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An assessment of research system and policies

Czech Republic

Lenka Hebakova, Miroslav Kostic

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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 Lisbon Strategy. The strategy reflects this in guideline No. 7 of the Integrated Guidelines for Growth and Jobs which 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. Four policy-relevant domains of the research system are distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. This analytical approach has been tested in 2007 by applying it to six countries. The report is based on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

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

The Czech Republic has a strong public research based on a developed network of public universities and research institutes. However, the main weakness of public research sector lies in a low production of commercially applicable results related to the insufficiently motivating system of R&D evaluation. This problem is addressed by the recently adopted R&D Reform, which also includes a new system of evaluation.

Lagging behind highly developed European countries in most R&D indicators is addressed by currently implemented strategic documents. Namely, 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, availability of a highly qualified labour force is becoming a key challenge for the Czech R&D policy with respect to the lack of S&T graduates.

The main weakness of Czech R&D systems lies in the insufficient 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.

The following table presents overview of main strengths and weaknesses of the Czech research system.

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	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.
	Securing long term investment in research	Long term orientation of R&D specified through National Research Programmes and Long-Term Principle Research Directions but a relatively high share of institutional support to R&D.
	Dealing with barriers to private R&D investment	Total expenditures on R&D in business sector have been recently rapidly increasing but venture capital financing is not developed in the country and Czech companies spend much less on R&D in comparison with the EU average.
	Providing qualified human resources	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.
Knowledge demand	Identifying the drivers of knowledge demand	High share of R&D expenditures by foreign companies positively influence globalisation of Czech business research and traditionally strong medium high-tech and developing high-tech sector and sector of services, but insufficient R&D expenses in the manufacturing industry lead to a much lower gross value added than the EU average.
	Co-ordination and channelling knowledge demands	Common use of ad-hoc group of experts, foresight methods and multidisciplinary approach in preparation of key strategic documents and new research programmes but fragmentation of R&D governmental support persists and systematic and institutional evaluation culture is in its beginning.
	Monitoring of demand fulfilment	Approved Reform and Green Paper on R&D and Innovation promising a clearer system of public R&D support including more efficient evaluation methods but basic research dominates over applied research in the public sector, experimental development dominates over applied research in business sector – this is not optimal for a harmonic development of a knowledge based society.
Knowledge production	Ensuring quality and excellence of knowledge production	Strong public research sector (with a dominant role of the Academy of Sciences) and developed network of public universities disposing of research capacities. Low evaluation culture not leading to supporting excellence, however, there are starting programmes supporting R&D excellence. Recent faster growth of publication activity slowly catching up advanced EU countries, but a low level of citations.
	Ensuring exploitability of knowledge	Low level of R&D outcomes commercialisation by public research organisations. Low level of patent production.
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	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 lack of 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.
	Profiting from international knowledge	Effective system of investment incentives supporting localization of R&D and knowledge intensive services in the Czech Republic.
	Enhancing absorptive capacity of knowledge users	Existence of specialized organisations promoting interests of industrial R&D and innovative companies but insufficient capacities of businesses to apply R&D outcomes.

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 TANDEM and IMPULS programmes. These programmes were rather successful in the support of research-industry collaboration and commercialisation of research outcomes. An improvement of conditions for knowledge circulation between public, university and private sector was also realised through the Structural Funds 2004-2006, namely the PROSPERITA programme supporting intermediaries between public and private R&D.

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

One of the main sources for financing R&D infrastructure as well as human resources for R&D lies in the EU Structural Funds 2007 – 2013 which represent probably the last chance of such a financial source for the Czech Republic in this field. More emphasis is to be put especially on human resources mobilisation, since the lack of qualified human resources could critically affect functioning of this newly built infrastructure.

The main recommendations of the European Commission to the Czech Republic in the field of R&D are linked with increasing the level and efficiency of R&D expenditure. Higher investment in innovation infrastructure promoting co-operation between public and private research is another objective of the Government in relation to the National Reform Programme (European Commission 2006/2007). The Czech Republic is currently working on implementation of most of the Commission's recommendations. The specific problems are addressed by the most relevant strategic documents including the newly adopted Reform of R&D and Innovation, prepared National R&D and Innovation Policy for the next period as well as other R&D measures covered by the FP7 and EU Structural Funds in the Czech Republic.

The main opportunities and risks related to recent policy dynamics are summarised in the following table.

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	• Reform of R&D and innovation system adopted by the Government in April 2008; • Prepared Reform of the Tertiary Education System based on the White Paper published by Ministry of Education in February 2008; • EU measures for R&D mainly within Structural Funds 2007 – 2013 and Framework Programme 7 for R&D.	• Lack of human resources in newly developed R&D infrastructure as well as innovative SMEs; • Insufficient R&D support coming from private sector; • Persisting brain drain of researchers due to unfavourable conditions in R&D; • Not efficient use of European and national funding based on insufficient evaluation leading to support of average research teams instead of excellence.
Knowledge demand	• Reform of RDI shall lead to reduction of fragmentation of the public R&D support; • Structural funds 2007 - 2013 to support medium high-tech and high-tech industry and sector of services leading to increasing business knowledge demand; • 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 the research results based on the knowledge demand; • Industrial policy supporting extensive business development and not corresponding to the needs of knowledge based economy.
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; • Enhancement of Czech research participation in ERA and ensuring sufficient linkages to international R&D; • New legislation improving conditions for immigration of researchers.	• 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 resources; • Decrease of attractiveness of the Czech Republic for foreign R&D investment (also related to the lack of HRST, especially S&T graduates).

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1 - Introduction and overview of analytical framework

1.1 Scope and methodology of the report in the context of the renewed Lisbon Strategy and the European Research Area

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are at the heart of the Lisbon Strategy. The strategy reflects this in guideline No. 7 of the Integrated Guidelines for Growth and Jobs. This aims to increase and improve investment in research and development (R&D), with a particular focus on the private sector. One task within ERAWATCH is to produce analytical country reports to support the mutual learning process and the monitoring of Member States' efforts.

The main objective is to analyse the performance of national research systems and related policies in a comparable manner. The desired result is an evidence-based and horizontally comparable assessment of strength and weaknesses and policy-related opportunities and threats. A particular consideration in the analysis is given to elements of Europeanization in the governance of national research systems in the framework of the European Research Area, re-launched with the ERA Green Paper of the Commission in April 2007.

To ensure comparability across countries, a dual level analytical framework has been developed. On the first level, the analysis focuses on key processes relevant to system performance in four policy-relevant domains of the research system:

1. Resource mobilisation: the actors and institutions of the research system have to ensure and justify that adequate public and private financial and human resources are most appropriately mobilised for the operation of the system.
2. Knowledge demand: needs for knowledge have to be identified and governance mechanisms have to determine how these requirements can be met, setting priorities for the use of resources.
3. Knowledge production: the creation and development of scientific and technological knowledge is clearly the fundamental role of a research system.
4. Knowledge circulation: ensuring appropriate flows and distribution of knowledge between actors is vital for its further use in economy and society or as the basis for subsequent advances in knowledge production.

These four domains differ in terms of the scope they offer for governance and policy intervention. Governance issues are therefore treated not as a separate domain but as an integral part of each domain analysis.

Figure 1: Domains and generic challenges of research systems

Resource mobilisation	Knowledge demand	Knowledge production	Knowledge circulation
• Justifying resource provision • Long term research investment • Barriers to private R&D funding • Qualified human resources	• Identification of knowledge demand drivers • Co-ordination of knowledge demands • Monitoring of demand fulfilment	• Quality and excellence of knowledge production • Exploitability of knowledge production	• Knowledge circulation between university, PRO and business sectors • International knowledge access • Absorptive capacity

On the second level, the analysis within each domain is guided by a set of generic "challenges" common to all research systems that reflect conceptions of possible bottlenecks, system failures and market failures (see figure 1). The way in which a specific research system responds to these generic challenges is an important guide for government action. The analytical focus on processes instead of structures is conducive to a dynamic perspective, helps to deal with the considerable institutional diversity observed, and eases the transition from analysis to assessment. Actors, institutions and the interplay between them enter the analysis in terms of how they contribute to system performance in the four domains.

Based on this framework, analysis in each domain proceeds in the following five steps. The first step is to analyse the current situation of the research system with regard to the challenges. The second step in the analysis aims at an evidence-based assessment of the strengths and weaknesses with regard to the challenges. The third step is to analyse recent changes in policy and governance in perspective of the results of the strengths and weaknesses part of the analysis. The fourth step focuses on an evidence-based assessment of policy-related risks and opportunities with respect to the analysis under 3) and in the light of Integrated Guideline 7; and finally the fifth step aims at a brief analysis of the role of the ERA dimension.

This report is based on a synthesis of information from the European Commission's ERAWATCH Research Inventory[1] and other important publicly available information sources. In order to enable a proper understanding of the research system, the approach taken is mainly qualitative. Quantitative information and indicators are used, where appropriate, to support the analysis.

After an introductory overview of the structure of the national research system and its governance, chapter 2 analyses resource mobilisation for R&D. Chapter 3 looks at knowledge demand. Chapter 4 focuses on knowledge production and Chapter 5 deals with knowledge circulation. Each of these chapters contains five main subsections in correspondence with the five steps of the analysis. The report concludes in chapter 6 with an overall assessment of strengths and weaknesses of the research system and governance and policy dynamics, opportunities and threats across all four domains in the light of the Lisbon Strategy's goals.

[1] ERAWATCH is a cooperative undertaking between DG Research and DG Joint Research Centre and is implemented by the IPTS. The ERAWATCH Research Inventory is accessible at http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.home. Other sources are explicitly referenced.

1.2 Overview of the structure of the national research system and its governance

The Czech Republic is a smaller European country (10,287,189 inhabitants in 2007) with only 2% of the total European Union (EU) population. In 2007, GDP per capita was on the level of 81.4% (in purchasing power standards - PPS) of the EU27 average and unemployment rates were 5.3% versus 7.1% of the EU27 average (Eurostat, 2008).

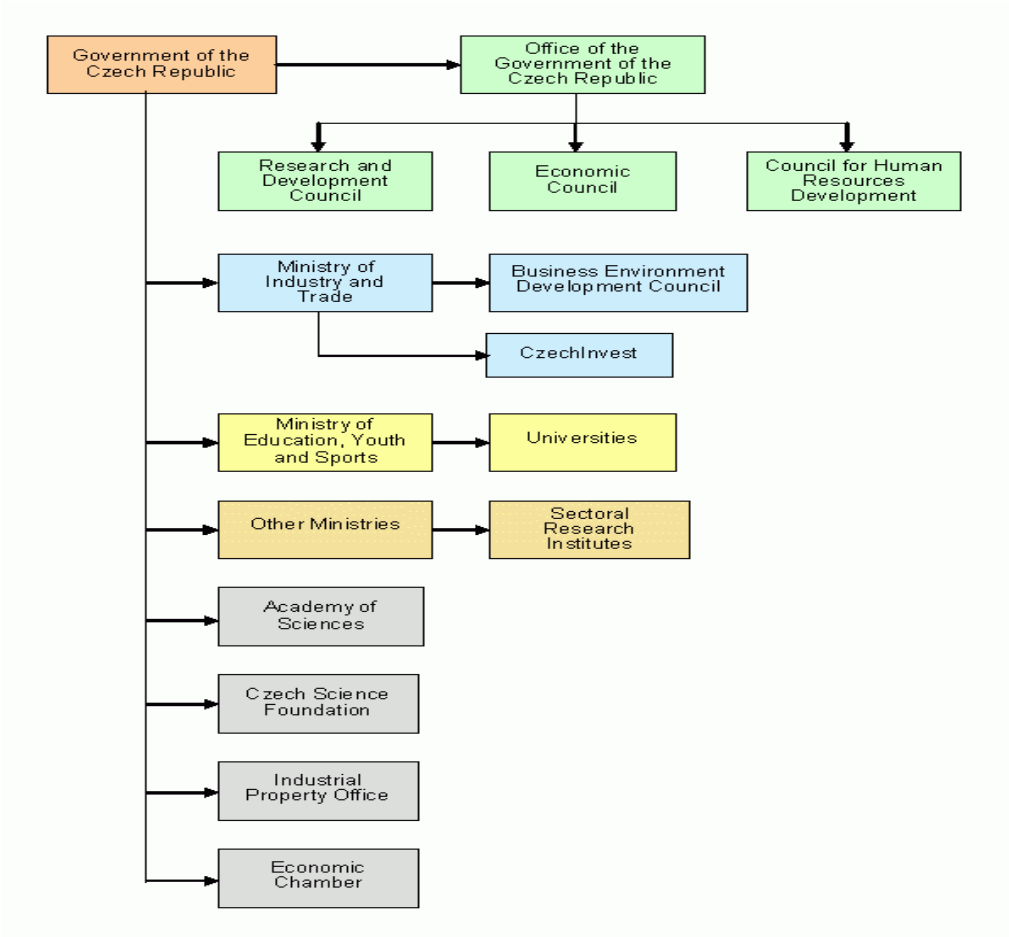
The Czech research and development (R&D) system is a centralised one. Private investment in R&D is dominated by foreign-controlled companies and at quite a high level within the EU. The public R&D sector is characterized by a traditionally strong position of the Czech Academy of Sciences (AS CR - focused mainly on basic research), similarly 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 restructuring of the Academy of Sciences, as well as in reducing the number of former sectoral applied research institutes controlled by individual ministries (they were either privatised or shut down). The public enterprises thus 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 virtual absence of applied research institutes to act as partners for the business sector. The largest R&D performer in the Czech Republic is the business sector spending 66.2% of GERD. The government sector comes second with 17.5%, followed by the higher and tertiary education sector with 15.9% and private non-profit sector with only 0.4% share in GERD in 2006.

