procedure for accepting nationals of third countries for purposes of science and research. The Czech Republic also respects the Regulation 1408/71 and 1612/68 on social benefits of European citizens even though they do not have permanent residency in the CR. The EU directive on Scientific Visa Package was transposed into the Czech Foreigner's law (Act n. 379) in December 2007. Since this date, the Scientific Visa is in place and can be applied for.

The above-mentioned bilateral R&D cooperation can also result in mobility of researchers. The national approach to mobility schemes for researchers from third countries is embedded also in the new Employment Act enabling the qualified labour force (i.e. not specifically researchers) from the third countries to stay for work in the CR. Moreover, Ministry of Labour and Social Affairs runs a programme Selection of Qualified Foreign Workers, which has been running since 2003, through which qualified workers are given the opportunity to apply for permanent residence within a shorter period, after one and a half year (highly qualified workers category) or two and a half years (standard category of qualified workers) of uninterrupted stay and work.

4 Conclusions

4.1 *Effectiveness of the knowledge triangle*

Generally speaking, the interaction between education, innovation and research policies is still a weakness of the CR.

Within research policy, new strategic / policy documents have been adopted recently and the reform steps are being fulfilled by the stakeholders accordingly. An interim evaluation of the policy priorities is just being provided by the CRDI. The newly established Technology Agency of the CR aiming at support of the applied research has improved the situation in the fragmentation of the Czech R&D funding. The R&D expenditures of the business sector are still not reaching the European average level and the increase of effectivity of the expenditures remains a challenge of both private and public sectors.

In the framework of innovation policy, the National Innovation Policy 2005-2010 has been recently replaced by the National RDI Policy 2009-2015. This should lead to a better interaction of research and innovation policy. Following the ideas of the European flagship initiative called Innovation Union, VERA (Czech advisory council for the ERA) has also introduced plans of the system changes ensuring the strong inter-linkages between the knowledge triangle policies. The Czech innovation environment is currently characterised by a high openness of the Czech economy linked to growing export volume and a high employment rate in medium high-tech and high-tech sector, but also by a low share of high-tech industry and services for value added generation and slow structural adaptation of the labour force to the market needs.

Concerning education policy, the White Book on Tertiary Education was produced in 2008 as a basis for the tertiary education reform. Unfortunately, this document was not adopted by the Government and the following debate of the experts and relevant stakeholders on this issue resulted in disagreement. This led to a situation where the reform steps still remain a challenge. However, the number of Czech students and graduates has been increasing and the technical and natural sciences fields in the universities are traditionally on a quite high level. Also financial resources from OP Education for Competitiveness should improve the situation towards the necessary reforms (system projects and methodologies) as well as towards a new curriculum framework responding more to the needs of the labour market and a better inter-sectoral and international cooperation of universities.

As an indirect impact of other policies on the development of knowledge triangle, the tax incentives (one of the Government fiscal measures) introduced in 2005 could be mentioned.

Main recent policy changes as well as strengths and weaknesses of the relevant knowledge triangle policies are listed in the following table:

Table 15: Effectiveness of knowledge triangle policies

	Recent policy changes	Assessment of strengths and weaknesses
Research policy	• Reform of RDI System • National RDI Policy • Technology Agency of the CR established • New methodology of RD results evaluation introduced • New programmes introduced mainly within the OPs 2007-13 • New Act on the Support of RDI	• S1 - newly introduced Reform and National RDI policy identified key priorities for the following years in the area of RDI • S2 - main basic as well as applied research funds providers are established and have their own national budget chapters (lower fragmentation of the RD financing) • W1 – low business RDI expenditures compared to the EU27 average • W2 – low effectivity of both public and private RD sources
Innovation policy	• National RDI Policy • OP Enterprise and Innovation funds (Innovation, Potential..) • VERA – Council for ERA established in 2010	• S1 - High openness of Czech economy linked to growing export volume • S2 - High employment rate in medium high-tech and high-tech sector • W1 - A low share of high-tech industry and services for value added generation • W2 - Slow structural adaptation of the labour force to the market needs
Education policy	• White Book on Tertiary Education • OP Education for Competitiveness	• S1 – University students and graduates share on population is increasing • S2 – traditionally high quality of technical and natural sciences disciplines on universities • W1 – still not realized Reform of the Tertiary Education planned from 2008
Other policies	• Tax incentives introduced in 2005	• S1 – Fiscal measures such as tax incentives introduced as indirect support to R&D • W1 – Global economic crisis leading to the cuts in RDI spending mainly in the business sector • W2 – not sufficient coordination and interaction of research, innovation and education policy

4.2 *ERA 2020 objectives - a summary*

According to the opening statement of the *2020 Vision for ERA* by 2020, all players should benefit from:

- The "fifth freedom" across the ERA: free circulation of researchers, knowledge and technology;
- Attractive conditions for carrying out research and investing in R&D intensive sectors in Europe;
- Healthy Europe-wide scientific competition, together with the appropriate level of cooperation and coordination.

ERA Vision 2020 was translated into 15 strategic objectives, with relevant indicators and targets attached in order to monitor and evaluate progress.

In the table below, there is an assessment of the national policies/measures supporting the strategic ERA objectives – derived from the ERA 2020 Vision.

