ICT RTD landscape in the CR: performance and policy framework

Anna Kaderabkova, Centre for Economic Studies Prague (for Berman Group)

Introduction

The development of ICT sector in the Czech Republic can be described in European context as one of the most dynamic in all the key economic indicators of production, trade and investment (both domestic and foreign). This dynamics partly reflects the former isolation from the advanced technology in the West and contributed to the position of the CEE country group as one of the leading ICT markets in terms of growth. An overall positive effect of the technology upgrading has been related to increasing demand and supply of ICT capabilities. At the same time, however, there is still significant lack of efficiency and effectiveness issues of the expended resources (both financial and human), in particular in the business sector. The results of field research show that despite an enormous investment activity in ICT, its benefits have been mostly perceived as rather limited or even disappointing in terms of productivity or competitiveness increases. The ICT potential has not been exploited fully so far, mostly due to the incomplete integration into production and management processes and missing (soft) skills of the workforce. On the other hand, the business sector in the Czech Republic benefits largely from foreign ICT knowledge thanks to its above average external openness both to trade and investment flows.

With the cost-based competitiveness rapidly diminishing, the further prospects of ICT sector development in the CR crucially depend on the development of local innovation capacities, closely integrated into multinational value chains and ERA activities and infrastructures. Such a transition, however, presents huge challenges to the extent and intensity of R&D and innovation activities both in business and government sectors (public research institutes and universities), including the efficiency of related public support measures (and their diverse resources) in the development of information society. The overall knowledge intensity of the ICT sector in the Czech Republic remains low, despite its above average values in cross-industry comparison and long-term increasing business and government expenditure (ICT themes are considered as priorities both in public R&D and structural fund programmes, and in public sector modernization).

Framework Programme is intended to play an important role in these efforts, in particular in pushing forward the technology frontier. However, so far, the participation of the CR in FP6 has been rather disappointing in Information Society Technologies theme, as compared both to other thematic priorities and EU countries (comparable in their size and technology development). According to FP6 participation statistics, the CR ranks 17th in terms of requested contribution and only 23rd in terms of eligible cost (per GDP), i.e. much worse than in the other themes. Business sector participants from the CR (and other new member states) mostly include smaller companies than those of EU-15. The CR participation statistics in FP has largely reflected the state of technology development and soft factors governing the quality of national innovation system (including the linkages between its key institutional sectors). Several pockets of scientific excellence do exhibit remarkable achievements even in international milieu; however the strength of knowledge producing (academic) agents is rather limited as well as its spillover (application) effects. Knowledge high intensive ICT activities in business sector are rather scarce, and they are not based on long-term and continuous R&D activities (more on imitation/adoption innovation mode).

Policy activities on ICT RTD in the Czech Republic have been rather scarce or even missing in terms of qualitative evaluation of development trends and strategy priorities. Most of them were produced as the starting points for thematic priorities in ICT in various public support programmes in R&D and innovation, including structural funds (mostly Czech Academy of Sciences, Ministry of Industry and Trade, Ministry of Education, to lesser extent also by other ministries for specific applications, e.g. health, environment, transport), in the process of governmental reform in public services (directed by Ministry of Interior, responsible also for the agenda of Information Society strategy) and in the programme documents of professional organisations and associations (most notably covered by CSSI and SPIS). The starting points of ICT priorities in RTD (largely reflecting the views of included interest groups) have been also formulated in the discus-

sion related to the current reform of national R&D and innovation policy directed by the responsible Government Council for R&D.

Other information resources comprise mostly statistics on ICT economic activities (in manufacturing and services) in the structure defined on industry basis in terms of the indicators of national accounts, data on R&D and innovation inputs (financial and human) and outputs in the methodology of Frascati, Oslo and Canberra manuals for the ICT sector (including international comparison), data on public R&D expenditures and their results (bibliometric and patent statistics) for ICT research activities specified in terms of individual programme recipients (and their consortia), and data on information society development regarding business, household and government sectors according to EUROSTAT methodology. However, the bulk of the existing information resources concentrates mostly on the development intentions in ICT RTD in the CR (mostly blended with the EC policy documents) but it is not based on evidence substantiated by a profound and systemic analysis, neither have been the past developments in public support evaluated as to their efficiency and effectiveness.

1. Policy support for information society development (weak and non-systematic)

The development stage of information society (IS) in the Czech Republic can be evaluated with the set of comprehensive indicators in broader international comparison (based primarily on Global Information Technology Report and i2010 Annual reports). They reveal the key weaknesses reflected, with varying intensity across time and agenda scope, in the related analytical and political documents. Currently, despite increasing attention given to the information society domain, no comprehensive and systemic programme for its development has been formulated at the national level. Therefore, the strategic responsibility rests decisively on the individual activities and initiatives of the related stakeholders at national, regional, and local levels (including both their formal and informal representatives). The most visible impacts of broader policy efforts have so far included the e-government focus (on quality public services for information society development), and horizontal style inclusion of ICT support into the wide range of operational programmes financed with structural funds.

1.1 Information society development

Within the conceptual framework of transition to knowledge or innovation-based competitiveness,[1] the information society development in the CR (in a broader country ranking) can be approximated with the **Networked Readiness Index** in Global Information Technology Report published annually since 2002 by World Economic Forum (within the series of Competitiveness reports). NRI measures (combining survey evaluations and hard data) three key aspects of IS development: (1) the presence of an ICT-conducive environment, by taking into consideration a number of features of the broad business environment, some regulatory aspects, and the soft and hard infrastructure for ICT; (2) the degree of preparation needed to use ICT for the three main national stakeholders—individuals, the business sector, and the government; and (3) the actual use of ICT by the above three stakeholders.

In the latest NRI edition (2008-2009), the CR scores 32nd position in the total of 134 countries (or 16th within EU-27), which is almost identical to the position within the broader Global Competitiveness Index (33rd). In time, the CR position in NRI has been gradually improving (within the new EU members, the CR currently falls behind Estonia, Malta and Slovenia). In terms of the individual NRI components (see table 1), the readiness and usage score around average values (31 and 33 respectively), on the other hand, the environment component scores much worse (36), in particular due to the chronically infavourable perception of the country political and regulatory framework (52). The low institutional quality in the CR has been also reflected in the below average NRI ranking of government both in its readiness (45) and usage (77!) components. More specifically, the ***policy support for information***

[1] The most consistent evaluation of country competitiveness in broader international comparison can be found in the Global Competitiveness Reports, published annually by World Economic Forum, or, in World Competitiveness Yearbooks, published by IMD in Lausanne.

society receives an overall poor assessment in low ICT prioritization (61) and promotion (108), as well as in its weak presence in government vision of future (96).

Table 1: Networked Readiness Index 2008-2009, Czech Republic

Components and indicators	Rank	Components and indicators	Rank
I. Environment component	**36**	Lowest cost of broadband	30
Market environment	*40*	Cost of mobile telephone call	33
Intensity of local competition	13	Buyer sophistication	41
Accessibility of digital content	21	High-speed monthly broadband subscription	42
High-tech exports	26	Residential monthly telephone subscription	75
Utility patents	33	*Business readiness*	*23*
State of cluster development	35	Business telephone connection charge	3
Freedom of the press	39	Local supplier quantity	8
Time required to start a business	41	Local supplier quality	21
Financial market sophistication	49	Computer and other services imports	22
Availability of latest technologies	49	Local avail. of research and training services	23
No of procedures required to start a business	60	Company spending on R&D	26
Extent and effect of taxation	61	University-industry research collaboration	26
Venture capital availability	68	Extent of staff training	28
Total tax rate	86	Quality of management schools	34
Burden of government regulation	115	Business monthly telephone subscription	68
Political and regulatory environment	*52*	*Government readiness*	*43*
Number of procedures to enforce a contract	9	UN E-Government Readiness Index	25
Laws relating to ICT	39	Gov't procurement of advanced tech. products	35
Quality of competition in the ISP sector	50	Government prioritization of ICT	61
Intellectual property protection	51	Importance of ICT to governm. vision of future	96
Judicial independence	61	**III. Usage component**	**33**
Property rights	63	*Individual usage*	*25*
Efficiency of legal framework	86	Mobile telephone subscribers	11
Effectiveness of law-making bodies	91	Personal computers	33
Time to enforce a contract	107	Broadband Internet subscribers	30
Infrastructure environment	*33*	Internet users	37
Availability of scientists and engineers	11	Internet bandwith	n.a.
Electricity production	20	*Business usage*	22
Quality of scientific research institutions	26	Extent of business Internet use	19
Secure Internet servers	31	Capacity for innovation	24
Tertiary enrollment	39	Availability of new telephone lines	27
Number of telephone lines	47	Prevalence of foreign technology licensing	37
Education expenditure	67	Firm-level technology absorption	38
II. Readiness component	31	*Government usage*	*77*
Individual readiness	23	E-Participation Index	58
Residential telephone connection charge	2	Presence of ICT in government offices	59
Quality of math and science education	8	Availability of government online services	78
Internet access in schools	19	ICT use and government efficiency	90
Quality of the educational system	26	Government success in ICT promotion	108

Note: Rank in 134 countries. Source: Global Information Technology Report 2008-2009, p. 181.

According to **i2010 Mid-term review** published in 2008, the progress has been made especially in e-government, rapid adoption of broadband by Internet users, and in business environment favourable to ICT investment, in particular with a good eSkill base (see table 2).