At the political level, the main role in the research system has been newly assigned to the Council for Research and Development, an advisory body to the Czech government in R&D, its strategic orientation and mid-term budgeting (including the preparation of national R&D policy strategy and documents). At the operational level, the Ministry of Finance allocates funds to the individual providers, with the Ministry of Education, Youth and Sports (MEYS) and the Academy of Sciences representing the largest providers of public R&D funding (respectively around 30% and 23% of public R&D funding). MEYS is responsible for international R&D cooperation, and it provides funds for research conducted at universities and also coordinates the National Research Programme. A specific role is also assigned to the Ministry of Industry and Trade which is responsible for industrial R&D and is the main body providing public support to private R&D (competitive grants for private sector and collaborative grants between public and private sectors). In addition, several Czech sectoral ministries have significant R&D budgets and also act as important R&D supporters (both through project-based and institutional funding). This concerns mainly the following ministries: Ministry of Health, Ministry of Transport, Ministry of Environment and Ministry of Agriculture.

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

Figure 2: Overview of the governance structure of the Czech RTDI system



Source: ERAWATCH Research Inventory:
http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&topicID=35&countryCode=CZ&parentID=34

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 R&D. These lie exclusively with national bodies. In most cases, lack of funds means that regions are largely passive participants in national level R&D policies. This is partly due to the fact that R&D capacities in the Czech Republic are highly concentrated in the capital city of Prague which, in turn, limits the motivation of other regions to make R&D their priority.

2 - Resource mobilisation

The purpose of this chapter is to analyse and assess how challenges related to the provision of inputs for research activities are addressed by the national research system. Its actors have to ensure and justify that adequate financial and human resources are most appropriately mobilised for the operation of the system. A central issue in this domain is the long time horizon required until the effects of the mobilisation become visible. Increasing system performance in this domain is a focal point of the Lisbon Strategy, with the Barcelona EU overall objective of national R&D

expenditures reaching 3% of GDP with the public/private ratio of 1:2 and also highlighting the need for a sufficient supply of qualified researchers.

Four different challenges in the domain of resource mobilisation for research which need to be addressed appropriately by the research system can be distinguished:

- Justifying resource provision for research activities;
- Securing long term investment in research;
- Dealing with uncertain returns and other barriers to private R&D investment; and
- Providing qualified human resources.

2.1 Analysis of system characteristics

2.1.1 Justifying resource provision for research activities

Resource mobilisation for research has not traditionally been high on the general policy agenda. Although a clear link between research and innovation policy has been established by the National Innovation Policy (2005-2010), there is an insufficient coordination among all providers of R&D related funding (currently 22 altogether).

The challenge to effectively justify increased resource mobilisation for research is addressed by National Research and Development Policy 2004 – 2008 and other official documents – especially the above mentioned National Innovation Policy (2005 - 2010). Four strategic objectives of the National Innovation Policy have been identified as follows:
to strengthen research and development as the source of innovation; to establish a working public-private-partnership; to secure human resources for innovation; and to make the performance of state administration in research, development and innovation more effective.

New National Research, Development and Innovation Policy should cover both of the above mentioned policies and is to be finished by March 2009 for the period of 2009 – 2015. Currently background documents are being prepared and gathered by the Council for Research and Development, e.g. Green and White Paper on RTDI (Technology Centre AS CR, 2008; for more information see 2.3) and other strategic studies and analysis including best practices in these areas.

Concerning the importance of research among other government objectives using the share of GBAORD in total government expenditures, the development is quite positive in the Czech Republic, while in 2002 the share of GBAORD reached 1.07% compared to the EU27 average of 1.6%, in 2006 it increased up to 1.3% compared to the EU27 average of 1.62% (Eurostat, 2008).

As for the debate regarding funding, the issues are mainly system related, rather than volume-based. Efficient allocation of available resources, which is to be based on the evaluation of research results, is a crucial issue. Motivation of private sources to invest in public research, e.g. enhancing cooperation between business and universities and research institutes, is another one. The Green Paper on R&D and Innovation in the Czech Republic serves as a basis for such discussions. The enhancement of public understanding of science and public debate on research

issues is not a priority topic, but there are initiatives in the Czech Republic promoting science among the general public, and particularly children and young people, e.g. *Science and Technology Week* (organised by the Academy of Sciences of the Czech Republic in the framework of the European Science Week).

2.1.2 Securing long term investment in research

Financing of R&D

In the Czech Republic, trends in R&D expenditures have been fairly positive over the years with total gross expenditure on R&D (GERD) increasing since 1995 (with the exception of year 2001/2002). In 2006, R&D investment exceeded €1.8b, and the share of total R&D expenditures in the Gross Domestic Product (GDP) was 1.55%. The increase against the previous year was 18.3%. Most of the increase in recent years has been due to the increased level of private R&D investment, strongly linked with the growing attractiveness of the country for foreign direct investment. Also public R&D investment has been on the increase since 2002.

Total R&D public expenditures in 2007 are €878m which corresponds to 0.58% of the GDP. Public funding of R&D is divided between institutional and project-based support. Recently there has been a debate about the need to reduce the share of institutional funding, which reached the share of 50-60% in the last decade. In 2008, the share of institutional funding decreased below 50% for the first time since 1999 (see Figure 2) which follows the expected share of 40 % of institutional funding and 60 % share of project-based funding.

A major part of the *institutional funding* in the Czech Republic is financed by the Ministry of Education, Youth and Sports (MEYS) and the Academy of Sciences (AS CR) and has the form of so-called "research plans" (*výzkumné záměry*) which represent the main source of multi-annual institutional funding.

The Czech Science Foundation (GACR) represents the main body on the Czech R&D scene that provides *non-thematic project-based funding*. The Czech Science Foundation administers the fourth largest share of the public R&D budget (after the Ministry of Education, Youth and Sports, Academy of Sciences and the Ministry of Industry and Trade) which is then distributed through open competitions through grants to researchers. Tenders for proposals are organised on a thematic basis within five scientific areas (technical, natural, medical, social and agricultural sciences).

Ministry of Industry and Trade is the main provider of the *thematic project-based funding bringing together industry and research*, which is provided namely through the TANDEM, IMPULS and Trvalá Prosperita (Sustainable Prosperity) programmes. These programmes fund projects of industrial research, either carried out by businesses themselves (IMPULS, Trvalá Prosperita), or by consortia of business and academic partners (TANDEM). Themes covered are relatively broad and cover a whole spectrum of topics from energy, materials, mechatronics and engineering, to diagnostic instruments, transport or pharmacy.

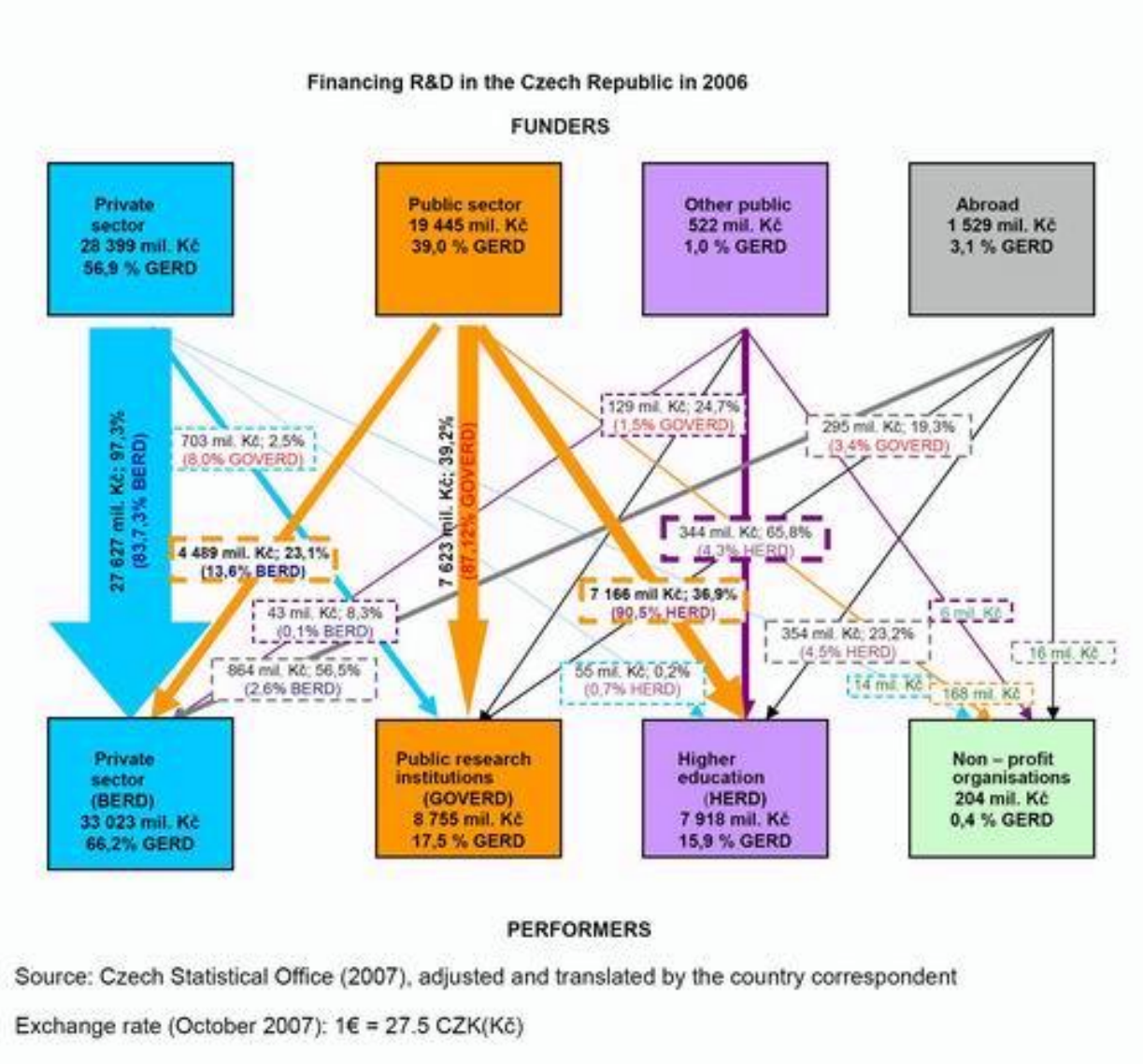
Thematic targeted funding in Czech research is also represented by specific sub-programmes of the National Research Programme II administered by the Ministry of Education, Youth and Sports, namely thematic sub-programmes addressing the following themes: "Healthy and High-Quality Life" (biomedical and environmental research), "Information Technologies for A Knowledge-Based Society" (ICT), "Socio-

economic Development of Czech Society" (research in social science and humanities).