Table 16: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	• Issue reflected in National RDI Policy and in the Reform as a high priority; • OP Education for Competitiveness and OP Human Resources and Employment support measures;	• Labour market for researchers still suffers from lack of researchers mainly in the S&T fields, • Post-graduate education has been classified as preparation for research career, but only 1/3 of PhD graduates choose the research career, • Number of university graduates and researchers has been increasing but there is still a significant lack of R&D personnel and graduates in S&T fields, both at universities and in the business sector; • International mobility is considered as the main challenge for improvement.
2	Increase public support for research	• GERD and GOVERD increasing in the last decade.	• Secured and increasing long term institutional and project-based funding of R&D (increasing GBAORD) but insufficient horizontal coordination between R&D and innovation policy.
3	Increase European coordination and integration of research funding	• VERA (Council for ERA – advisory board of the CRDI) established in 2010 to deal with these issues including the formulation of the Czech position on the FP8 priorities. • TA CR (Technology Agency of the CR) established in 2009 replacing the high number of providers of the applied research project based funding on the national level.	• One of the main weaknesses of the Czech R&D remains the low level of the public R&D expenditures, even though increasing in a long-term horizon.
4	Enhance research capacity across Europe		
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	• OP RDI Priority Axis 1 + 2: support to centres of excellence and regional R&D centres.	• There is a number of projects supporting the development of research infrastructures from the Structural Funds, but there is question remaining on the sufficient number of researchers for these new infrastructures.

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
6	Strengthen research institutions, including notably universities	• Institutes of the ASCR have become autonomous / independent public research institutions including the financial responsibility.	• Universities are quite autonomous in the Czech Republic, including the field of research. Anyway, new methodology on evaluation of research results shall be introduced to lead the research providers to excellence.
7	Improve framework conditions for private investment in R&D	• OP Enterprise and Innovation support • MIT national support measures – Tandem, Tip, Trvalá Prosperita • Tax incentives introduced in 2005	• Private sector is still more purchasing the knowledge from abroad and financing the low cost labour cost in the CR, more than support the RDI qualified HR in the Czech Republic.
8	Promote public-private cooperation and knowledge transfer	• OP RDI Priority Axis 3 aiming at support of the commercialisation of research results including the technology transfer offices. • Issue addressed in the national RDI policy as a priority • EF-TRANS project creating methodology for the knowledge and technology transfer offices.	• Existence of R&D programmes supporting research-industry co-operation and industrial R&D with the aim to lead research towards practical outcomes but a low level of services provided by organisations ensuring technology & knowledge transfer into practice. Insufficient supply of mediation services provided to innovative companies and unfavourable conditions for setting up academic spin-offs. Low support to inter-sectoral (private-public-university sector) mobility of researchers.
9	Enhance knowledge circulation across Europe and beyond	• VERA: formulation of the Czech priorities within the FP8; • Issue addressed in the national RDI policy as a priority • FP7 Cooperation – international teams common projects	• National and European funding enabled the development of science parks, incubators, TTOs, but also qualified human resources for the big research infrastructures including for TTOs are still a challenge.
10	Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world	• FP7 Cooperation – international teams common projects • Czech participation in Eureka, COST, FP7 etc.	• Low success rate in the international research programmes compared to national ones leading to a low participation of Czech teams in the international activities in the field of research.
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	• National RDI Policy and Reform	• Coordination of the knowledge triangle policies in the CR is not sufficient yet, nevertheless the common research and innovation policy is a first step towards improvement.

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
12	Develop and sustain excellence and overall quality of European research	• OP RDI Priority Axis 1 – Centres of Excellence • New Methodology for Evaluation of Research Results and its interconnection with institutional funding	• Several new centres of excellence are being supported through the SF in the Czech Republic. PROs and Universities shall be financed according to their research results from 2011.
13	Promote structural change and specialisation towards a more knowledge - intensive economy	• Government Office established "National Economic Council" – group of experts dealing with the issues of necessary reform and structural changes steps.	• Reform of the Tertiary Education and Research Systems shall be finished ASAP including the measures aimed at increasing the effectiveness of R&D expenditures.
14	Mobilise research to address major societal challenges and contribute to sustainable development	• Priorities of the Applied Research 2009-2011 replaced in 2009 the Long Term Principal Directions – addressing the societal challenges.	• Societal challenges shall be included in the research programmes priorities to be addressed by researchers (CSF, TACR).
15	Build mutual trust between science and society and strengthen scientific evidence for policy making	• TTOs support both from national and SF sources • VERA – supporting the scientific evidence for policy making.	• Policy documents mention the issue, but still a gap between science and society remains significant. More popularisation and medialisation steps are needed.

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List of Abbreviations

ASCR	Academy of Sciences of the Czech Republic
BERD	Business Expenditures for Research and Development
CERN	European Organisation for Nuclear Research
COST	European Cooperation in Science and Technology
CR	Czech Republic
CRDI	Council for Research, Development and Innovation
CSF	Czech Science Foundation
ERA	European Research Area
ERA-NET	European Research Area Network
ERP Fund	European Recovery Programme Fund
ESA	European Space Agency
ESF	European Science Foundation
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EU27	European Union including 27 Member States
FDI	Foreign Direct Investments
FP	European Framework Programme for Research and Technology Development
FP7	7th Framework Programme
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D

GUF	General University Funds
HEI	Higher education institutions
HERD	Higher Education Expenditure on R&D
HES	Higher education sector
ICT	Information and Communication Technologies
IP	Intellectual Property
JPI	Joint Programming Initiative
OECD	Organisation for Economic Co-operation and Development
PRO	Public Research Organisations
R&D	Research and development
RDI	Research, Development and Innovation
RI	Research Infrastructures
RTDI	Research Technological Development and Innovation
S&T	Science and Technology
SF	Structural Funds
SME	Small and Medium Sized Enterprise
TACR	Technology Agency of the Czech Republic
VC	Venture Capital