Broadband penetration has increased from at 9.6% in October 2006 to around 16% in 2008, with more than half of users benefiting from technologies other than DSL. The transition from narrowband to broadband connections in households is growing fast with a 41% increase from 2006 to 2007. A major driver in the broadband transition is the use of Internet telephony or videoconferencing which almost doubled from 2006 to 2007 and is well above EU average. The use of other online services is still relatively low and in general below EU average. While the online availability of public services for enterprises reached 100 % in the CR, in case of citizens it remains low, about half the EU-27 average.

Considerable lags behind the EU average show up in terms of ICT exploitation in **households** (with the exception of mobile phones). PCs may be found in 39% of homes and any form of Internet connection in 35%, which is one of the worst situations compared with other countries

(although both indicators show fast improvements year on year). The low demand for PCs and the Internet in the CR may be partly due to poor language skills (especially English) that radically restrict the use of available online content. **ICT skills** in the population changed significantly between 2006 and 2007 with far fewer people reporting no or low levels of Internet skills and a threefold growth in high level skills to above the EU average.

Table 2: Information society indicators – Czech Republic

Czech Republic	2003	2004	2005	2006	2007	EU27	rank
Broadband							
Total DSL coverage (as % of total population)			75	81		89	20
DSL coverage in rural areas (as % of total population)						72	
Broadband penetration (as % of population)		2.2	6.4	10.6	14.6	20.0	19
DSL penetration (as % of population)		1.0	3.0	4.8	6.0	16.0	23
Predominant download speed							
% of households with an internet connection			19	29	35	54	24
Households with broadband as % of households with internet			27	57	80	77	13
% of enterprises with broadband access	20	38	52	69	77	77	14
Internet Usage							
% population who are regular internet users			26	36	42	51	20
Take up of internet services (as % of population)							
sending emails			27	37	42	48	18
looking for information about goods and services			20	32	37	47	18
Internet telephoning or videoconferencing			6	9	16	10	7
playing/downloading games and music			9	12	20	22	19
listening to the web radio/watching web tv			3	6	8	15	23
reading online newspapers/magazines			12	19	22	21	14
internet banking			5	10	12	25	24
eGovernment Indicators							
% basic public services for citizens fully available online		17		8	25	51	21
% basic public services for enterprises fully available online		50		63	100	72	1
% of population using e-Government services			5	17	16	30	23
of which for returning filled in forms			1	3	4	13	25
% of enterprises using e-Government services		75	79	76	73	65	15
of which for returning filled in forms	22	24	32	32	34	45	23
e-Health							
% of GPs with Broadband connection					39	48	17
% of GPs with secondary care connection					10	24	18
% of GPS using electronic networks for transfer of patient data					33	48	13
e-Commerce							
e-commerce as % of total turnover of enterprises	6	6	8	7	9	11	10
% enterprises receiving internet orders	17	13	15	9	10	14	14
% enterprises purchasing on the internet		31	37	27	32	39	12
e-business. % enterprises:							
with integrated internal business processes			18	28	31	41	18
with integrated external business processes			4	10	8	14	21
using ERP systems					19	17	12
using analytical CRM					15	17	10
sending/receiving e-invoices					33	18	3
using digital signatures					24	16	7
using secure protocols for internet orders					3	5	15
using open sources operating systems					22	12	2
Employment and Skills							
% of the population with no internet skills				52	47	40	18
% of the population with low internet skills				30	25	29	
% of the population with medium internet skills				14	17	23	
% of the population with high internet skills				4	11	8	8
% of persons employed with ICT user skills.	15.6	16.5	16.9	17.4	17.9	18.2	18
% of persons employed with ICT specialist skills	3.8	3.9	3.9	4.1	4.4	3.1	2

Source: European Commission, i2010 Mid-Term Review, p. 15.

Enterprises are significantly more advanced in ICT than citizens with over three quarters now having broadband connections, a rapid increase since last year. The proportion of enterprises carrying out e-commerce is slightly below the EU average but use of most e-business applications is higher than average. Online presentation and, more importantly, the quality and sophistication of online content have become an indispensable requirement for all companies. Key criteria include trade functionality, customisation and personification options for web site users, level of integration with corporate IT databases and applications as well as the speed of site updates. Czech companies have been quick in adopting the Internet, thus creating favourable conditions for future development of e-commerce and e-business. Czech companies started massively investing in ICT during the 1990's and have already reached a rather high level

of sophistication. The initial motivation was to get basic business agendas in electronic form, soon to be followed by complete processing of business cases, which today integrates in-house activities and processes related to suppliers and customers. ICT, the Internet and mobile technologies also play an important role in developing and processing product and service design.

Despite the above favourable figures regarding Czech companies connection to the Internet (with no significant differences among industries or companies of various size), the **intensity** of employees use of PC or level of sophistication of ICT use still remains rather limited. Only two thirds of companies have their own computer networks, which is an essential requirement for the existence of an IT system of any kind, and only one fifth have own Intranets. Furthermore, there are major differences among industries in terms of availability of PCs, e-mail and web services. On average, Czech companies remain very conservative in their use of ICT and fail to seize its potential to increase productivity and competitive strength. Using the Internet to conduct business, i.e. e-commerce, still remains low compared with the overall ICT availability. In the CR, revenues from e-commerce represent 9% of the total corporate revenue but the European average is just 2 p.p. higher (a similarly low ratio has been identified for companies that process orders or purchase goods and services online). Expansion of e-commerce, or complex online support of business processes, requires, in addition to the necessary technology, adequate improvements of business and logistics conditions.

1.2 Information society policy framework

The infavourable ranking in the government component of NRI rather adequately reflects the turbulent and mostly inconsistent policy towards information society development in the CR. Chronologically, its formal beginning can be dated back to 1999, when the State information policy (and separately, the National telecommunications policy) was formulated. The responsibility for the key ICT agendas (mainly telecommunications and postal services, electronic signature, and public information systems), however, remained institutionally fragmented until 2003, with only weak coordination role of Government council for state information policy (originally intended as cross-ministerial body, actually weakened with unclear role and competences).

A sort of breakthrough in the policy arrangement came with the ongoing convergence of ICT agendas, resulting in the constitution of the self-standing **Ministry for Informatics** (on 1st January, 2003), responsible, primarily, for the transposition of EU legislature on electronic communications, and for strategic documents on the related policy issues (implementing mostly the objectives and measures of e-Europe). They included the State information and communications policy (so called e-Czech 2006), with four priorities in communication services, informatics education, e-government, and e-business environment; National policy for broadband access, National strategy for information security, Programme for development of digital broadcasting. MI coordinated the process of e-government (electronization of public services), and strongly prioritized National programme for computer literacy (directed mainly to digital inclusion of disadvantaged groups).

Despite some of individual achievements, the strengthening (mostly politically motivated) attacks finally resulted in the abolishment of the MI (on 1 June, 2007). Its agenda was again divided among other ministries, and the coordination role formally overtaken by the newly formed **Government council for information society**, institutionally attached to the Ministry of Interior and chaired by the prime minister. Its only conceptual document has so far included Strategy for development of services for information society (published in March, 2008, when also the last session of the council took place). The strategy actually focuses rather exclusively on **e-government** issues (see box 1) viewed as an integral part of the more comprehensive reform towards increasing government and public administration efficiency, effectiveness and user-friendliness (smart administration).[2] The more efficient gov-

[2] Besides the network of one-stop-shops called Czechpoint (operating since September, 2007), the related legislative efforts of Ministry of Interior has so far resulted in only one important initiative of the Act on e-government (effective on 1st July, 2009), supporting the electronic communication between public service and citizens. It introduces two important novelties: data boxes and authorised conversion of documents. Data boxes

ernment is conducive to the development of spontaneously created information society, i.e. based on the free initiative of citizens and entrepreneurs, with quality public services adequately responding to their needs.[3]

Box 1: E-government strategy in the CR (2008)

The priorities under the e-government programme include:

- Basic registers and identification: territorial identification and identification of real estate, population, private and corporate persons, rights and obligations. The organisational and technical architecture solution should allow these registers to connect to agenda registers (in order to eliminate data duplicity while maintaining high security standards).
- Universal contact point: assisted and self-service communication with public administration, public administration portal and individual agenda portals, data inbox system.
- Guaranteed and safe electronic communication among authorities and between citizens and the state, including supervision of compliance with security and operation rules.
- National ID card in the form of smart cart with computer chip.

Services designed specifically for information-based society cover primarily the following areas:

- Healthcare, pensions, education: these systems work with electronic cards of their specific users, i.e. insured persons, pupils and students.
- Public administration in the narrower sense: judicial, administrativeand tax procedures, especially maintenance of electronic files allowing simple transfer of agendas among different public administration agencies.
- Asset management for the state and local governments: state treasury, asset records, budgeting, asset and cash disposal, public contracts, subsidies.
- Digitisation and filing of data records: national digitisation centre, national digital library, historical monument records, national digital archives.

Given the absent broader policy framework at national level, the other IS agendas have been developed with diverse intensity, largely depending on the initiative and conceptual capacity of their guarantees. The domain of **electronic communications** was attached to the Ministry of Industry and Trade, mostly responding only ex post to the external impulses (with occasional competence clashes with the Ministry of Interior).