In addition to these national *thematic programmes*, there are R&D budgets managed by individual sectoral ministries (e.g. Ministry of Health, Ministry of Transport, Ministry of Environment and Ministry of Agriculture) to be allocated to their specific sector-related research.

Overview of public funding flows of the Czech research system including sectors of performance and their expenditures on support of R&D in 2006 is described within the following Figure 3.

Figure 3: Overview of public funding flows of the Czech research system



Source: http://cordis.europa.eu/erawatch/docs/image/CZ_Funding_Flowchart.jpg

To define long term orientation in research, 8 national thematic priorities – the so called Long-Term Principal Research Directions (DZSV) – were defined. The DZSV include sustainable development, molecular biology, energy sources, material research, competitive engineering, information society, security research and socioeconomic research. These national thematic priorities are currently being

updated. The DZSV influence priorities of public R&D support programmes such as National Research Programmes.

Use of European funding

The potential of using Structural Funds through Operational Programmes targeting R&D represent at present by far the most visible and prominent impact of EU support policies on the Czech R&D scene. This is mainly because the amounts involved are so important that they truly have the potential to bring a major structural change in the Czech R&D system. The role of the Framework Programme is also important and its significance has been increasing in recent years, especially since the EU-accession. The impacts of other EU policies in the field of research, although not negligible, are distinctly less visible and profound than the impacts of Structural Funds and the Framework Programme.

The Czech Republic is one of only a small number of countries which decided to formulate separate Operational Programmes for R&D in 2007 - 2013, to be financed from both ERDF (*OP R&D for Innovation*) and ESF (*OP Education for Competitiveness*). This is in sharp contrast to the previous planning period 2004 - 2006 when the Czech Republic provided support for a limited number of R&D-related activities (building capacity for innovation in the business sector), but not for R&D investment as such. Research and development issues in the last programming period of 2004 – 2006 were only partly covered by two OPs on the national level (excluding Prague): OP Industry and Enterprise (ERDF) and OP Human Resources Development (ESF). According to the National Strategic Reference Framework approved by the EC in July 2007, the combined allocation through these two OPs equals approximately to €3.8b. Co-financing for these OPs will be provided from the national R&D budget, and will represent around 15% of the total SF and Cohesion Fund allocation for Convergence regions in the Czech Republic (this includes all regions except for Prague). Both of these two OPs fall under the competence of the Ministry of Education, Youth and Sports. Compared to the annual national public R&D of approximately €0.8b/year (2007), the SF allocations clearly represent an important boost to the Czech R&D system. Their impact is likely to be even more pronounced in Czech regions because most of the existing Czech public R&D capacities are concentrated in Prague (roughly 60%) while the bulk of the SF funding will be channelled to the Convergence regions.

The negotiation of OP Education for Competitiveness was concluded in autumn 2007 while the negotiation *OP R&D for Innovation* is still continuing into 2008. Nonetheless, it can be said that the OP R&D for Innovation will concentrate on support for R&D infrastructures (labs, research equipment, as well as some key national R&D infrastructures). In April 2008 the Government adopted the final text of the Operational Programme R&D for Innovation 2007 – 2013 which is still to be approved by the European Commission. The *OP Education for Competitiveness* focuses on developing human resources for R&D and setting up high-quality research teams. In addition, the *OP Entrepreneurship and Innovation* (administered by the Ministry of Industry and Trade) will allocate part of its budget of €3b to R&D-relevant activities, specifically for building R&D capacities in the business sector and for joint activities in the field of innovation and R&D among businesses and public R&D organisations.

Finally, some of the allocation from the *OP Competitiveness for Prague* will also be allocated to R&D activities. 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 etc. Technology transfer and human resources in R&D are partly covered by the *OP Adaptability for Prague*. The total allocation for Prague from both ERDF and ESF equals to €420m for the period 2007 - 2013.

Participation of Czech research teams in the *EUREKA* and mainly in the *EU Framework Programmes for R&D* represents another access to the EU funding. Czech participation in the EU Framework Programme (FP) is regularly monitored 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 2007) covering Czech participation in FP6 until May 2007, Czech participants still feature one of the lowest participation rates in the EU (21st out of 27) 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). On the more positive side, the Czech participation between the 5th and 6th Framework Programme increased substantially (in financial terms it doubled). The Ministry of Education, Youth and Sports, in addition to its existing projects which fund several regional and thematic networks providing information to potential FP participants, also decided to open a dedicated liaison office for R&D in Brussels called the Czech Liaison Office (CZELO). The main aim of the office established in 2005 is to encourage and facilitate the participation of Czech researchers in the FP in cooperation with the National Information Centre for European Research project (NICER), both performed by Technology Centre AS CR.

2.1.3 Dealing with uncertain returns and other barriers to business R&D investment

The total BERD of the Czech Republic is CZK33b (€1.2b), which is 66.2% of GERD. This share corresponds to the EU27 average but some of the EU15 reached almost 75%. Total R&D expenditures in the business sector have been increasing by 13% a year since 2000, moreover in the last two years BERD increased by 20% a year. Total expenditure in the business sector doubled between 2000 and 2006.

The above mentioned increase of BERD is mainly caused by significant increases in R&D investment by *multinationals* (MNEs - 59% of BERD is funded by foreign-controlled companies). It raises a question about the current position of the Czech Republic in global R&D operations of multinational enterprises and more concretely about localisation motives of MNEs in setting up their R&D operations. Up to the end of 2005 investment incentives were assigned to 314 foreign firms. Supported investors should invest more than CZK327b / €12b and create more than 77.000 new jobs (Technology Centre AS CR, 2007). *Czech companies* still generally spend less on R&D in comparison with companies abroad.

In addition, the increase in BERD may be also caused by the introduction of a new act concerning *tax deductions* on R&D expenditure. This legislation also increases motivation of businesses to report more accurately on their investments in R&D, which may make the levels of R&D spending more apparent. The effect of the tax deductions is, however, more visible in the low and medium high-tech industrial sectors than in the high-tech sectors.

International comparisons show that venture capital financing has not really been developed in the country (UNU-MERIT-JRC EC, 2007: indicator 3.4, 2007). This situation has been aggravated by missing supporting legislation or by existing inhibiting legislation (e.g. double taxation occurring in venture capital funds has not yet been removed) (European TrendChart on Innovation, 2007). The situation is to be improved partly by reforms of public administration and measures within the OP R&D for Innovation to support the establishment of seed funds for the commercialisation of R&D results.

2.1.4 Providing qualified human resources

This chapter is based on challenges identified in the OECD analyses (OECD, 2006) and other national studies concerning human resources in and for R&D.

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.

The comparison between *students and graduates in the technical and natural science fields* shows that even though the share of students in these fields in the population between 20-29 years was 30% in 2005, the share of graduates in these fields in the population between 20-29 years was only 23% in 2005. This reflects the fact that the students in these fields quit the university because of e.g. more demanding study conditions in comparison with other fields or just because the study does not fulfil their previous expectations or because of easier admission procedures.

However, 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.

Even though the 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 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%) (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 the field of R&D. Recently (in 2007) this award was also extended to include awards for gifted young secondary school students. The Council for Research and Development announced in 2007 that from 2008 it will also be awarding an annual award to distinguished scientists - Prize of the Chairman of R&D Council. In addition, two 2-year projects supported by Structural Funds entitled Otevřená věda (Open Science) and Otevřená

věda pro regiony (Open Science for Regions) were launched by the Czech Academy of Sciences in 2005 and 2007 respectively. Both projects target primarily secondary school teachers and their students and aim to assist teachers in directing students to research careers and making the curricula of secondary school regarding science more attractive.

The draft version of the White Paper on the Tertiary Education, prepared by the Ministry of Education, Youth and Sports in February 2008 (MEYS, 2008a), aims mainly at increasing the number of qualified human resources meeting needs of the labour market and increasing social mobility.

The number of R&D personnel as well as 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 much below the EU25 average. In 2005, the total number of researchers in FTE (full time equivalent) per 1000 labour force reached 80% of the EU25 average and about 40% in comparison with Finland or Sweden.

The highest share of researchers (in FTE) is in the business sector (51% in 2006) and the number has been recently increasing. Nevertheless, the number of researchers in the business sector in the Czech Republic equals to 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 2006. 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 2006. 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.

Since 2005 the Czech government has adopted strategic documents aiming to facilitate the integration of immigrants in the Czech Republic (brain gain) and to create attractive environment for Czech researchers to avoid the brain-drain.

2.2 Assessment of strengths and weaknesses

Strengths of the Czech R&D system in the field of resource mobilisation are mainly the secured and increasing long term public R&D investment including its thematic orientation based on the DZSV and implemented through the National Research Programmes (I – III) and increase of business R&D expenditures as well as number of university graduates and researchers. On the other hand, there is still lack of R&D personnel needed mainly in the S&T fields and Czech firms still spend much less on R&D than the companies abroad.

Assessment of strengths and weaknesses is based on the information provided within the Chapter 2.1 and also on the SWOT analysis provided in the Green Paper on Research, Development and Innovation (Technology Centre AS CR, 2008) and White Paper on Tertiary Education (MEYS, 2008a).

Main strengths	Main weaknesses
• Secured and increasing long term investment within institutional and project-based funding of R&D (increasing share of GBAORD); • Long term orientation of R&D based on National Research Programmes and Long-Term Principle Research Directions (DZSV); • Total expenditures on R&D in business sector have been recently rapidly increasing; • Number of university graduates and researchers has been increasing recently.	• Lack of a horizontal coordination within R&D and innovation policy; • Relatively high share of institutional support to R&D; • Venture capital financing is not very developed in the country; • Czech companies spend much less on R&D in comparison with the EU average; • Lack of R&D personnel and graduates in the S&T fields.

2.3 Analysis of recent policy changes

The Czech Republic adopted, similarly to other Member States, the National Reform Programme 2005 - 2008 (NRP) in autumn 2005 where measures supporting economic growth and employment were defined. The first *Implementation Report of the National Reform Programme in the Czech Republic* was approved by the Government of the Czech Republic on 25 October 2006 and consequently presented to the European Commission. Commission then prepared *Annual Lisbon Progress Report 2006* where in the area of research and development stressed the need to improve the cooperation between private and public research institutions as well as the importance of increasing the volume and effectiveness of public expenditures assigned to research and development.

In January 2007 the responsibility for the coordination of the Lisbon strategy in the Czech Republic has transferred to the Deputy Prime Minister for European Affairs. The *Lisbon Progress Report 2007* thus assesses the implementation of the second year of the three-year cycle of the renewed Lisbon strategy covered by NRP. In the Chapter 4.2 Research and Development, Innovations of this report, some of the progresses in this field are mentioned: amendment to Act No. 130/2002 Coll. on the system of public support for research and development is under preparation at present as well as the new National R&D Policy and the National Research and Development Programme III. Operational Programmes were used to solve and implement 30 of 46 Commission recommendations (including development of innovation infrastructure, support of innovating SMEs, development of Business Angels network, supporting the integration of business entities, research institutions and tertiary education institutions into clusters, support of public research and private sector cooperation etc.). The Government of the CR approved the state budget expenditures for research and development in 2007 and in the mid-term perspective 2008 and 2009 (Rammer, 2007) with a view to reaching a 1.0% GDP share by 2010. Work proceeds on the update of the Methodology on Evaluation of R&D and their Results for 2007 have begun.

Czech Republic is currently working on improvement of most of the Commission recommendations in the field of R&D – namely the problems are addressed by the most relevant strategic documents including the newly adopted Reform of R&D and Innovation, prepared National R&D and Innovation Policy for the next period as well

as other R&D measures covered by the FP7 and EU Structural Funds in the Czech Republic.