The ICT **education and literacy** domain was originally divided between the Ministry of Education (responsible for the target group of pupils and students), and Ministry of Informatics (focused on the adult population). The formal State policy on informatics in education (mostly concentrating on support to internet accessibility of schools) was decisively weakened due to chronically lacking funds (preceded by the spectacular failure of the large-scale national project on internet access) and after tedious budget and jurisdiction struggles the related ministerial efforts were formally terminated in April, 2008. With some delay (in September, 2008), the Ministry of Education submitted the proposal on Strategy for ICT development in education for 2009-2013 including broader range of agendas besides the internet access for schools (technology equipment, education of teachers, ICT support for teaching and learning activities, school portal). However, no specific targets and measures have been defined so far, and only tentative budget estimates presented (relying heavily on non-ministerial financial resources coming mainly from regional authorities and structural funds).

(mandatory for state agencies and bodies corporate but optional for individuals) will serve as the entry point for electronic communication with the state. Authorised conversion means complete transfer of electronic documents to physical form and vice versa. A converted document will have the same legal validity as a copy verified by a notary. To complete the government's vision, however, many other legislative changes will be necessary, above all, the Act on Basic Registers, electronic ID cards, the electronic Collection of Law and legal regulations on the archiving of electronic documents.

[3] Efforts developed by non-governmental initiatives are certainly worth mentioning, most prominent example being that of the Association for Information Society (SPIS). SPIS was founded in 1998 as a professional organisation of enterprises operating in ICT sector in the CR. Its key objective is the full implementation of e-government, as well as improving services for citizens and reducing the bureaucratic burden by introducing new technologies. This involves monitoring and influencing the lawmaking process related to the use of ICT, especially with impacts on citizen and enterprises. SPIS is also involved in the introduction of international ICT standards in the CR. In 2004, SPIS published Knowledge Society Manifesto, identifying country priorities in the European context. The second Manifesto called A journey to success in 2005 focused on the topics of Czech economy competitiveness and public sector performance. The 2006/2007 Manifesto focused on e-government implementation.

1.3 ICT development supported with structural funds

The role of ICT development support in operational programmes (divided into 2004-2006 and 2007-2013 periods) has been both widespread and rather intensive in the CR, with strong horizontal characteristics. The key role of ICT domain for national competitiveness and knowledge-based economic performance was pointed to repeatedly in the related conceptual documents of National strategic reference framework, and in the individual operational programmes. However, no in-depth analysis for an evidence-based policy supporting ICT development has been undertaken (beyond the scope of the usual benchmarking, desktop exercises at individual ministries or regional authorities), which is rather common governance practice in the CR in other policy domains as well (due to the general incapacity of strategic intelligence and/or its effective implementation).

In the shortened programming period **2004-2006**, the direct, sectoral specific support was involved in the Joint Regional OP, within the measure 2.2 on the development of ICT in regions (the priority of regional infrastructure development). The ICT calls showed up high turnover, generating a large number of projects with relatively short application period (i.e. sufficient absorption capacity). The key projects were submitted by regional authorities, often initiated and co-elaborated by ICT businesses supplying the technology solutions. The more indirect ICT support was involved in the sectoral OPs (including the horizontal objective of information society), i.e. – Human resource development (focused on social integration, adaptability capacity, lifelong learning, and active employment policy), and Industry and enterprise (focused on entrepreneurial environment, and business competitiveness). Horizontal type of ICT support was also included in the specific programme for the Prague region (SPD 2 with focus on information society services, PPP partnership, innovation infrastructure, and SPD 3 focusing on human resource quality and adaptability).

The combination of direct and indirect support for ICT development within structural funds has shown up also in the current programming period **2007-2013**, in which, however, stronger emphasis is given to the factors of knowledge intensive competitiveness (considered as strongly interrelated), especially internal as well as outsourced innovation capacity of companies (OP Enterprise and innovation, OPEI), knowledge production and application capacity of academic sectors (OP R&D for innovations, OPRDI), and improving quality of education and training at all levels, including the production of high-skill professionals, and application of ICT supported teaching and learning activities (OP Education for competitiveness, OPEC). The support for the e-government agenda (public administration and service modernization, including ICT application) at regional level is involved in the Integrated OP, closely linked to the priority of OP Human resources for employment, focused on improving the quality of public administration and social services. The support for ICT development is also included in some region specific OPs, focusing on the related infrastructure improvements and digitalization, and in the OP Competitiveness designed exclusively for Prague (together with OP Adaptability), exempted from standard structural fund support.

More specifically, within the OP **Enterprise and innovation**, two programmes focus explicitly on ICT domain: ICT and strategic services, and ICT in enterprises. The first programme promotes supply of new ICT products and services (i.e. new IS/ICT solutions and applications, new shared service centres and new repair centres for high-tech products and technologies) and creation of new jobs in the ICT sector. The second programme is aimed to support use of ICT (information systems – e.g. Enterprise Resource Planning/Enterprise Resource Management, Customer Relationship Management, teleworking, knowledge management etc.) in SMEs. None of the programmes is intended to support of R&D activities in the field of ICT, both are designed to support enterprise competitiveness through use of modern ICT technologies and the growth of the ICT sector and information society in general in the CR.[4] Moreover, one of the horizontal objectives includes specifically Information society support (see box 2).

[4] Both programmes were launched shortly after the beginning of the current programming period (beginning of 2008 and mid 2007 respectively) and demand for its support has been so far relatively satisfactory, yet lower than

Box 2: Information society as horizontal objective in the OP Enterprise and innovation

There are two decisive factors in the transition to knowledge economy and information society: human capital quality and creation, dissemination and implementation of technological, organisational and institutional innovations. The processes of intensification of innovation activities proceed across economic sectors and branches. Knowledge management activates the relations between marketing, research and production and changes the ways of internal functioning of organisations. A fundamental component in these processes is that of the information infrastructure due to increasing flexibility of labour force, supporting creating, development and success of business plans and it also contributes to higher accessibility of the goods, services and information. In the realisation of the steps oriented to the transition to knowledge economy and information society the Czech Republic in comparison with other countries is only in its early stage. The key issues are:

• low effectiveness of the programmes oriented to lifelong learning where in addition to insufficient offer of educational activities also a low motivation for further education plays a negative role – both on the side of employees and on the side of employers;
• insufficient degree of development of the infrastructure of consulting and information services;
• low development of the programmes oriented to ICT implementation in small and medium-sized enterprises and in the whole sector of services;
• insufficiently motivating environment facilitating commercial applications of research and development projects;
• unfavourable qualification structure of the workers in research and development and lacking interlinking of the development of tertiary education with the needs of the sector.

In the area of professional education it is most important to create the conditions for establishing a system of verification of qualifications acquired in further professional education with the use of accreditations and certifications related to initial education and to reach a higher coordination of this education with prospective needs of the enterprises on the labour market.

Besides the two specific ICT oriented programmes, most of the other OPEI activities can also provide support to the related development, cooperation and/or knowledge based activities, including partners from other institutional sectors (universities, R&D facilities, intermediaries); for the review of the current or closed calls see table 3 with a short characteristics of the individual programmes.[5]

Table 3: Launched calls in OP Enterprise and innovation related to knowledge intensive activities

Interv. area	Programme	Cal No.	Appl. dead
1.1 Starting business	START: Realisation of business plans of people taking up business for the first time or after a longer pause with the use of subordinate loans or soft guarantees with financial contribution to the guaranteed loan. The beneficiaries are micro enterprises only, focused specifically on innovation based projects, spin-offs etc.	I.	31.1. 2008
2.1 Bank instruments. for SMEs	PROGRESS: Subordinate loans strengthening the capital assets of the entrepreneur for the period up to six years, enabling the realisation of larger business projects for the development of SMEs with a lower capital background or with limited access to external financing. The contribution to the subordinate loan should motivate the entrepreneurs to increase the employment rate. The beneficiaries are SMEs only.	I.	31.12 2009
	GUARANTEE: Facilitation of business projects of SMEs in the form of guarantees and soft guarantees with financial contributions, directed to the regions with concentrated support of the state. The beneficiaries are SMEs only.	I.	31.12 2009
2.2 Production capacities and services	DEVELOPMENT: Support for the purchase of new technology, machinery, land, buildings, and licenses and know-how.	II.	15.9. 2009
	ICT and STRATEGIC SERVICES: Support for the software development, shared services centers, customer support services (not included in call II), high-tech repair centres.	II.	15.1. 2010
	ICT IN ENTERPRISES: Facilitation of introduction and expansion of information systems for increasing the internal efficiency of companies, in the development of new products and technologies or improvement of existing products and technologies, for increasing the efficiency of supplier-customer relationships, development and improvement of technical infrastructure and basic software, outsourcing of information systems or their part in companies .	II.	31.5. 2009

in several other programmes. Therefore, particularly in the first programme there is a risk that all the funds allocated for this support will not be spent.

[5] Other calls within OPEI include support of Eco-energy technologies, building of Training centres, Business real estates, development of Business consultancy services, and Marketing activities.

Table 3: Launched calls in OP Enterprise and innovation related to knowledge intensive activities, ctd.

Interv. area	Programme	Cal No.	Appl. dead
4.1 Increas. innova-tion perfor-mance	INNOVATION — PROJECT: Facilitation of product innovation (improvement of technical and use values of products, technologies and services), process innovation (improvement of production processes and provision of services), organisational innovation (introduction of new methods of organizing company processes and cooperation with other firms and public institutes), marketing innovation (introduction of new sales channels).	III.	31.12 2009
	INNOVATION — PATENT: Acquisition of patents, utility models (abroad and in the CR), industrial designs and protected trademarks (only abroad).	I.	31.7. 2009
4.2 R&D industr. capaci-ties	POTENTIAL: Strengthening capacities in the SMEs already engaged in research and development and deepening collaboration of SMEs with R&D institutions, the establish-ment or expansion of development centres (departments) aimed at research, develop-ment and innovation of products and technologies, including specific software and appli-cations (part of the products or technologies).	II.	30.11 2009
5.1 Coop-eration platforms	COOPERATION — Technology platforms: Development of sector groupings associating key stakeholders at the national level that focus on RTD projects.	I.	31.12 2008
	COOPERATION — CLUSTERS: Development of cooperative groupings associating businesses, regional authorities, universities, RTD workplaces.	I.	30.4. 2009
	PROSPERITY: Establishment and further development of science and technology parks, business incubators, and technology transfer centres, creation of a network of business angels which encourage the establishment and development of innovative firms.	I.	31.12 2009

Source: Ministry of Industry and Trade (updated on 30.5.2009).

OP **R&D for innovation** concentrates support into four priority areas, the key two are repre-sented by large investment projects intended for building European-level excellence centres, and regional R&D centres (with stronger application focus). So far an informal pre-selection has been made at the Ministry of Education with the recommendation on the support for 6 large-scale investment projects, including IT4Innovations (see box 3), submitted by the Technical University in Ostrava, Northern Moravia (in partnership with other academic institu-tions in the region (including the Masaryk University in Brno) and in close cooperation with the local IT cluster including more than 40 companies). This is the only large-scale project submitted from the region, the development of which can be markedly influenced by its suc-cess (the region was seriously hit by structural crisis in the past related to heavy industry restructuring). As to the regional R&D centres, the first call was closed at the end of April, 2009, and included two (multidisciplinary) projects explicitly related to IT domain (with strong multidisciplinary accent): Research centre for information, communication, and biomedical technologies, submitted by the Technical University in Brno (Southern Moravia), and Centre for security, information, and advanced technologies by Tomas Bata University in Zlin (Cen-tral Moravia). Next calls are to be opened in the second half of the year, 2009. The remaining OPEC priorities involve the support for popularization and commercialization of R&D, and for human resource development related to R&D activities.

Box 3: IT4Innovations – Example of a large-scale project for ICT Centre of Excellence (www.it4i.eu)

The project was motivated by the increasing requirements of the application sphere and foreign investors related to the rapid growth of information technologies, to which the current R&D capacities do not respond adequately, mainly due to their fragmentation and technical underdevelopment. The infrastructure created by IT4Innovations without only function as a high-quality partner for the application sphere, but will also motivate industry to develop new and innovative products and solutions based on the effective use of modern technologies. The overall aim is to create a mutually interlinked, closely cooperating workplace focusing on the following 4 key areas of activity: (1) **IT4People** *(Information Technology for People)* focusing on improving quality of life in society via the develop-ment and provision of new services based on modern IT. (2) **SC4Simulations** *(Supercomputing for Simula-tions)* focusing on supercomputing and research into the development of new methods and algorithms of compu-tational mathematics with subsequent application in multidisciplinary simulation tasks (stress and deformation analysis of complex systems, shape optimization, fluid flow problems, materials design, biomechanical simula-tions, etc.). (3) **EC4Innovations** *(Embedded Computing for Innovations)* focusing on the research and develop-ment of sophisticated embedded systems applied in mechatronics and innovative medicine.(4) **The-ory4IT** *(Theory for Information Technology)* focusing on basic research into the development of new and non-traditional computing methods, based on disciplines such as softcomputing, formal methods, knowledge-oriented and biologically motivated algorithms.

2. ICT sector and market (driver of domestic economic development)

ICT sector includes remarkably diverse knowledge-intensive segments of the fragmented (multinational) value chains. Increasing knowledge intensity of value added represents a major condition for sustained competitiveness of the more advanced countries. A crucial role in technological development of ICT sector plays the process of international standardization. The ability to uptake and imitate technological knowledge (largely facilitated by the less efficient enforceability of intellectual property rights) makes the catching up process easier for the countries with less developed knowledge base (though capable of effective application of foreign technology) in combination with cheaper inputs. An important role in technology upgrade has been played by FDI inflows in the CR, accelerated since 2004 (first in ICT manufacturing, later followed by strategic and ICT services). Despite the above average productivity and export performance of the (mostly green-field) FDI companies in the CR, their knowledge intensity remains rather low, with negligible requirements for local R&D input. The dramatic expansion in FDI sector, at the same time, increased the skill mismatches at the labour market, pushing up the wage levels, and therefore deteriorating the position of smaller (domestic) companies.

The ICT sector (for its alternative definitions see box 4) is one of the few Czech industries with sufficient growth potential and opening new opportunities in foreign markets. Although the local market is still relatively under-saturated, it is too small for expanding companies. Entering the industry may require little investment in some areas, but is highly demanding in terms of professional qualification and successful business model. The unhindered entry to the market (including the removal of trade barriers thanks to the widespread globalization) helps increase competitive pressure and supports continuous innovative efforts. The key challenge for ICT sector development lies in the capacity to move up the quality ladder towards the knowledge more intensive production (segments), possibly in top value added, rather narrow specialized market niches. Such a transformation, however, is extremely difficult to achieve, as it cannot be based on foreign technology alone. Local knowledge inputs and sufficient financial resources (venture capital) must be readily available together with effective entrepreneurial strategies (knowledge based entrepreneurship).

Box 4: Definition of ICT sector

(1) The NACE rev 1.1 industries included in the ICT Sector (OECD, 1998, 2002, 2007): **Manufacturing:** 3000: Office, accounting and computing machinery, 3130: Insulated wire cable, 3210: Electronic valves and tubes and other electronic components, 3220: Television and radio transmitters and apparatus for line telephony and line telegraphy, 3230: Television and radio receivers, sound or video recording or reproducing apparatus and associated goods, 3312: Instruments and appliances for measuring, checking, testing, navigating and other purposes except, industrial process equipment, 3313: Industrial process equipment, **Services:** 5150: Wholesale of machinery, equipment and supplies (part only, where possible), 5151: Wholesale of computers, computer peripheral equipment and software, 5152: Wholesale of electronic and telecommunications parts and equipment, 6420: Telecommunications, 7123: Renting of office machinery and equipment (incl. computers), 72: Computer related activities

(2) A more aggregated (operational) definition (NACE Rev.1.1): **Manufacturing:** 30: Manufacture of office, accounting and computing machinery, 32: Manufacture of radio, television and communication equipment and apparatus, 33: Manufacture of medical, precision and optical instruments, watches and clocks, **Services:** 64: Post and telecommunications, 72: Computer and related activities.

Note: The **CZ-NACE rev. 2** classification was introduced since 2008. It was not used in the presented ICT sector statistics, with exception to the latest data on month indexes development (since 2007 onwards): **Manufacturing:** 2610: Manufacture of electronic components and boards, 2620: Manufacture of computers and peripheral equipment, 2630: Manufacture of communication equipment, 2640: Manufacture of consumer electronics, 2680: Manufacture of magnetic and optical media, **Services:** 5820: Software publishing, 6100: Telecommunications,, 6200: Information technology service activities, 6310: Data processing, hosting and related activities; web portals, 9510: Repair of computers and communication equipment.

(3) Most consulting firms specialising in ICT market analysis (Gartner, IDC, Forrester Research and others) usually use a different classification: **IT market** includes (a) hardware: servers (Windows/x86, Linux, Unix, special servers), PCs (desktop, notebook), peripheries, office equipment, (copiers, fax machines, multifunction equipment) network cards, cables and wires, routers, switches, (b) software: standard (boxes), tailor made, (c) services: consulting, project services, implementation/system integration, system administration and operation, outsourcing including ASP, technical and other support, helpdesk, equipment servicing (under and post warranty), training, financing and other additional services. **Telecommunications** include (a) telecommunication technology, (b) telecommunication services: landline services, mobile services.

The size and dynamics of the **ICT market** may be roughly approximated in terms of related expenditure (in % GDP), which has been consistently higher in the CR than the EU average (see table 4). An important indicator is expenditure on telecommunication technology, mainly due to the modernization investment improving the outdated equipment (infrastructure). This indicator is high for all new EU members. On the other hand, developed economies show a more prominent share of spending on information technology.

Table 4: ICT expenditure in % GDP, 2006

	EU-27	EU-15	Top EU	Czech republic		
				2004	2005	2006
Total	5.7	5.6	..	6.7	7.2	7.6
Information Technology	2.7	2.7	3.8 SE	2.8	3.0	3.2
Communication Technology	3.0	2.9	7.6 LV	3.9	4.2	4.4

Source: EUROSTAT – Information Society Statistics, 30. 5. 2009.

2.1 Economic performance of ICT sector and its structure

More specifically, the set of key economic indicators show the developments in ICT sector in the CR, differentiated in terms of manufacturing and services, company size (the role of large companies with more than 250 employees), and ownership (domestic vs. foreign). The compatible data are available for the period 2002-2007. In all the key indicators (see table 5) the increasing and dominant role in ICT sector has been played by foreign affiliates and large companies (with the exception of their share in the total employment). The weight of services vs. manufacturing industry largely depends on the type of indicator, services strongly dominate in value added (which is influenced by their lower share of intermediate consumption and import dependence). While turnover shows up strong average growth rate, the employment increase was less pronounced, and the investment even decreased. Growth performance of foreign companies (their gap vs. domestic sector) is markedly higher especially in value added.