In February 2008 the Council for Research and Development approved and published the first version of the *Reform of the Research, Development and Innovation System in the Czech Republic*. Concrete reform steps will be elaborated during 2008. Subsequently, the document has been approved by the Resolution of the Czech Government n. 287 on March 26, 2008. The *main goal* of the R&D and Innovation Reform is to create an innovation environment in the Czech Republic, where "Research is the transformation of money into knowledge, and innovation is the transformation of knowledge into money"- which is an official motto introducing the Reform (Council for R&D, 2007).

The Reform identifies the following concrete measures to improve the situation in R&D, especially concerning the lack of human and financial resources:

- Structure of public R&D support will be simplified, with the number of R&D funding providers decrease from 22 to 11;
- Excellence in research will be emphasized, funding will be based on new evaluation methods and provided not any more by ministries but mainly by professional agencies concerned – the Czech Science Foundation for basic research and from 2010 a newly established Technology Agency of the Czech Republic for applied research;
- Support of co-operation between research organisations and private sector in the field of R&D as the base of innovation;
- A new amendment of the Act on R&D support n. 130/2002 (available in Czech only) is being prepared to bring it in compliance with the Community Framework regarding support to R&D and innovation. Especially the following is to be amended: 1. definition of innovation; 2. conditions for supporting innovation; 3. allowed level of support; 4. ownership of results and rights to their use. This should contribute to the creation of a fully pro-innovative environment in the Czech Republic, including motivation of companies to invest in research and human resources in R&D;
- Synergies between the OPs concerned have been defined to secure the interconnection of supported projects. Also the monitoring system of OPs is to be connected with the Information system on R&D and Innovation;
- A new R&D and Innovation Policy is being prepared to update and interconnect the current National R&D Policy and the National Innovation Policy. The Council for Research and Development shall be responsible for both the preparation and implementation of this policy (currently the Ministry of Education, Youth and Sports is responsible for the R&D policy; no government body has been given the competence for the innovation policy). Council will be renamed to Council for R&D and Innovation;
- Institutional support to R&D will be based on results in the past 5 years and at universities the institutional support to conducting research will be replaced by the project-based support provided by the Ministry of Education.

Green Paper on R&D and Innovation (Technology Centre AS CR, 2008) as an official annex to the Reform represents a complex analysis of the current situation and

recent development in the field of R&D and innovation including its macroeconomic framework, inputs and outputs of the system in the international context. This Paper will be used as a basis for formulating new strategic documents in shaping knowledge based society in the Czech Republic. The White Paper on R&D and Innovation is being currently prepared as a result of the public debate based on the Green Paper on R&D and Innovation. It will include not only the EU legislation and EU recommendations on the development of European knowledge based society but will also specify concrete goals, measures and steps to be done.

White Paper of the Tertiary Education (described more in the Chapter 2.1.4) shall lead to the reform of the education system including changes in curricula at universities so that they more correspond to the labour market needs and needs of knowledge based society. The reform of the education system should also result in increasing human resources in R&D.

On April 2, 2008 the Government also adopted the final text of the *Operational Programme R&D for Innovation 2007 – 2013* (MEYS, 2008b), which should, together with other national and European sources, bring significant support from the ERDF to the R&D infrastructure. The document is to be approved by the European Commission soon, while the negotiations about the content between Czech MEYS and DG REGIO have finished in July 2008.

Main challenges in the field of resource mobilisation and the responding main policy changes are summarised in the following table:

Challenges	Main policy changes
Justifying resource provision for research activities	• Reduction of the institutional funding share on public R&D funding supported by several strategic documents; • Reduction of the number of R&D funding providers (R&D Reform, 2008).
Securing long term investment in research	• EU Framework Programmes for R&D to encourage and facilitate the participation of Czech researchers in the FP;
Dealing with uncertain returns and other barriers to business R&D investment	• Introducing tax deductions on R&D expenditure.
Providing qualified human resources	• Increasing the number of qualified human resources is one of the main policy objectives included in the White Paper on the Tertiary Education (2008); • Adoption of strategic documents aiming to facilitate the integration of immigrants in the CR by the Government (since 2005); • Measures aimed at increasing R&D personnel (Operational Programmes, National Research Programmes).

2.4 Assessment of policy opportunities and risks

Reform of the RTDI system recently approved by the Government 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. Concrete main policy opportunities and main policy-related risks are described in the table below. They are based on the precedent chapters 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).

Main policy opportunities	Main policy-related risks
• Reform of R&D and innovation system adopted by the Government in April 2008; • Prepared Reform of the Education system based on the White paper published by MEYS in February 2008; • EU measures for R&D mainly within funding principles from Structural Funds in 2007 – 2013 and through the Framework Programme 7 for R&D.	• Lack of human resources in newly developed R&D infrastructure as well as innovative SMEs; • Insufficient R&D support coming from private sector; • Persisting brain drain of researchers due to unfavourable conditions in R&D; • Not efficient use of European and national funding based on insufficient evaluation leading to support of average research teams instead of excellence.

2.5 Summary of the role of the ERA dimension

The Czech reaction to the 3% Action Plan at the EU level was reflected in the adoption of a national document entitled Action Plan for Europe – Approach of the Czech Republic in 2004. This document builds partly on the National R&D Policy 2004 - 2008, partly on other activities carried out by various national bodies, and describes existing or proposed future activities in the Czech Republic corresponding to measures proposed in the 3% Action Plan. In addition to this document, the Economic Growth Strategy set out a quantified national target of 1% of public R&D expenditure to be reached by 2010, a target that was subsequently integrated in the National Reform Programme.

According to the *Lisbon Progress Report 2007*, assessing the implementation of the second year of the renewed Lisbon strategy covered by National Reform Programme, some of the progresses in R&D are mentioned: amendment to Act No. 130/2002 Coll. on the system of public support for research and development is under preparation at present as well as the new National R&D&I Policy. Operational Programmes were used to solve and implement the most of Commission’s recommendations in the field of R&D.

3 - Knowledge demand

The purpose of this chapter is to analyse and assess how research related knowledge demand contributes to the performance of the national research system. It is concerned with the mechanisms to determine the most appropriate use of and targets for resource inputs.

The setting and implementation of priorities can lead to co-ordination problems. Monitoring processes identifying the extent to which demand requirements are met are necessary but difficult to effectively implement due to the characteristics of knowledge outputs. Main challenges in this domain are therefore:

- Identifying the drivers of knowledge demand;

- Co-ordinating and channelling knowledge demands; and
- Monitoring demand fulfilment

Responses to these challenges are of key importance for a more effective and efficient public expenditure on R&D targeted in IG7 of the Lisbon Strategy.

3.1 Analysis of system characteristics

3.1.1 Identifying the drivers of knowledge demand

Structure of knowledge demand

Business expenditures on R&D (BERD) are far below the EU27 average (amounting to about 35 % of the EU15 average in EUR per one inhabitant in 2006) and the share of BERD in the total R&D expenditure (GERD) approaches 66 %. According to statistical data (Czech Statistical Office, 2007) business R&D expenditures increased by more than 20 % from 2005 to 2006, which significantly exceeds the EU27 average and most of the EU15 countries. This development reflects the fact that the CR is ranked among countries which are in the transition phase from efficiency-driven competitiveness to innovation-driven competitiveness (Lopez-Claros, 2006) and utilisation of knowledge plays a more significant role for building a competitive advantage of Czech enterprises. Business knowledge demand consequently grows.

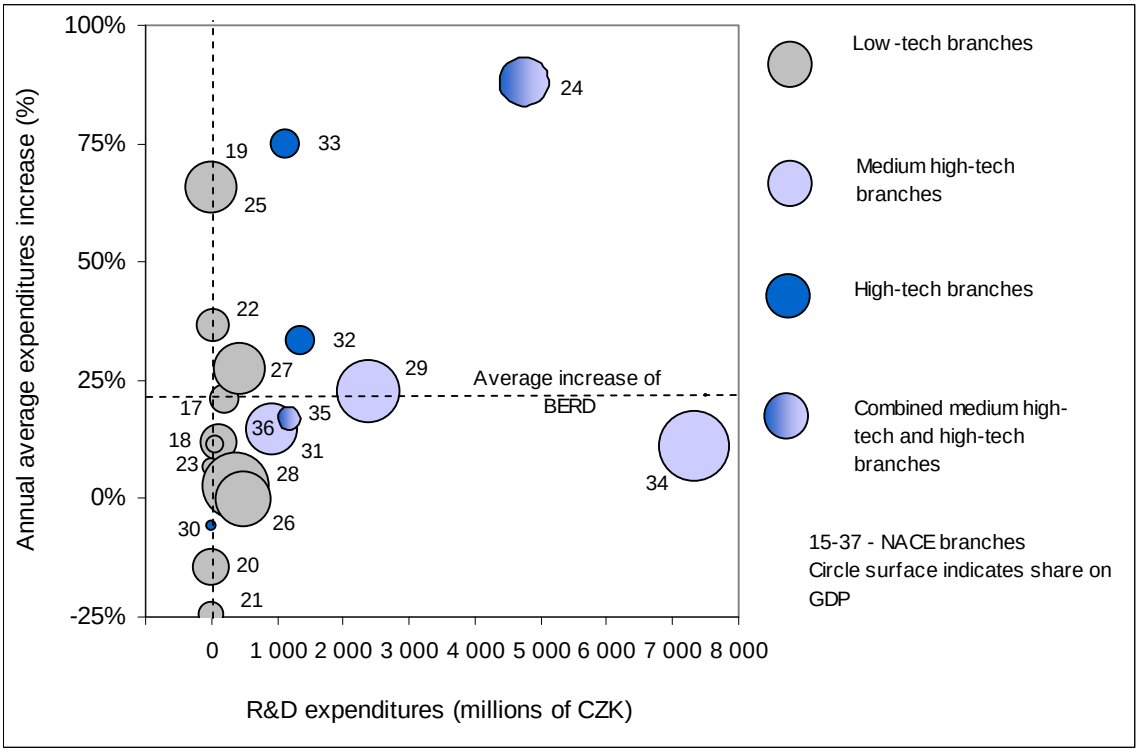
In 2006, about 35 % of BERD was realised in the medium high-tech sector, about 22 % of BERD was spent in the high-tech sector and less than 9 % of BERD was spent in medium low-tech a low-tech sectors. The share of high-tech services was about 22 % of BERD. The share of the high-tech sector in BERD has been growing in the last years; however, the share of high-tech services shows a moderate decrease.

Over 22 % of total business R&D expenditures (BERD) in 2006 were realised in the automotive industry (NACE 34), but expenditures in this branch have recently increased more slowly than the total R&D expenditures (see Figure 3). Very high R&D expenditures have been also recorded in the NACE 24 branch – Chemical industry (almost 15 % of BERD in 2006). R&D expenditures in this branch also grow 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).

The Czech Republic is a country with a quite globalised research. At present, the share of R&D expenditure of multinational enterprises (MNEs) is about 60 % BERD and it has been continuously growing. The high share of MNEs is seen particularly in the manufacturing industry where the share of MNEs exceeds 70 % and in some sectors like automotive and chemical industries where it reached 80% to 90%. The high share of foreign companies in R&D expenditures positively influences involvement of Czech research in international research conducted by multinational corporations and utilisation of new research outcomes and technologies. On the other hand, it implies that the domestic research is very weak. Gross value added, generated within the manufacturing industry in the CR by one employee is much lower than in the EU15 countries. This fact can be among others caused by low and inefficiently spent R&D expenditures in the manufacturing industry. Lag of the CR

behind the EU15 countries is in this context most visible in the high-tech branches where the R&D expenditures are much lower than in the EU15.

Figure 4: Structure of the business R&D expenditures (BERD) in the Czech Republic in 2006 and their annual average increase



Source: Green Paper of Research, Development and Innovation. Technology Centre AS CR, 2008.

The Government is the key driver of societal knowledge demand. The share of the government sector in GERD (GOVERD) was 17.5 % and the share of higher and tertiary education sector (HERD) was 16 %. The non-government non-profit sector share reached less than 1 %. The institutional (non-targeted) support of research is still prevailing in comparison with the targeted (project-based) support of research.

Long-term thematic orientation of the societal knowledge demand is specified by the Long-Term Principle Research Directions, which were approved by the Government in 2005, 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 (see Chapter 2.1.2 for more details). R&D programmes should be based on these priorities.

The share of basic research in total R&D expenditures (GERD) is quite high (almost 30 % in 2006), 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 (EU27 countries as well as the USA and Japan are in the opposite situation) and has been decreasing since 2003. In 2006 the expenditures on applied research amounted only to 24% of total R&D expenditures. Share of experimental development in total R&D expenditures slightly increased and in 2006 amounted to 47% of GERD in the Czech Republic. Experimental development is mainly conducted by the business sector.

Processes for identifying the drivers of knowledge demand

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 thematic orientation of National Research Programmes (NRP) for public funding of research.

The last foresight exercise was initiated by the Ministry of Education, which is responsible for R&D policy, in June 2006. The project took place from June 2006 to June 2007 and led up to the proposal of the National Research program III (NRP III) with problem-oriented and multidisciplinary research priorities corresponding to potential opportunities and risks in the future. This foresight exercise combined analyses of current situation (see next chapter) prepared by the coordinating team and scenarios generated by the group of about 70 invited experts both from public and private sectors (including large multinational enterprises), participating in plenary meetings followed by combined with electronic communication. The expert group used results of the analyses for proposing particular research themes and within the process developed subsequently two kinds of scenarios – explorative scenarios describing possible evolutions in the future, and normative scenarios specifying the necessary steps how to explore the opportunity or overcome the threat. The multidisciplinary approach was ensured by involvement of experts from various disciplines (natural, technical, social sciences, humanities etc.) and from both public (including the state administration, universities) and private sectors.

The use of ad-hoc group of experts for development and/or consultations during the preparation of strategic documents is relatively common in the CR. For instance, the proposals of strategic priorities for the new programming period of the EU Structural Funds (2007 – 2013) were prepared by the working groups constituted specifically for particular areas. Also the Long-Term Principle Research Directions setting up strategic thematic orientation of research in the CR (see Chapter 2.1.2) were elaborated by working groups of experts. At present, expert groups have been also involved in preparation of the White Paper on Tertiary Education and White Paper on R&D and Innovation, which can be considered as key documents for the upcoming reform of tertiary education and a new research, development and innovation policy.

3.1.2 Co-ordinating and channelling knowledge demands

R&D policy and knowledge demand priorities have been so far formulated by the Ministry of Education, Youth and Sports (MEYS) and the Council for Research and Development played the role of an advisory body. After adoption of the Reform of R&D, the R&D Council will have extended responsibilities and competence and will be in charge of both preparing conceptual documents regarding R&D and innovation as well as their implementation.

Preparation of the last National Research Programme III (NRP III) should be used for financing research from public funds in 2009 – 2014. The NRP III is planned to be a multidisciplinary and problem oriented R&D programme and its individual research themes corresponds to potential opportunities and risks (technological as well as societal), which can be expected in the time horizon 2015 – 2020 not only in the Czech Republic, but internationally.

Thematic orientation of the NRP III should be also used for selecting proposals within the OP Research and Development for Innovation, which will be financed from the EU Structural Funds and which will be used for building / reconstruction of R&D capacities in the CR. Such thematic orientation of new infrastructures reflecting the knowledge demands can noticeably contribute to their sustainability in the future after termination of financial support from the EU Structural Funds. The analyses produced during the development of the NRP III proposal will be also used for updating the Long-Term Principle Research Directions. This approach shall ensure consistency in the process of identifying and updating national research priorities.

However, the thematic orientation of research described above covers only a relatively small part of governmental appropriations to R&D. The largest part of the governmental budget for research covers institutional funding that reflects the tradition of public research but not the excellence in research. Support provided by grant agencies uses a bottom up approach (researchers propose a research theme) and the link to knowledge demand of private sector is usually weak. On the other hand, programmes of industrial research, in which the participation of both public research and private sector is obligatory, should correspond to companies knowledge needs (outcomes have to be prototypes, new technologies etc.).

An important weakness of the research system in the CR consists in the fragmentation of public support, which does not allow for concentration of resources and synergies needed for carrying out large multidisciplinary R&D projects for societal and/or technological needs. However, this weakness has been already addressed in strategic documents – the national R&D Reform is the most recent one.

Current GBAORD percentage shares of socioeconomic objectives (NABS) reflect the allocation of public support of R&D described above. The biggest share recently (2000 – 2006) falls on the Non-Oriented Research (NABS 11) with 26.8 % in 2006, on Research financed from general university funds (GUF – NABS 10) with 25.6 % in 2006 and on Industrial production and technology (NABS 7) with 12.4 % in 2006. Other NABS shares are smaller than 8 %. When comparing the GBAORD division with the EU27 average in 2006, 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, 2008).

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 1044 participants only 16 of them were from the Czech Republic. If we take into account projects themselves, Czech teams participated only in 14 projects from the total number of 106. As the reason of the Czech low participation we can see the lack of interest from the projects 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).

3.1.3 Monitoring demand fulfilment

Systematic and institutional evaluation culture in the Czech Republic is not satisfactory yet. The evaluation of research results financed from public resources is based on methodology prepared by the Council for Research and Development of

the CR. Even though this methodology supports creation of applicable results, the differentiation of further allocation of finances according to the evaluation results is insufficient.

However, the Reform of R&D includes a new proposal for evaluation and monitoring of publicly funded research. Evaluation and monitoring of R&D results will be simplified and prepared by the Council for Research and Development with the aim to effectively distribute institutional support including substantial differentiation of further public support based not only on publications and citations in the field of basic research but also on patents, realized technologies, software, legislative results and certified methodologies in the field of applied research.

During the last years several ad hoc analyses and evaluations of research and innovation system have been also elaborated. These studies were often commissioned by ministries and agencies responsible for implementation of financial support from the EU Structural Funds and were usually performed by independent non-government organisations. These analyses often mapped drawing of financial support from the EU SF in the previous programming period (2004 - 2006) and were used for a better orientation of further public support, including the development of strategic priorities for the financial support from the EU Structural Funds (2007 - 2013).

3.2 Assessment of strengths and weaknesses

Strengths of the Czech R&D system in the field of knowledge demand are mainly the globalisation of Czech business R&D and traditionally strong medium high-tech and developing high-tech service-sector. Another positive point is the use of multidisciplinary approach and different foresight and evaluation methods. On the other hand, there is space for the increase of R&D expenses in the manufacturing industry and the share of applied research in both public and private sector.

Assessment of strengths and weaknesses is based on the information provided within the Chapter 3.1 and also on the SWOT analysis published in the Green Paper on Research, Development and Innovation (Technology Centre AS CR, 2008).

Main strengths	Main weaknesses
• High share of foreign companies R&D expenditures positively influencing globalisation of Czech business research; • Traditionally strong medium high-tech sector and developing high-tech and service sector; • Common use of ad-hoc groups of experts, foresight methods and multidisciplinary approach for preparation of key strategic documents and new research programmes; • Approved Reform and Green Paper on R&D and Innovation promising a clearer system of public R&D support including more efficient evaluation methods.	• Insufficient R&D expenses in the manufacturing industry leading to much lower gross value added than the EU average; • Basic research dominates over applied research in the public sector, experimental development dominates over applied research in business sector – this hampers development of the knowledge based society; • Fragmentation of governmental support to R&D and systematic and institutional evaluation culture are still in the beginning.

3.3 Analysis of recent policy change

Since 2004, several analyses and assessments of knowledge economy of the CR have been performed. These analyses were focused on the evaluation of utilisation of financial resources from the EU Structural Funds in 2004 – 2006 as well as on identification of strengths and weaknesses of the knowledge economy in the CR. These studies were used by the government for the preparation of several strategic documents and priorities for the financial support from the EU Structural Funds in the new programming period 2007 – 2013.

Reform of R&D prepared by the Council for Research and Development and approved by the Government of the CR in March 2008 is a necessary prerequisite for improvement of the situation in the area of knowledge demands. The new R&D evaluation principles proposed in this Reform should significantly improve orientation of public R&D to the knowledge demand of the application sector. This evaluation will also use internationally respected methods to assure comparability with the EU Member States R&D results. For more details on the Reform see Chapter 2.3.

In 2005, the Czech Government also launched tax incentives for R&D enabling companies to deduct R&D expenditures spent on their in-house research from their tax base. However, current legislation does not allow to deduct R&D expenditure spent on purchasing research, e.g. from public research institutions and universities. Further improvement of these incentives could also help increase knowledge demand of the private sector and improve its cooperation with the public sector.

The CR has a unique opportunity to use financial support from the EU Structural Funds in 2007 - 2013 for the elimination of weaknesses in the research and innovation system. In comparison with the previous programming period (2004 – 2006) a completely new operational programme focused on research and development has been prepared (*OP Research and Development for Innovation*). This OP will effectively contribute to fulfilment of knowledge demands aiming also to create effective infrastructure for excellent research and development – carefully selected excellent large research infrastructures for multidisciplinary research at the frontier of knowledge in strategic thematic areas corresponding to actual knowledge demands (stated in DZSV) are to be built, as well as infrastructure for applied research, experimental development and realisation of research results in innovations mostly on the regional level. The implementation structure of the programme as well as publicity and administrative burdens are still to be improved.

Main challenges in the field of knowledge production and the responding main policy changes are summarised in the following table:

Challenges	Main policy changes
Identifying the drivers of knowledge demand	• Preparation of the National Research programme III proposal with problem-oriented and multidisciplinary research priorities (2007)
Co-ordinating and channelling knowledge demands	• Specification and adoption of the Long-Term Principle Research Directions (2005) • Preparation of the White Paper on R&D and Innovation (2008) proposing measures to increase private R&D expenditures and adjust public research more to demands of enterprises and society
Monitoring demand fulfilment	• New system of evaluation and monitoring of R&D results included in the R&D Reform (2008)

3.4 Assessment of policy opportunities and risks

Policy changes in the field of R&D system based on the Reform reflect also the opportunities and risks described below. Main opportunities are related to reduction of public R&D support providers and efficient utilisation of the EU Structural Funds 2007 – 2013 as well as new evaluation methods leading to effective support to development of knowledge based economy in the Czech Republic. Risks relate to not flexible response of public research to knowledge demand because of insufficient monitoring and evaluation on both sides and also to not well co-ordinated the goals of the R&D&I policy and industrial policy.

Concrete main policy opportunities and main policy-related risks are described in the table below. They are based on the precedent chapters 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).

Main policy opportunities	Main policy-related risks
• Reform of RDI shall lead to reduction of fragmentation of public R&D support; • Structural funds 2007 - 2013 to support medium high-tech and high-tech industry and sector of services leading to increasing business knowledge demand; • 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 supporting extensive business development and not corresponding to the needs of knowledge based economy.

3.5 Summary of the role of the ERA dimension

Czech Republic's participation in the ERA has led to several changes within the R&D system including the use of new monitoring and evaluation methods of research results corresponding to the market and societal needs and an effort to introduce efficiency into the R&D public support. Also measures specified in the relevant Operational Programmes should correspond to national measures to be applied within the R&D system of the Czech Republic (e.g. National Research Programme III is planned to be a tool financing research conducted in the infrastructure financed by the Operational Programme Research and Development for Innovation). Czech delegates in the Programme Committees of the FP7 contribute to the discussion on priorities supported by the FP7 according to the needs of Czech research teams. Czech participation in ERA-NET projects, which are considered as very successful and useful instruments for the coordination of national research programmes at the European level, is, however, rather unsatisfactory due to the lack of interest from the eligible Czech participants and difficulties with financing transnational joint research.