Table 5: Turnover, value added, employment, investment in ICT manufacturing, and services in the CR

	% Turn-over		Growth	% Value added		Growth	% Employ-ment		Growth	% Invest-ment		Growth
	2002	2007	12.5	2002	2007	7.8	2002	2007	3.8	2002	2007	-2.6
Manuf./servic.	46.1	54.3	16.2/8.8	20.6	20.3	7.4/7.9	45.2	45.6	4.0/3.6	15.4	42.9	19.5/-10.0
Dom../foreign	43.2	24.5	0.4/19.1	65.4	29.9	-10.1/24.2	62.4	44.6	-3.3/12.1	51.2	22.7	-18.0/6.8
Empl. 250+	72.5	71.2	12.1	69.3	66.4	6.9	51.7	50.7	3.3	85.1	66.5	-7.3

Note: Growth as annual average rate in %. The shares in the totals are presented for manufacturing ICT and domestic companies. Source: CZSO – Information economy statistics, own calculations.

ICT sector contributes markedly to the **foreign trade**, both to export and import flows. The share ICT goods in the total export in 2006 represented 14.2 %, with annual growth rate 18.5% in 2002-2006 (the share in the total import made 15.0%, the average growth rate 13.7%). Trade balance has been still negative, though gradually improving. Trade flows are strongly concentrated geographically, more than 51% of exports go to only four countries (Germany, Netherlands, UK, and France), similarly more than 58% of imports (China, Germany, Netherlands, Japan). The commodity structure of trade flows is typical for assembly type of production, i.e. the bulk of imports include electronic components assembled into computers. As to the foreign trade with ICT services, compatible data are available only from 2005. The trade flows make much smaller share compared to ICT goods (about 7,7% of their trade turnover in 2006), the balance was consistently slightly positive.

Structure of ICT sector is analyzed for manufacturing and services (see table 6). The structure of ICT manufacturing shows the dominant (and in time mostly increasing) share of electronic parts (321) and, to a lesser extent, consumer electronics (323) subsectors, particularly in investment. Slightly different are the positions in terms of productivity (value added per employee). The highest was achieved in the subsectors control devices in industry (144% of ICT manufacturing) and in communication technology (129), in contrast, the electronic parts productivity is the lowest (84). In services, the decisive is the position of telecommunications (642), however, some segments of computer technology show up quite impressive development,

especially consultancy in software (722), with more than half of the ICT services employment. Due to the high capital intensity, telecommunications show also the top productivity level (186% of ICT services), within computer technology services, the subsectors the performance is much weaker, mostly around the average or below average values.

Table 6: Turnover, value added, employment, investment in ICT manufacturing, and services in the CR (in %)

	Turnover			Value added			Employment			Investment		
	2002	2007	Gr.	2002	2007	Gr.	2002	2007	Gr.	2002	2007	Gr.
30 – computers, accessories	**40.6**	**38.4**	**15.0**	**11.0**	**10.6**	**6.7**	**15.3**	**14.8**	**3.3**	**25.8**	**9.1**	**-2.9**
32 – electronic parts and eq.	**43.4**	**53.1**	**21.0**	**62.7**	**62.0**	**7.2**	**58.1**	**61.7**	**5.2**	**57.7**	**81.4**	**28.1**
321- electronic parts	11.6	13.5	19.8	28.0	25.0	5.0	33.2	29.4	1.4	23.0	35.2	30.1
322 – communication technology	19.8	13.6	7.8	23.0	16.1	0.0	14.0	12.4	1.4	22.8	4.7	-12.8
323 – consumer electronics	12.0	26.0	35.5	11.7	20.8	20.6	10.9	20.0	17.4	11.8	41.4	53.6
33 – precision dev., instr. (part)	**16.1**	**8.5**	**19.5**	**26.2**	**27.4**	**28.0**	**26.6**	**23.5**	**12.1**	**16.6**	**9.5**	**29.6**
332 – precision devices	13.8	5.4	-3.5	21.6	17.4	2.8	22.3	16.6	-2.0	14.3	6.4	1.8
333 – control devices in Industry	2.3	3.1	23.0	4.6	10.0	25.2	4.3	6.9	14.1	2.3	3.1	27.8
642 – telecommunications	**63.4**	**53.0**	**5.0**	**70.0**	**57.7**	**3.8**	**43.8**	**31.1**	**-3.3**	**91.8**	**74.4**	**-13.7**
72 – computer technology	**36.6**	**47.0**	**14.4**	**30.0**	**42.3**	**15.6**	**56.2**	**68.9**	**7.9**	**8.2**	**25.6**	**13.1**
721- consultancy in hardware	1.8	2.1	12.6	1.4	1.5	10.2	2.3	2.6	6.8	0.7	0.6	-13.9
722 – consultancy in software	25.6	37.0	17.2	21.1	34.0	18.7	39.0	52.5	9.9	4.8	20.0	19.7
723 – data processing	4.6	3.9	4.9	4.2	3.8	5.5	8.5	7.2	0.2	2.1	1.8	-13.0
724 – databases	0.5	0.8	20.5	0.3	0.8	27.2	1.0	1.6	15.0	0.1	0.5	20.0
725 – repairs and maintenance	3.6	3.0	4.6	2.6	2.1	3.3	4.9	4.8	2.9	0.4	2.8	34.5
726 – other	0.5	0.2	-8.4	0.3	0.2	-3.3	0.6	0.3	-11.8	0.1	0.1	-5.5

Note: Growth as annual average rate in %. The shares in the totals are presented for manufacturing and services. Source: CZSO – Information economy statistics, own calculations.

ICT activities in the CR are extremely concentrated **regionally**, as can be seen in the shares of all the available indicators, especially in services (see table 7). As to the number of enterprises, in manufacturing, just three regions involve 44% of the country total, even more in services (52%). Slightly different is the regional structure of ICT employment. The dominance of Prague is less pronounced in manufacturing, even if the regional concentration is rather high again (three regions make for 45% of the total ICT employment). In services, the regional concentration is extremely pronounced. Prague alone makes for more than 40% of the total employment, followed at rather large distance by the region of South Moravia (together they involve 55% of the country employment). Size concentration in the CR favours large companies (250+) in manufacturing, where they make for 62% of the total employment (together with 100+ they represent 76%), in services, however, only 41%, where the second most important size group includes small companies (with less than 20 employees, making 23% of employment in the sector). The total number of large companies in ICT sector made 81 (of them 47 in manufacturing), medium-large 109 (51 in manufacturing).

Table 7: Number of ICT enterprises and employees in CR regions, 2007

Region (NUTS 3)	Enterprises				Employment			
	Manufacturing		Services		Manufacturing		Services	
	No.	%	No.	%	No.	%	No.	%
Praha	1 235	**17.7**	7 198	**28.0**	6 560	**11.0**	19 516	**40.2**
Středočeský	969	**13.9**	2 937	**11.4**	5 715	9.6	1 881	3.9
Jihočeský	429	6.1	927	3.6	3 331	5.6	4 579	9.4
Plzeňský	185	2.6	2 651	10.3	3 902	6.5	1 900	3.9
Karlovarský	133	1.9	553	2.2	1 016	1.7	154	0.3
Ústecký	502	7.2	1 863	7.3	2 305	3.9	1 350	2.8
Liberecký	229	3.3	473	1.8	962	1.6	773	1.6
Královéhradecký	276	3.9	1 167	4.5	4 527	7.6	1 671	3.4
Pardubický	255	3.6	948	3.7	9 651	**16.2**	1 403	2.9
Vysočina	434	6.2	746	2.9	1 688	2.8	940	1.9
Jihomoravský	856	**12.2**	3 301	**12.9**	10 355	**17.3**	7 272	**15.0**
Olomoucký	398	5.7	1 069	4.2	1 755	2.9	1 595	3.3
Zlínský	602	8.6	914	3.6	4 772	8.0	1 465	3.0
Moravskoslezský	626	9.0	2 717	10.6	3 205	5.4	4 002	8.3

Note: Employment in services only for NACE 72. Source: CZSO – Information economy statistics, own calculations.

2.2 Performance and structure of ICT market

An alternative view of ICT developments presents the European Information Technology Observatory (EITO) which estimated the value of the **local market** for IT segment at EUR 3.2 bln in 2007 (see table 8) while the value of the communication technology market at EUR 4.3 bln. Overall, ICT grew 8.4% in 2007.

Table 8: Value of Czech ICT market (in EUR mln)

	2006	2007		2006	2007
ICT total	6914	7494	Communications total	3999	4279
IT total	2915	3215	- accessories	464	475
- hardware	1034	1166	- Classic. network	1019	1036
- software	598	659	- mobile network	2222	2419
- IT services	1017	1117	- other	294	349

Source: EITO (2008).