4 - Knowledge production

The purpose of this chapter is to analyse and assess how the research system fulfils its fundamental role to create and develop excellent and useful scientific and technological knowledge. A response to knowledge demand has to balance two main generic challenges:

- On the one hand, ensuring knowledge quality and excellence is the basis for scientific and technological advance. It requires considerable prior knowledge accumulation and specialisation as well as openness to new scientific opportunities which often emerge at the frontiers of scientific disciplines. Quality assurance processes are here mainly the task of scientific actors due to the expertise required, but subject to corresponding institutional rigidities.
- On the other hand there is a high interest in producing new knowledge which is useful for economic and other problem solving purposes. Spillovers which are non-appropriable for economic knowledge producers as well as the lack of possibilities and incentives for scientific actors to link to societal demands lead to a corresponding exploitability challenge.

Both challenges are addressed in the research-related Integrated Guideline and in the ERA green paper.

4.1 Analysis of system characteristics

4.1.1 Improving quality and excellence of knowledge production

Knowledge production in the Czech Republic is, as in the most of the post-Communist countries, strongly concentrated into the public sector represented mainly by the Academy of Sciences and 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.

The Academy of Sciences, which consists of 53 research institutes, is therefore currently the most important public research organisation in the country. The Academy formulates its own research policy, plays the role of an advisory body of public institutions on major R&D policy issues, manages national and international research programmes, and promotes cooperation with both applied research bodies and industry to foster technology transfer and the exploitation of scientific knowledge. In addition to the Academy, there are research institutes controlled by individual ministries. As a result of socioeconomic transformation and cuts in public spending after 1990, the number of these research institutes was substantially reduced.

The higher and tertiary education sector in the Czech Republic consists currently of 25 public and 39 private institutions providing tertiary education. Since 1990s, universities have been increasing their scientific output (measured by publications). The average annual growth of HERD (16%) during 2000–2006 exceeded the growth in business, government as well as private non-profit sector.

As a result of dominant scientific specialisation in the communist era, HERD is still oriented towards engineering (approximately 34% in 2006), while the share of medical sciences (20%) is catching up the share of natural sciences (which recorded a decrease from 30% in 1999 to 26% in 2006). The picture is quite different in GOVERD where approximately 56% of R&D spending goes to natural sciences while engineering is allocated only 13% (Erawatch Network, 2006).

The existence of university managing boards enables external bodies to participate in the internal decision-making process at universities. However, the role of managing boards is quite limited – their competences are connected mainly with property related-decisions. Besides that, they are also allowed to make comments on plans and budgets of universities. Compared with the majority of European countries, the managerial self-governance of Czech universities is higher and the role of external bodies is very weak (MEYS, 2008a).

According to a governmental resolution, regular evaluation of public R&D results has been carried out since 2004, when the Methodology for Evaluation of R&D Results was introduced. The methodology is using data from the Central Register of R&D Results managed by the Council for Research and Development and is used as a basis for allocating future funds to individual funding bodies (based on evaluating individual R&D performers).

On the other hand, 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).

However, in many other cases, Czech centres of excellence, comprising just one laboratory, have only some attributes of European and international centres. At the same time, the centres are often financed from the national public programmes of applied R&D although they are mainly dealing with basic research. The mismatch in the factual and declared activities complicates obtaining resources from both European and private funds. In relation to the low level of excellence of Czech R&D and the present system of R&D evaluation, which does not motivate researchers sufficiently to produce quality outcomes, the Czech Republic lags behind the EU15 countries in production of scientific publications (Czech Republic – 134 publications per 1000 researchers; EU15 – 196 publications per 1000 researchers in 2006). However, thanks to an increased growth of publication activity, it is slowly catching up with the EU15 average. During 2003 - 2006, the number of Czech publications increased by 24.4%, while in the EU15 countries only by 12.8% (Eurostat data on S&T, 2008; Council for R&D, 2007).

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. more than Slovakia (278) or Poland (392) but less than Hungary (593) or Slovenia (651) and substantially less than the EU15 average (953) (Eurostat, 2008).

Czech scientific specialisation is strongly influenced by the past specialisation in disciplines related to physics and chemistry. In 2003, publications specialized in chemistry represented 19%, physics 16%, biology & biochemistry 9%, and plant & animals 9% of total scientific publications. Compared with the countries of EU15,

most Czech publications are published in material sciences, physics, chemistry, plant & animals, agricultural sciences and economics. Citation in mathematics, biology & biochemistry, microbiology and environment is above the average figures for the old member states.

Dominating specialisation of Czech scientific publications is considerably reflected in the prevailing scientific citations. When comparing the number of citations with average figures for the EU15, the most frequently cited are Czech publications in chemistry, material sciences and mathematics, followed by physics and plant & animals. In the last years, citations in engineering have also gained a better position (Erawatch Network, 2006).

4.1.2 Improving exploitability of knowledge production

In order to promote research disciplines that produce quality results and play a key role in the Czech economy development, 8 national thematic priorities – so called Long-Term Principal Research Directions (DZSV) – were defined (for more information see Chapter 2.1.2.1). However, these priorities are only partly reflected in the actual public funding of R&D.

Commercialisation of knowledge produced by public research organisations is hindered especially by a lack of motivation and missing mediators providing an interlink - like specialised departments within these organisations, bringing produced knowledge to market, or specialists /mediators able to direct partners from application sphere to relevant researchers. 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 testing and assessment departments and technology transfer departments within research institutes as well as the process of commercialisation of R&D outcomes itself. Nevertheless, the support is conditioned by a verifiable potential of the applying organisation – proved by commercially successful projects in the past, quality research outcomes (e.g. patents), interest of business in the co-operation, etc. (MEYS, 2008b).

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. 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).

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 reach even 8% of the EU27 average (111.0). In the group of countries with a similar R&D performance, the Czech Republic overtakes Slovakia or Poland (both featuring 3.7 applications per million inhabitants) but lags behind Hungary (12.3 applications per million inhabitants in 2003) and especially Slovenia (53.8) (Eurostat, 2008).

The low patenting activity of Czech subjects is connected with a relatively weak correlation between BERD, patents and technology specialisation of industry expressed by the value added. Unlike scientific publications, Czech (EPO) patents do not show a clear specialisation pattern. Compared with the old member states, Czech subjects are more successful in patenting only in few disciplines – mainly in

pharmaceuticals, less importantly in chemicals and food. Other disciplines are far below the EU15 average. These results indicate that an explicit technological effort of Czech industry is still limited. During 1999 - 2003, the highest shares of Czech applicants´ patents registered by the European Patent Office (EPO) were granted in the following branches: pharmaceuticals 16%, chemicals 15%, machinery 12%, motor vehicles 10%, electrical equipment 9%, and office machinery 8%.

Better performance is achieved in the fields of trademarks and industrial designs, which underwent a significant growth in the last years. This way of protecting intellectual property rights, with a smaller role of new knowledge, is popular mainly for businesses. However, performance of Czech research subjects is still far below the EU27 average – 33.1 community trademarks and 51.6 community industrial designs per million inhabitants compared with 108.2 and 109.4, respectively, at the EU27 average level in 2007 (UNU-MERIT, 2007).

4.2 Assessment of strengths and weaknesses

The following table summarises main strengths and weaknesses of the Czech research system in terms of knowledge production.

Quality and excellence of knowledge production is ensured by strong public research sector. Although the issue of R&D evaluation represents an important challenge, the main weaknesses of the sector lie in the exploitability of research outcomes related to weak performance of public research organisations in commercialisation and IPR issues.

Main strengths	Main weaknesses
• Strong public research sector (with a dominant role of the Academy of Sciences) and developed network of public universities with research capacities; • Starting programmes supporting R&D excellence; • Recent faster growth of publication activity slowly catching up advanced EU countries.	• Low evaluation culture not leading to supporting excellence; • Low level of R&D outcomes commercialisation by public research organisations; • Low level of patenting and scientific citation.

4.3 Analysis of recent policy changes

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. Individual research institutes of the Academy of Sciences have thus become independent public research organisations with their own legal entity, even though the Academy retains common central management responsibilities. Research institutes controlled by ministries are also qualified under the new law as public research organisations.

The prepared Reform of R&D and innovation system in the Czech Republic stipulates the need to simplify the evaluation of R&D outcomes, carried out by the Council for R&D, 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. As for the

basic research, only worldwide accepted results (e.g. in case of scientific articles only those published in internationally respected journals) will be evaluated (excluding specific nationally oriented disciplines of social sciences and humanities). In case of applied R&D, only results exploitable for innovation (e.g. patents, realized technologies, software and results projected into rules of law or other rules/methodologies) will be considered in the evaluation.

Main challenges in the field of knowledge production and the responding main policy changes are summarised in the following table:

Challenges	Main policy changes
Ensuring quality and excellence of knowledge production	• The new Law on Public Research Organisations increasing the autonomy and legal & budgetary independence of research organisations • Prepared R&D Reform (2008) changing the present system of evaluation to the system based primarily on achieved results
Ensuring exploitability of knowledge production	• Increasing the innovative capacity of enterprises and protecting their intellectual property rights, also supported within the OP Entrepreneurship and Innovation (2007) • Support of commercialisation of R&D results and technology transfer from research institutes within the OP R&D for Innovation (2008) • Responsibility of universities and public research organisations for their own R&D commercialisation and IPR policies and rules according to the R&D Reform (2008)

Within the Operational Programme Entrepreneurship 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). Support of patenting activity is also covered by the National Innovation Policy 2005 - 2010 (EC, 2007b).

According to prepared strategic R&D documents connected with the R&D Reform, universities and public research institutes will be obliged to prepare their own policies for utilisation and commercialisation of new knowledge, including rules for patent protection of inventions, rules for division of royalties from patents and licences among their authors and respective institutions, etc. These changes should also positively influence performance of Czech R&D in the field of patent production.

In order to enhance the generally low excellence of Czech R&D, a debate about the question of concentrating support to a limited number of top national research units has emerged recently. This discussion is also partly linked to the implementation of EU Structural Funds.

Within the Operational Programme Research and Development for Innovation (2007 - 2013), European Centres of Excellence as well as Regional R&D Centres are to be 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. The Centres of Excellence will be built in areas, where research of quality and provable outcomes exists, and at the same time, they will be oriented at priority research disciplines from the national point of view (in accordance with the Long-Term Principal Research Directions).

The Regional R&D Centres, oriented at applied R&D, will co-operate with the application sphere (business, health care, etc.) according to needs of the respective region. The Centres will concentrate a substantial share of applied R&D capacities in nationally important disciplines and will function as mediators of new knowledge towards the application sphere, especially innovative SMEs (MEYS, 2008b).

4.4 Assessment of policy opportunities and risks

Main policy opportunities and policy-related risks in terms of knowledge production are summarised in the following table.

Barriers in the field of knowledge production are predominantly addressed by recently prepared (2008) policy documents – R&D Reform and OP R&D for Innovation, thus the efficiency of proposed measures has to be seen in near future. Main policy-related risks could emerge mainly in the case of unsuccessful implementation of R&D Reform.

Main policy opportunities	Main policy-related risks
• Increased autonomy of public research institutes should lead to 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 by the Reform and 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 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 and 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.

4.5 Summary of the role of the ERA dimension

Czech participation in the Framework Programmes has lead among others to support of three centres of excellence. Czech R&D excellence (support of Regional R&D Centres and European Centres of Excellence) is currently addressed within the Operational Programme Research and Development for Innovation. European Centres of Excellence 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.

During previous years, a harmonisation of Czech law with EU legislation in the field of protection of intellectual property rights had taken place. Tools for the improvement of IPR protection and subsequent increase of patent production are included in the Operational Programmes as well. Participation in the ERA has also led to an effort to produce internationally comparable and relevant R&D results, expressed by the prepared reform of R&D evaluation system.

5 - Knowledge circulation

The purpose of this chapter is to analyse and assess how the research system ensures appropriate flows and sharing of the knowledge produced. This is vital for its further use in economy and society or as the basis for subsequent advances in knowledge production. Knowledge circulation is expected to happen naturally to some extent, due to the mobility of knowledge holders, e.g. university graduates who continue working in industry, and the comparatively low cost of the reproduction of knowledge once it is codified. However, there remain three challenges related to specific barriers to this circulation which need to be addressed by the research system in this domain:

- Facilitating knowledge circulation between university, public research organisations and business sectors to overcome institutional barriers;
- Profiting from access to international knowledge by reducing barriers and increasing openness; and
- Enhancing absorptive capacity of knowledge users to mediate limited firm expertise and learning capabilities.