The Czech ICT market long-term growth was rather impressive over the past ten years with 9.6% on average between 1998 and 2007 (see table 9). To a large degree, the good performance reflects the initial technology backwardness. As demand is being satisfied, the growth is gradually slowing down and is expected to stabilise in the medium-term outlook at levels common in West Europe, i.e. 2-4% per annum. In terms of the three basic segments of the information technology market, the share of hardware has been consistently falling in favour of software and services, which means that customers are becoming increasingly sophisticated. In other words, they already overcame the initial stage of acquiring hardware and now want to put it in efficient use in order to increase competitiveness of their companies.

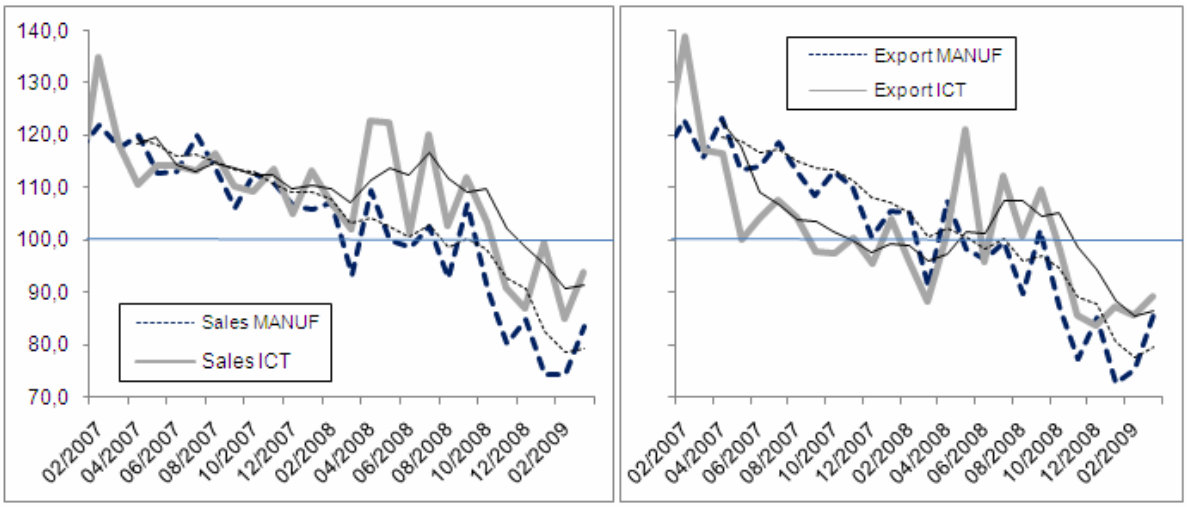
Table 9: Annual growth in the Czech ICT market (in %)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Growth %	17.5	-2.0	29.7	6.7	9.6	10.8	6.3	5.1	9.6	8.4

Source: EITO (2000–2008).

It is indeed very difficult to predict an impact of current **worldwide crisis** to the Czech IT industry. Presumably, the exporters will be hit by the slowdown of Western European economies, but with the consequences not as severe as e.g. the automotive industry. The Czech IT export is oriented almost entirely to the businesses rather than consumers. B2B market in IT is relatively stable due to the long-term character of projects. Among the Czech IT managers and entrepreneurs, the cautious optimism seems to prevail now. The monthly data on sales and export developments in the CR (see figure 1) show rather consistent trend decline from the peak values in February, 2007 (on year-to-year basis), both in manufacturing total and in ICT, with worse position of the former (particularly in turnover). The slight improvement can be seen recently, starting in February, 2009, however difficult it is assess its sustainability.

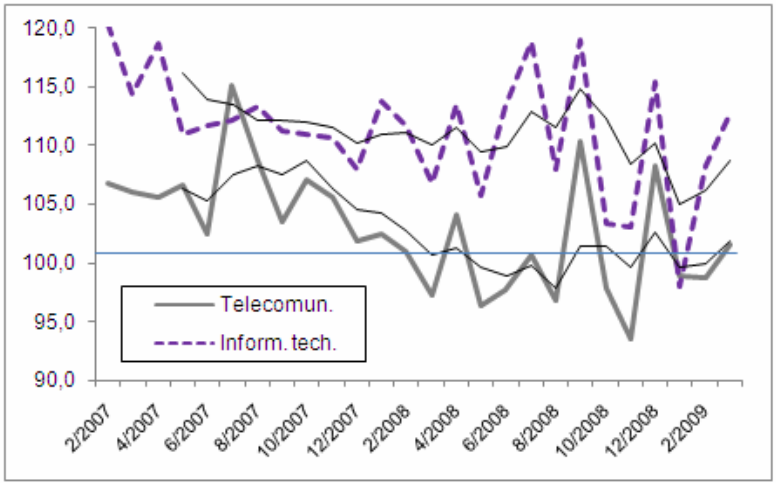
Figure 1: Sales and direct export sales, CR manufacturing total and ICT (monthly year-on-year index)



Note: From values in current prices. Source: CZSO – Fast information on development in industry, 30.5.2009.

As to ICT services (see figure 2), the telecommunications activities were hit by the economic fall much more seriously than information technology subsector (and more than services total) which also scored remarkably better than ICT manufacturing. In both ICT service subsectors the revival of sales came at the beginning of 2009, but again, its sustainability is still questionable.

Figure 2: Sales in CR ICT services (monthly year-on-year index)



Note: From values in current prices. Source: CZSO – Fast information on development in industry, 30.5.2009.

The Czech IT market represents approximately EUR 3.2 bln with roughly EUR 1 bln, or nearly one third of the total volume, attributable to **local production**. This includes nearly all IT services and a small portion of software and hardware production. In telecommunications, landline and mobile services are considered a local product while practically all devices and equipment used in these networks are imported. The vast majority of the industry leading global companies is represented in the Czech Republic. For example, Hewlett-Packard has around 800 employees in the country and another 1,500 will be added after its acquisition of DHL is completed. IBM ČR, SAP and several other companies have comparably strong staffs in the CR. All of these businesses are gradually abandoning their original model (importing products and later services) in favour of local, export-oriented production in the CR. Primarily, it brings software development and shared-service centres that provide various activities to foreign clients (from bookkeeping to network administration).

In 2007, the biggest **PC suppliers** in the Czech market were Acer, Hewlett-Packard and Asus (together amounting to nearly a half of total sales). Local producers have been forced to retreat from their previously strong positions. A good example is AutoCont, traditionally the biggest Czech PC company whose assembly plant in Ostrava used to produce up to 20% of all computers sold in the CR (2000-2002). The holding is currently intentionally moving away from PC production and its core business now focuses on IT services, administration and development of corporate IT systems as these activities offer a higher added value and there is less competition. Globally, the PC market seems to be heading towards a situation with a handful of giant companies outsourcing production to China. Naturally, the Czech industry follows the same trend. However, the CR is also one of the target countries of outsourcing.

Table 10: Biggest PC suppliers in the Czech market, 2007

	Acer	Hewlett-Packard	Asus	Fujitsu Siemens	Dell
Number of PCs	179 567	163 786	118 363	78 375	78 100
Growth in %	32.3	32.9	71.9	37.3	8.4

Source: IDC and Inside.

The **IT wholesale market** is currently going through consolidation. There are now approximately ten major distributors and about 2,000 end ICT sellers but price pressure (to minimise margins) has been cutting the number of competitors. Some companies have been forced to leave the business while others are merging. The biggest Czech ICT wholesale company (without a

competitor of comparable size) is the eD'system + BGS Levi conglomerate with annual turnover over CZK 18 bln. The second and third biggest distributor – Tech Data Distribution and ATComputers – have turnover of about CZK 6 bln each.

Hardware development for the mass market requires heavy investments and is the domain of technological superpowers – USA, China, Japan, Scandinavia. The only perspective for success for Czech companies lies in niche markets. An example could be the Prague-based 2N Telekomunikace, a manufacturer of private branch exchanges for small companies and security systems for connection to the telephone network including software. There are several businesses with even narrower specialisations but all have troubles securing capital for their further growth.

Box 5: PC production in the CR

Production of market PCs has been on the decline in the Czech Republic and currently yields no more than 200,000 machines a year, i.e. 20% of Czech demand. However, the CR is an important exporter of PCs and other electronic devices (such as LCD monitors), mainly through the local subsidiary of the Taiwanese company Foxconn Technology Group (the world's biggest IT OEM, i.e. manufacturer of products for other brands). In the Czech Republic, Foxconn assembles mainly Hewlett-Packard and Acer computers (approx. 4 million a year). Its plants in Pardubice, Rudná u Prahy and Kutná Hora employ 5,000 people and generate CZK 88 bln in revenue (in 2007), making the company the country's second biggest exporter after Škoda Auto. Other companies have founded large assembly plants in the Czech Republic as well: Panasonic in Plzen (LCD TV sets and monitors) and IPS Alpha, a consortium of Hitachi and Panasonic, in Žatec (LCD monitors). Production mainly consists of assembling devices with little added value. It does not require highly skilled workforce and has been placed in the Czech Republic primarily due to relatively low production cost (especially cheap labour). As this advantage is gradually slipping away, the producers may be expected to close down their Czech plants and move to cheaper locations.

The situation of Czech **software** companies offers a better picture, as they are able to easily present their products online and attract customers as well as potential investors for little cost. Several Czech software companies have successfully expanded to foreign markets. We may cite two projects developed by Roman Staněk whose company NetBeans was bought by Sun Microsystems for USD 10 mln and another of his companies (Systinet) was acquired by Hewlett-Packard for USD 105 mln.

Companies with mixed **software/services** business model offer tailor-made solutions or provide personalised data processing. The leading Czech businesses in this area include Adastra, Unicorn and Cleverlance. Czech software developers are among the best in the world in computer games (Illusion Softworks, Geewa) and PC security (Grisoft/AEG, Alwil Software). Software602 has enjoyed a prominent position since its phenomenal success in the early 1990's when it developed the first text editor for the Czech language. Today, the company mainly focuses on supporting documents for public administration. Several multinationals, such as Logica. Skype, Sun Microsystems, Red Hat Software and IBM, have opened large development centres in the Czech Republic, too.

The Czech Republic has built rather a strong position of an **IT service provider for foreign markets**. The country's largest outsourcing centres serving customers in West Europe have been opened by DHL and Accenture (Prague), IBM (Brno) and TietoEnator (Ostrava) and smaller companies are following their example. These centres are often set up with little publicity for fears of negative reactions due to loss of jobs in the companies' home countries.

A greater expansion of outsourcing in the Czech Republic has been consistently prevented by the (worsening) lack of **skilled workforce** due to the widening gap between the number of graduates and demand in the labour market. As a result, there is great pressure to increase wages, which clashes with the business cost efficiency concerns and may discourage other potential investors. Active demand for new IT employees in the country is currently around 6,400 persons a year and keeps growing each year. Czech universities produce only a half of the demanded graduates (a solution could be more openings in study courses, re-qualification or opening the market to experts from less developed countries). Outsourcing centres have pushed demand for IT specialists to new levels. Wages are growing due to the lack of suitable candidates, especially for programmers. This favours foreign companies. Local smaller businesses cannot compete on this front and have been losing their former competitive

advantage (based on high-skilled and relatively cheap workforce). Most small IT companies blame the situation on investment incentives given to big corporations in the past.[6]

ICT services currently offer the most interesting prospects in the industry both for suppliers and customers. From supplier perspective, services allow companies to realize higher added value and higher margins. On the other hand, customers need ICT services to achieve attractive rates of return on ICT investments because technologies alone often bring little advantage if not coupled with continuous efforts to put them to efficient use. Only in the past few years has there been a development where corporate clients stop seeing ICT as an indispensable operating expenditure and instead look at it as a (potentially dispensable!) investment with defined parameters, including rates of return. Connecting corporate ICT with business processes and goals of the organisation has thus gained in importance. This opens opportunities for the development of ICT services that promise to realize such objectives. Rates of return on ICT investments, however, are often hard to measure since there are no reliable metrics while soft methods (such as questionnaires on subjective customer and user satisfaction) cannot be entirely trusted.

Multinational suppliers clearly dominate the Czech ICT service market. Companies tend to be specialised (vertically or focusing on a specific types of services and skills) rather than universal. Market leaders are Hewlett-Packard and IBM, followed by approximately 15 other important companies. Many other smaller companies often act as sub-suppliers to larger contracts. Telefónica O2 is in a very interesting position as it says its future lies to a certain degree in ICT services as would seem natural given the general trend of convergence between IT and telecommunications. An analogy may be found in Germany with T-Systems, a subsidiary of the German Telekom. The most important market for IT services still consists of traditional industries: financial institutions, public administration, telecommunications and the car industry. However, there has been increasing demand from healthcare as well, especially for large and sophisticated hospital information systems for image processing (PACS).

Table 11: major ICT service providers in the Czech market, 2007 (in CZK mln., in %)

	Sales 2007	ICT services	Growth in %	ICT in % of services
Hewlett-Packard	6132	3931	68.9	64.1
IBM	..	3250	25.0	..
Logica	1750	1715	42.9	98.0
Telefónica O2	63000	1700	190.1	2.7
SAP	..	1400	15.2	..
T-Systems	2648	1311	-4.7	49.5
Siemens IT Solut. & Serv.	1321	1078	-15.6	81.6
Unicorn	1205	1058	25.8	87.8
Adastra	1061	1040	43.1	98.0
Asseco Czech Republic	1030	850	-7.2	82.5
Ness Czech	..	850	29.2	..
TietoEnator Consulting	850	833	85.1	98.0
ICZ	1378	758	-18.4	55.0
AutoCont CZ	2 353	677	21.5	28.8

Source: Companies listed according to revenues from ICT services. Source: Inside.

A promising growth area is that of services related to **mobile telephony**.[7] At the end of 2007, the apparent mobile penetration of the CR (i.e. number of active SIM cards per capita) reached

[6] In addition to the relatively low cost (with the exception of wages demanded by top experts, although there are very few such positions), international comparisons often state cultural compatibility with the West and political stability among the CR strengths as an outsourcing centre host country. On the other hand, weaknesses include underdeveloped language skills, poor government support (despite a massive investment incentive programme in the past) and labour unavailability.

[7] In post-communist countries that inherited spectacularly bad telecommunications infrastructures from the previous regimes, mobiles became an easy way to get telephone connection. Since its inception in 1995, the Czech mobile market has been booming. At the same time, interest in landlines and the number of fixed telephone customers has been dropping. Mobile phones became available before the fixed network had had a chance to improve technically and cut prices. Furthermore, mobile telephony has always been a deregulated, fully competitive market. Many people,

127%, which is the sixth highest rate in the world (the latest figures vary according to the methodology used by different sources and the immediate situation in the market), the first being Estonia with just under 150%. This means that mobile carriers can no longer attract new clients, with the exception of children. Instead, they rely on three key business strategies: sale of additional services (data, MMS, TV in mobiles, paid content, ring tones, games, etc.), luring customers from rivals and switching customers from pre-paid services to standard deals that offer greater reliability and higher revenue for the carrier.[8] An important trend is represented by Smartphones, basically pocket computers and telephones in one, often combined with satellite GPS navigation. Their popularity opens new opportunities for mobile carriers (combined voice-Internet-multimedia-navigation services) as well as software developers due to the growing demand. The CR, being something of a mobile superpower, has a lot to offer and gain in this area.

Box 6: Specialization of ICT service sector in the CR (the case of South Moravia)

Based on the field research undertaken in 2008 (see Berman Group, 2008), the four specialization segments have been identified in ICT (service) sector with diverse knowledge intensity of production and/or sources of their competitive advantage: (1) **SW production**, including development and sale of the own software (programmes) intended for the market of end customers (company or domestic users), (2) **Custom SW**, including services of system integration and job-order development software for a specific customers, (3) **Outsourcing IT activities**, including IT support, (4) **Sale, service and consultation**, including those for computer equipment.

Most companies specialize in complex provision of custom-made IS based on specific needs of individual customers (most frequently companies). Complex provision includes consultation, project design, implementation (including system integration) and related service. The highest importance of R&D activities is listed by companies dealing in production of proprietary off-the-shelf SW. For all companies from this segment, SW development represents the key activity, upon which the existence of the company is built. But they mostly are not implementing their own research, but contact with its latest achievements is essential (mainly IT, but also fields into which developed software is implemented). Also most companies place great emphasis on system proprietary development from the segment of system integration and IS custom-made for the customer. It is this capacity to flexibly and quickly develop specific solutions for customer specific needs that plays the decisive role in competitiveness. Some companies in this segment perform development activities to be prepared for an expected demand. As opposed to the first segment however, they do not create demand by their development, but rather react to it, which requires a somewhat unique approach and competence in comparison with the first category. FDI affiliates in the second segment (SI and IS custom-made solutions) do not undertake internal development in the region, they rely on their parent knowledge sources, only adjusting them to local needs (for which, however, some internal development capacity is necessary). Neither outsourcing IT nor activities in basic consultation and sale of IT are founded upon (or even generate) R&D. They can be considered as rather routine economic activities not requiring a continuous build-up of know-how.

Specialization segments in ICT services	**1** Development of proprietary software for sales to end customers	**2** Devel. of software and IS on job order, system integration, consultation	**3** Outsourcing IT activities	**4** Sale (of IT products), service and basic IT consultation
Entrepreneurial strategy	anticipation of demand-development-sale-profit based on sold quantity	profit based on sale of skilled IT work, incl. analysis, management, consultancy	profit based on sale of (often lower) skilled IT work	supply of hw, sw, services, profit on sold quantity, service hours etc.
Geographic market scope	mostly national with prospect to world expansion	mostly national or neighboring countries	often foreign/ large companies at national market	mostly local, regional (national)
No. of customers	large	small	small	medium-large
Unit price	low	high	high	low
Risk	high	medium	low	medium
Autonomy	high	medium	low	high
Marketing complexity	high	medium	low	high
Creativity	high	medium	low	low
Wages	varying	higher	lower	lower
Growth potential	high	medium	low	low

therefore, bought mobile phones not as an addition to their landline but instead of traditional phones. This has been typical for all post-communist European countries that are today the leaders in mobile penetration even on the global scale (given the current low number of fixed lines). In West Europe and the USA, mobile phones were slower to take off because they had to fight strong competition from high-quality fixed networks.

[8] O2 has been trying to deal with the declining number of landline customers primarily by offering alternative uses, mainly ADSL data connection for broadband Internet access and digital TV broadcasting. The number of landlines keeps falling despite these efforts (in 2008, the total number fell under two million).