Effective knowledge sharing is one of the main axes of the ERA green paper and significant elements of IGL 7 relate to knowledge circulation. To be effectively addressed, these require a good knowledge of the system responses to these challenges.

5.1 Analysis of system characteristics

5.1.1 Facilitating knowledge circulation between university, PRO and business sectors

Co-operation between public research (including universities) and businesses has been a long-lasting weakness of the Czech R&D system. Lacking financial resources by SMEs and prevailing orientation at utilising relatively low-cost labour force and low value-added production resulted in a low demand for R&D outcomes from business. Research-industry co-operation is hampered by the public R&D system as well, concerning the ineffective system of R&D evaluation and low motivation of researchers (see 4.1.1). Last but not least – an insufficient number of organisations mediating technology and knowledge transfer from public research institutes and universities to industry does not contribute to the improvement of research-industry co-operation either (Technology Centre AS CR, 2008).

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, there are 28 science parks in the Czech Republic with an average occupancy rate of 60 %. However, quite a number of these science parks are mainly focused on leasing office space without providing other business services. From this point of view, innovation businesses would appreciate especially technology transfer services, contact mediation and advisory in IPR issues.

Very weak linkages between business and public research are reflected in a low share of private resources in GOVERD and HERD – in 2005, the business sector had 9.7% share in GOVERD (i.e. €26m) and only 0.8% share in HERD (i.e. €2m).

The corresponding figures for the EU27 average were 8.3% in GOVERD and 6.3% in HERD, respectively.

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 Innovation Policy 2005 – 2010 (EC, 2007b).

Nevertheless, there is only one national programme supporting industrial R&D, which provides a direct support to private-public R&D collaboration between research institutes and private sector enterprises – the TANDEM programme administered by the Ministry of Industry and Trade. The IMPULS programme, administered by the same Ministry, is complementary to TANDEM. The programme provides support to R&D with a strong focus on projects with a short-term application and commercialisation potential. Another programme managed by the Ministry, the Trvalá prosperita (*Sustainable Prosperity*) programme provides support to R&D projects of businesses as well as universities or public research institutes (see also 2.1.2.1).

An opportunity for improving knowledge circulation between public, university and private sector is related to using the Structural Funds. The PROSPERITA (Prosperity) programme, launched by CzechInvest (an agency established by the Ministry of Industry and Trade) and financed from the Structural Funds (2004 - 2006) was oriented at supporting intermediaries between public and private R&D. 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 programme. However, projects realized through the programme were often linked with construction of buildings and equipment and short-term funding of initiation phase of respective organizations. Thus there are several well-functioning intermediary (transfer) centres with uncertain future (MEYS, 2008a). Currently, there are around 15 centres for technology transfer in the Czech Republic. Majority of these centres operate within universities or specialized intermediary organizations. Nevertheless, the level of services provided by individual technology transfer centres differs substantially. The most important intermediaries in the Czech Republic (Technology Centre of the Academy of Sciences in Prague, BIC Plzeň, JIC Brno, BIC Ostrava) and several regional development agencies and regional economic chambers have been associated within the Enterprise Europe Network focused on services and information for the development of innovative entrepreneurship.

The KLASTRY (Clusters) programme represents another CzechInvest tool supporting inter-sectoral R&D co-operation and is funded from the Structural Funds 2004-2006. The programme is aimed at creating formalised alliances among enterprises, higher education/research organizations and other entities (e.g. regional authorities). Besides “classic” clusters of companies, there are clusters sharing technology infrastructure, human resources for R&D and innovation in general terms. An example of such project is the CEITEC Cluster – Bioinformatics in Brno (MEYS, 2008a).

The National Research Centres programme, launched in 2000, can be considered as an example of improved research-industry co-operation. The centres are established in locations where a ‘critical mass’ in terms of R&D knowledge and capacities and of interest in co-operation already exists. Research centres are established as new public-private-partnerships with the aim to become nuclei of competitive research infrastructures. Their purpose and aim is to increase the level of interdisciplinary and inter-sectoral cooperation, to foster links between existing research potential and

potential users of research results, to attract new technology intensive companies and promising young engineers and scientists and to stimulate necessary changes in infrastructure and regional research governance systems. For this purpose the underlying policy measure aims both at promoting development of research activities and supporting infrastructures and services, e.g. for technology transfer, consulting, etc.

Compared with highly developed countries, there is a very small number of spin-offs set up at universities and public research institutes. Unfavourable milieu, which does not motivate researchers and university students to get involved in business activities based on utilisation of research outcomes, has a key role in this situation. There are several other reasons hampering the creation of spin-offs: lack of disposable financial resources, lack of available advisory services, educational and training programmes, lack of suitable technical background and infrastructure, connected with research institutions and providing the needed awareness of business environment.

Improving conditions stimulating national horizontal mobility of researchers and technology oriented staff between the academic and business sphere also needs attention. Academic and business sphere largely function in parallel, side-by-side. Moreover, existing policy measures have been concentrated mainly on international staff mobility.

New measures introduced under new Operational Programmes for 2007-2013 – OP Entrepreneurship and Innovation, OP Research and Development for Innovation and OP Education for Competitiveness – may improve this situation in the future.

5.1.2 Profiting from access to international knowledge

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.

However, the overall Czech participation in the EU Framework Programmes is still at a relatively low level compared with advanced EU member states (see 2.1.2.2). An effort to improve this situation has led to several initiatives, namely to the introduction of two financial instruments to cover the costs of participants – one managed by the national contact organization for the EU Framework Programme, the Technology Centre of the Academy of Sciences, which covers the costs of preparation and negotiation of proposals that qualify and receive financial support; and one managed by CzechInvest, which supports only private sector participants, including those who do not receive the grant but meet a minimum threshold evaluation score.

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.

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. Particularly investment incentives like the Framework Programme for Support of Technology Centres and Centres of Business Support Services have been an important tool for establishing and developing R&D activities (see 2.1.3) (Technology Centre AS CR, 2007).

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 2004. This trend clearly illustrates the dynamic role of FDI in the Czech business R&D sector. The interest of foreign companies in Czech universities goes beyond their search for university graduates in the context of a lack of graduates at the labour market. In some cases, a systematic co-operation takes place within training of graduates, consultation of their theses, establishing joint laboratories or participating in joint R&D projects.

Although most immigrants to the Czech Republic are low-qualified workers from the post-communist states, the country is attractive also for foreign researchers, especially from the post-Soviet states (Russia, Ukraine, and Kazakhstan). Recently, the Government has adopted a number of strategic documents aimed at facilitating integration of immigrants. The proposed measures do not have a clear R&D dimension; however, they may have a positive effect on the immigration of further foreign researchers, from both post-communist and highly developed countries.

5.1.3 Absorptive capacity of knowledge users

Although the share of innovative companies in the Czech Republic (UNU-MERIT, 2007) indicates a sufficient absorptive capacity of businesses and total expenditure on innovation corresponds to the EU average, the real absorptive capacity of businesses is rather low. According to a detailed analysis (Czech Statistical Office, 2008), companies use their resources mainly for acquisition of technology equipment. The share of R&D expenses in the total amount spent on innovation is substantially lower than in the advanced EU countries. It is caused by the capital intensity of R&D expenditure and by a low confidence of companies in the return of their investment in R&D.

Another barrier decreasing the absorptive capacity of knowledge users is an insufficient supply of qualified human resources for R&D. Although the share of human resources in science & technology (HRST) in the total labour force in the Czech Republic is slightly below the EU27 average, the share of S&T graduates in the age group 20-29 (see 2.1.4) is one of the lowest within the EU27 after Malta, Cyprus and Hungary (CZSO, 2008).

At the institutional level, there are national organisations promoting interests of business R&D and innovative companies. The Association of Research Organization (AVO – www.avo.cz), founded in 1990, represents and supports 8 000 institutions, organizations and individuals of various branches conducting applied R&D in business. The Association has also an important consultative and advisory role in the R&D policy debate. The Association of Innovative Entrepreneurship of the Czech

Republic (AIP CR – www.aipcr.cz), founded in 1993, supports activities of innovative companies and aims at creating a favourable business environment for innovative entrepreneurship. Members of the Association include major private research organisations, universities as well as important national and international enterprises.

5.2 Assessment of strengths and weaknesses

The following table summarises main strengths and weaknesses of the Czech research system in terms of knowledge circulation.

In the field of knowledge circulation between universities, public research organisations and business sector, policy responses to the main challenges are in place. However, practical outcomes of programmes and policy measures are still insufficient. The issue of researchers' mobility between the mentioned sectors needs more attention. System responses to the challenges connected with access to international knowledge (and favourable geographic location of the Czech Republic) are in place and could be assessed as rather successful. In terms of enhancing absorptive capacity of knowledge users, the corresponding networks exist. However, the cross-cutting issues related to the access of businesses to financial resources and qualified human resources remain challenges.

Main strengths	Main weaknesses
• Existence of R&D programmes supporting research-industry co-operation and industrial R&D with the aim to lead research towards practical outcomes; • Effective system of investment incentives supporting localization of R&D; • Existence of specialized organizations promoting interests of industrial R&D and innovative companies;	• Insufficient supply of mediation services provided to innovative companies; • Lack of organisations ensuring technology & knowledge transfer into practice; • Unfavourable conditions for setting up academic spin-offs; • Low support to inter-sectoral (private-public-university sector) mobility of researchers; • Insufficient capacities of businesses to apply R&D outcomes.

5.3 Analysis of recent policy changes

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 and the National Innovation Policy in 2005. 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 weak.

Fiscal measures, which were introduced in 2005 in order to stimulate private R&D effort, had only a negligible impact on the collaboration between private and public sector, since they cannot be used for the purchase of R&D outcomes from universities and public research institutes. Indirect support of research by tax relieves should be one of the outcomes of implementation of the currently prepared Reform of R&D and Innovation system. A new tax system should stimulate co-operation between business, universities and public research institutes. Co-operation within the newly set conditions will be more favourable for businesses than just the existing tax deductions for which legal entities are eligible. The objective of this measure consists

in stimulating businesses to assign research projects to universities and research institutions.

Main challenges in the field of knowledge circulation and this and other responding main policy changes are summarised in the following table:

Challenges	Main policy changes
Facilitating knowledge circulation between university, PRO and business sectors	• Programmes supporting private-public R&D co-operation (especially TANDEM, IMPULS, KLASTRY) • New tax system initiated by the R&D Reform (2008) stimulating co-operation between business and public research • Support to business incubators with the aim to create conditions for setting up spin-offs within the OP Entrepreneurship and Innovation (2007)
Profiting from access to international knowledge	• Implementation of the EC Directive 2005/71 facilitating immigration of researchers in Czech legislation (2007)
Absorptive capacity of knowledge users	• Increasing R&D capacities of businesses supported by the OP Entrepreneurship and Innovation (2007) • Support of training human resources for innovation within the OP Entrepreneurship and Innovation (2007) • Preferential support to university infrastructure related to S&T fields of study through the OP Education for Competitiveness (2007)

Financial resources from the Structural Funds 2007-2013 represent a big opportunity for further improvement of co-operation between businesses and research & university sphere and for further development of innovation infrastructure as well. Within the Operational Programme Entrepreneurship and Innovation (2007-2013), issues of private-public R&D co-operation are addressed. One of the OP priorities supports building R&D capacity of companies (especially SMEs), internally as well as for collaboration with public research institutions. Collaboration platforms (particularly clusters and technology platforms) helping to create infrastructures for a collaboration among companies, research and training institutions, are supported within the SPOLUPRÁCE ("Co-operation") sub-programme of the OP. The infrastructure for business R&D and for training and development of human resources for innovation is another focal area of the OP. Attention is given to establishing, operating and developing business incubators with the aim to enhance starting new enterprises and creating conditions for setting up academic spin-offs.

Nevertheless, the lack of human and financial resources for operating planned capacities turn into a possible setback in utilising Structural Funds in this programming period and in the overall improvement process of innovation infrastructure in general. Efficient links to the business sphere and international networks are essential for ensuring sustainability of infrastructural projects after the termination of subsidies. Within the OP R&D for Innovation, preferential support is to be provided to research infrastructure used by research consortiums of universities, public research institutes and businesses. Preferentially also research infrastructure related to the ESFRI Road-map is to be supported, which guarantees its involvement in international R&D co-operation. Relevance of the infrastructure – at least at the national level – is required as one of the conditions for receiving financial support. Unexploited infrastructure has to be utilized for education and training of students and researchers once the Reform takes effect. Ensuring linkages to the business

sphere is another condition for receiving financial support to developing research infrastructure. In the context of lacking qualified human resources, the Operational Programme Education for Competitiveness provides a preferential support to university infrastructure related to S&T study fields.

The issue of "brain gain" related to potential immigration of researchers to the Czech Republic has been discussed at the highest political level. At the end of 2007, the EC Directive 2005/71 on a specific procedure for admitting third-country nationals for the purposes of scientific research was transferred to the Czech legislation. Consequently, the Czech Parliament started a debate on amending Czech Immigration Act.

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).

5.4 Assessment of policy opportunities and risks

Main policy opportunities and policy-related risks in terms of knowledge circulation are summarised in the following table.

Policy challenges in the field of knowledge circulation are addressed mainly by the existing Structural Funds programmes and measures, especially those on innovation infrastructure support. Another barriers hampering successful knowledge circulation were addressed by amendments of tax conditions and conditions for immigration of researchers. Nevertheless, tax conditions for research organisations need more improvement. Possible risks could emerge in the case of inefficient utilisation of Structural Funds resources as well as in relation to human resources for R&D and their mobility.

Main policy opportunities	Main policy-related risks
• Utilisation of Structural Funds for developing 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; • Enhancement of Czech research participation in ERA and ensuring sufficient linkages to international R&D; • New legislation improving conditions for immigration of researchers.	• Questionable sustainability of new R&D infrastructure after termination of public support (in case of insufficient links to industry and private funding); • Continuing separation between public and private sector R&D aggravated by a low horizontal mobility of human resources; • Decrease of attractiveness of the Czech Republic for foreign R&D investment (also related to the lack of HRST, especially S&T graduates).

5.5 Summary of the role of the ERA dimension

Large infrastructure projects for the purposes of research-industry knowledge circulation are financed through Operational Programmes, as well as initiatives supporting research-industry co-operation (clusters, technology platforms etc.). Involvement in the ERA creates conditions for Czech participation in a number of international research organizations and for establishing links to international

networks promoting innovation businesses. Although Czech participation in the EU Framework Programmes is below the EU average, Czech industrial companies are among the most active private partners in the FPs.

6 - Overall assessment and conclusions

6.1 Strengths and weaknesses of research system and governance

Recently published strategic documents as well as documents being currently prepared identify main strengths and weaknesses of the Czech research system. Majority of measures based on these documents are already being implemented. Namely 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.

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	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.
	Securing long term investment in research	Long term orientation of R&D specified through National Research Programmes and Long-Term Principle Research Directions but a relatively high share of institutional support to R&D.
	Dealing with barriers to private R&D investment	Total expenditures on R&D in business sector have been recently rapidly increasing but venture capital financing is not developed in the country and Czech companies spend much less on R&D in comparison with the EU average.
	Providing qualified human resources	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.
Knowledge demand	Identifying the drivers of knowledge demand	High share of R&D expenditures by foreign companies positively influence globalisation of Czech business research and traditionally strong medium high-tech and developing high-tech sector and sector of services but insufficient R&D expenses in the manufacturing industry lead to a much lower gross value added than the EU average.
	Co-ordination and channelling knowledge demands	Common use of ad-hoc group of experts, foresight methods and multidisciplinary approach in preparation of key strategic documents and new research programmes but fragmentation of R&D governmental support persists and systematic and institutional evaluation culture is in its beginning.
	Monitoring of demand fulfilment	Approved Reform and Green Paper on R&D and Innovation promising a clearer system of public R&D support including more efficient evaluation methods but basic research dominates over applied research in the public sector, experimental development dominates over applied research in business sector – this is not optimal for a harmonic development of a knowledge based society.

Domain	Challenge	Assessment of strengths and weaknesses
Knowledge production	Ensuring quality and excellence of knowledge production	Strong public research sector (with a dominant role of the Academy of Sciences) and developed network of public universities disposing of research capacities. Low evaluation culture not leading to supporting excellence, however, there are starting programmes supporting R&D excellence. Recent faster growth of publication activity slowly catching up advanced EU countries but a low level of citations.
	Ensuring exploitability of knowledge	Low level of R&D outcomes commercialisation by public research organisations. Low level of patent production.
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	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 lack of 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.
	Profiting from international knowledge	Effective system of investment incentives supporting localization of R&D and knowledge intensive services in the Czech Republic.
	Enhancing absorptive capacity of knowledge users	Existence of specialized organisations promoting interests of industrial R&D and innovative companies but insufficient capacities of businesses to apply R&D outcomes.

Despite a strong public research in the Czech Republic, based on a developed network of public universities and research institutes of the Academy of Sciences, lack of excellence is one of the major problems of the Czech R&D. The present system of R&D evaluation does not emphasise sufficiently international comparability of R&D results and consequently leads to supporting mediocrity. Applicability of R&D results is another issue. Researchers are not sufficiently motivated to produce R&D results to be applied by industry. This situation is also reflected in a low production of patents.

Existing programmes supporting research-industry co-operation are a precondition for investments of business sector into public R&D, which is currently at a very low level, especially in the higher education sector. The massive inflow of FDI 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 availability of a highly qualified labour force is becoming a key challenge for the Czech R&D policy with respect to the lack of S&T graduates. Moreover, the horizontal mobility of researchers and technology oriented staff between public and private sector is not sufficiently addressed by the existing R&D policies.

6.2Policy dynamics, opportunities and risks from the perspective of the Lisbon agenda and the ERA

Recently prepared reforms, including the Reform of Public Finance, the Reform of R&D and Innovation system (adopted in April 2008) and the Reform of Tertiary Education address the main challenges identified in the field of R&D.

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	• Reform of R&D and innovation system adopted by the Government in April 2008; • Prepared Reform of the Tertiary Education System based on the White Paper published by MEYS in February 2008; • 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 supporting extensive business development and not corresponding to 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.

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

The R&D Reform aims to make changes in financing research, e.g. to reduce the share of institutional financing in favour of project-based financing. Another objective is to reduce the number of support providers in public R&D. Tax incentives and other indirect support mainly by the Ministry of Industry and Trade is planned to increase the share of business expenditures on R&D.

In order to improve the low production of applicable R&D outcomes, a new methodology for evaluation and monitoring of the R&D results was created and included in the R&D Reform. Addressing IPR issues in the National Innovation Policy (2005-2010) and the Operational Programme Entrepreneurship and Innovation (2007-2013) should also contribute to a higher production of patents by Czech research organisations.

One of the main sources for financing R&D infrastructure as well as human resources for R&D lies in the EU Structural Funds 2007 – 2013 which represent probably the last chance of such a financial source for the Czech Republic in this field. More emphasis is to be put on motivating young people to start a research career and reach the PhD level of their studies, especially in the S&T fields responding to the labour market needs.

6.3 System and policy dynamics from the perspective of the ERA

To sum up the role of the ERA dimension of the Czech research and development system:

The Czech reaction to the 3% Action Plan at EU level consisted in the adoption of a national document entitled Action Plan for Europe – Approach of the Czech Republic in 2004. This document describes existing or proposed future activities in the Czech Republic corresponding to measures proposed in the 3% Action Plan.

In addition to this document the Economic Growth Strategy set out a quantified national target of 1% of public R&D expenditures by 2010, a target that was subsequently integrated in the National Reform Programme. The Economic Growth Strategy published in 2005 anticipated an annual growth of public R&D expenditures in the range of 20–25% per year. The budget plan adopted by the government in May 2007, however, proposes annual growth in the range of 7–8% per year. Nonetheless,

the official target still remains in place and since the budget plan is only binding for the nearest financing period, the fulfilment of the target is still theoretically possible.

The Czech Republic's participation in the ERA has led to several changes within the R&D system including the monitoring and evaluation methods of research results corresponding to the market and societal needs. Also measures specified in the relevant Operational Programmes should correspond to national measures to be applied within the R&D system of the Czech Republic (e.g. National Research Programme III is planned to be a tool financing research conducted in the infrastructure financed by the Operational Programme Research and Development for Innovation). Czech delegates in the Programme Committees of the FP7 contribute to the discussion on priorities supported by the FP7 according to the needs of Czech research teams.

Within the process of building the European knowledge based economy there is a plan in the Czech Republic to support the research and innovation system by formulating a new National Research, Development and Innovation Policy in 2009. New National Research, Development and Innovation Policy should cover both of the above mentioned policies and is to be finished by March 2009 for the period of 2009 – 2015. Currently background documents are being prepared and gathered by the Council for Research and Development, e.g. Green and White Paper on RTDI and other strategic studies and analysis including best practices in these areas.

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List of Abbreviations

AIP CR	Association of Innovative Entrepreneurship of the Czech Republic
AS CR	Academy of Sciences
AVO	Association of Research Organisations
BERD	Business Expenditures on Research and Development
CIS	Community Innovation Survey
CR	Czech Republic
CZELO	Czech Liaison Office for R&D in Brussels
CZK	Czech Koruna (currency)
CZSO	Czech Statistical Office
DZSV	Long-Term Principle Research Directions
EIS	European Innovation Scoreboard
EPO	European Patent Office
ERA	European Research Area
ERDF	European Regional Development Fund
ESF	European Social Fund
ESFRI	European Strategic Forum on Research Infrastructures
EU	European Union
FDI	foreign direct investment
FPs/FP7	Framework Programmes EU on R&D / Framework Programme 7
FTE	full time equivalent (used for employment indicators)
GACR	Czech Science Foundation
GBAORD	Government Budget Appropriations or Outlays on Research and

	Development
GDP	Gross Domestic Product
GERD	Gross Expenditures on Research and Development
GUF	General University Funds
HERD	Higher Education Expenditures on Research and Development
HRST	Human Resources in Science and Technology
IGL 7	Integrated Guidelines for Growth and Jobs 2005-2008 – no. 7: To increase and improve investment in R & D, in particular by private business.
IPR	Intellectual Property Rights
ISCED	International Standard Classification of Education
ISCED 5	Tertiary Education without PhD level;
ISCED 6	PhD level of the tertiary education
MEYS	Ministry of Education, Youth and Sports of the Czech Republic
MNEs	Multi-National Enterprises
NACE	Noménclature générale des activités economiques dans les Communautés Européennes
NABS	socio-economic objectives using NABS methodology (Nomenclature pour l´Analyse et la Comparaison des Budgets et Programmes Scientifiques)
NICER	National Information Centre for European Research project
NRP	National Reform Programme 2005 - 2008
NUTS	Noménclature des Unités Territoriales Statistiques
OECD	Organisation for Economic Cooperation and Development
OPs	Operational Programmes
PPS	purchasing power standards
R&D	Research and Development
RDI	Research, Development and Innovation
RTDI	Research, Technology, Development and Innovation
S&T	Science and Technology
SVTP CR	Science and Technology Parks Association of the Czech Republic
TC AS CR	Technology Centre of the Academy of Sciences of the Czech Republic

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Abstract

The main objective of ERAWATCH country reports 2008 is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. The reports are produced for each EU Member State to support the mutual learning process and the monitoring of Member States' efforts by DG Research in the context of the Lisbon Strategy and the European Research Area. In order to do so, the system analysis focuses on key processes relevant for system performance. Four policy-relevant domains of the research system are distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The reports are based on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.
This report encompasses an analysis of the research system and policies in Czech Republic.

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