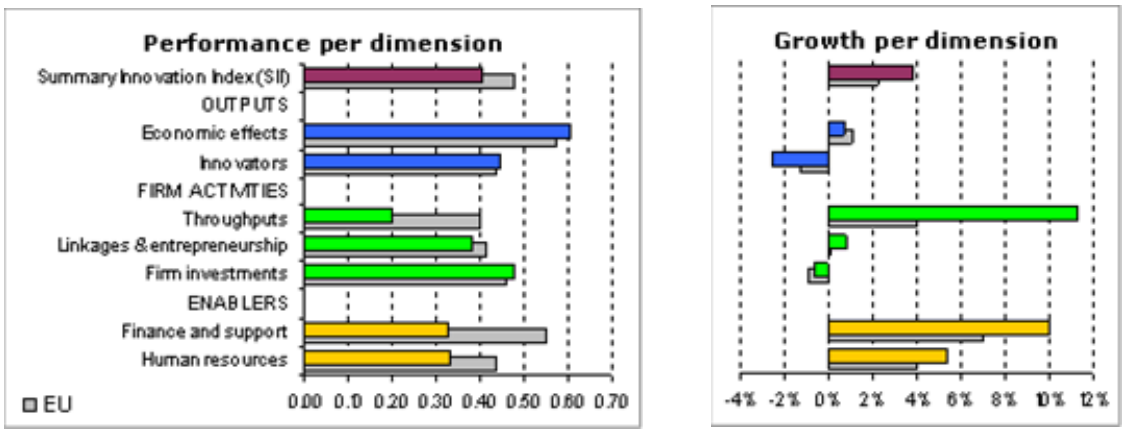
3. Knowledge intensity and its policy support in the CR

The position of the Czech Republic is typical of the group of the less developed EU members, i.e. with prevailing reliance on adopted technologies, own innovation capabilities being still less developed. This position in development of innovation-based competitiveness represents a great challenge for formulation and implementation of the supporting policies. The Czech Republic is one of the best among the new EU members, which means an average position among EU-27. The key issue therefore is the form ad scope of the impulse that might stimulate a shift towards **above-average results** in knowledge production and their use in knowledge high intensive industry and service activities. This shift is absolutely necessary for sustainability, let alone increase of innovation-based competitiveness. The new EU members, due to their medium-technology intensive structure in the traditional manufacturing industries, are most threatened by competitors from the emerging Asian and Latin American economies. Their qualitative position in global economy begins to change – they penetrate more and more to the segments with higher technology intensity, they are able to offer attractive conditions for technology intensive foreign investment, including above-average production of highly educated human resources. EU countries will inevitably face external competition on ever higher levels of technology knowledge.

The ongoing system changes, the growth of external openness, use of technology transfer and development of educational and research capacities in the CR have favourably affected above all the so-called **absorption capacity** for successful technology catch-up. Thanks to integration into supra-national value (mainly production) chains the share of industries with higher (medium-high) technology intensity has significantly increased, while their actual knowledge intensity has still remained low. There is the prevailing reliance on adopted technologies (external technology knowledge) with eventual modifications for local needs. In just a small number of companies innovation activities (whether in-house or external) represent a strategic source of their competitiveness. Another problem is strong specialisation to traditional manufacturing industries with rather limited technology potential and strong sensitivity to decreasing cost competitiveness. Underdeveloped remains the segment of industries with **high knowledge intensity** (based on top technology and development of own innovation capacities) and thus high value added both in manufacturing and in services (the so called science-based industries, or industries of specialised suppliers).

In terms of **European Innovation Scoreboard 2008**, the Czech Republic is among the group of moderate innovators with innovation performance below the EU27 average but the rate of improvement is above that of the EU27 (see figure 3). Relative strengths, compared to the country's average performance, are in firm investments, innovators and economic effects and relative weaknesses are in throughputs, finance and support and human resources.

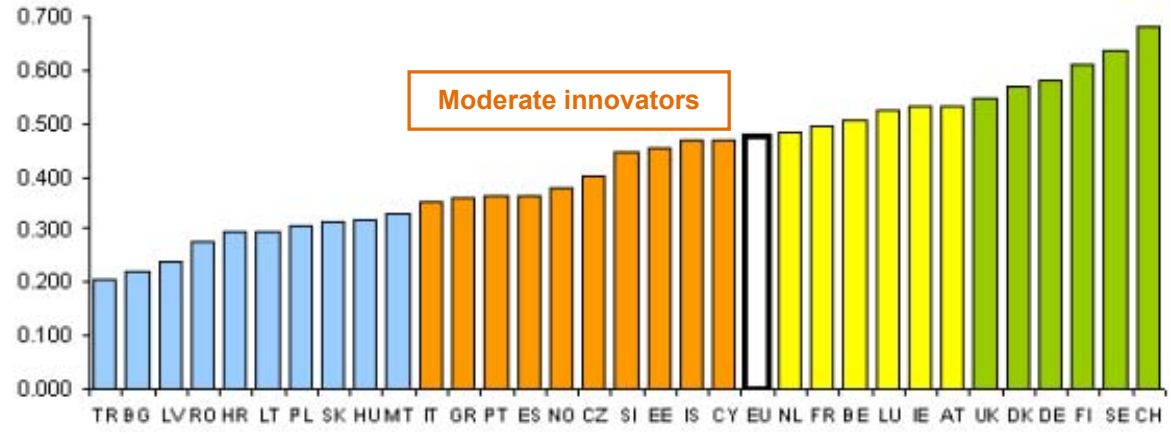
Figure 3: Innovation dimension for the CR (and relative to the EU), 2008



Source: European Innovation Scoreboard 2008 – Country profiles.

Over the past 5 years, throughputs, human resources and finance and support have been the main drivers of the improvement in innovation performance, in particular as a result from strong growth in community designs (26.0%), technology balance of payments flows (13.1%), S&E and SSH graduates (14.1%), Private credit (11.8%) and broadband access by firms (40.1%). Performance in Innovators has worsened, due to a decrease in SMEs introducing product or process innovations (-2.6%).

Figure 4: Innovation performance – Summary innovation index 2008

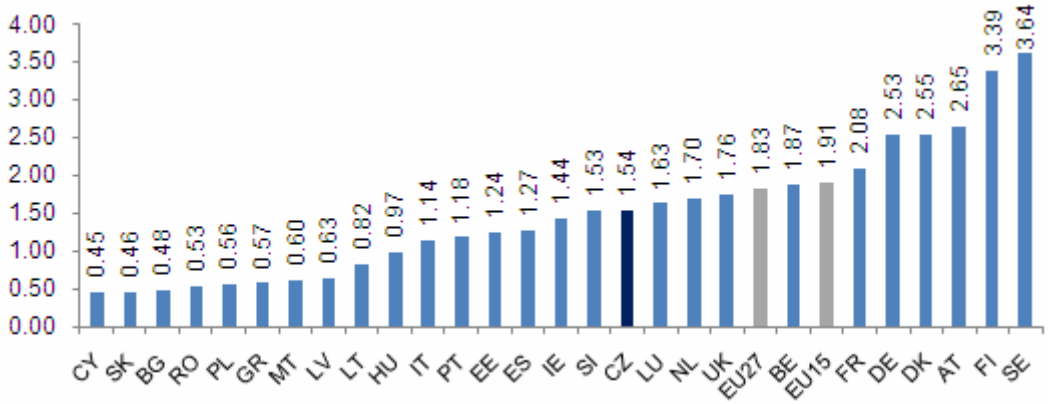


Source: European Innovation Scoreboard 2008 – Country profiles.

3.1 Innovation inputs and outputs in the CR

Research and development capacities are a significant source of innovation efficiency in the traditional sense. According to indicators that look at the extent of financial and human resources invested in this area, the CR occupies a leading position in the group of new EU countries (see figure 5). Moreover, it has come considerably closer to the EU-15 average in recent years. In the case of gross expenditure on research and development, the lag of the CR behind the original members of the EU stood at 0.75 percentage points in 2002, but was only 0.37 percentage points in 2007. Even then, however, a level of expenditure amounting to 1.53 % GDP cannot be regarded as sufficient since it does not make even half of the 3% target set out as part of compliance with the Lisbon strategy. However, only Finland and Sweden have been able to meet this target of the other members of the EU. The feasibility of actually reaching this target level has recently been the subject of ever fiercer debate because this could be significantly conditioned by the industrial structure of the individual countries (a varying share of industry with different demands on the added value of research and development).

Figure 5: Gross expenditure on research and development (GERD, in % of GDP), 2007-2008



Source: EUROSTAT – Structural indicators 30.5.2009.

The expenditure on R&D in the CR is strongly **regionally concentrated** in Prague, and the regions of Central Bohemia and Southern Moravia, where almost 70% of all the expenditure

on R&D in the Czech Republic is invested. This concentration is the highest in the governmental sector, in which the above-mentioned regions receive almost 90% of the invested resources. In the business sector the most significant amount of resources is concentrated in Prague and Central Bohemia (55% in total). Prague and Southern Moravia have the most significant share of the whole country's expenditure in the university sector. The share of other regions in the total expenditure on R&D is significantly low. The lowest expenditure on R&D is in structurally affected Karlovarský and Ústecký regions. R&D employees are markedly concentrated in Prague, Central Bohemia and Southern Moravian Region. Whereas in the business R&D sector these regions have a share of almost 65%, in the governmental sector the proportion is almost 90%. The lowest number of employees in R&D can be found in regions with the lowest expenditure on R&D, i.e. Karlovarský, Ústecký and Vysočina regions.

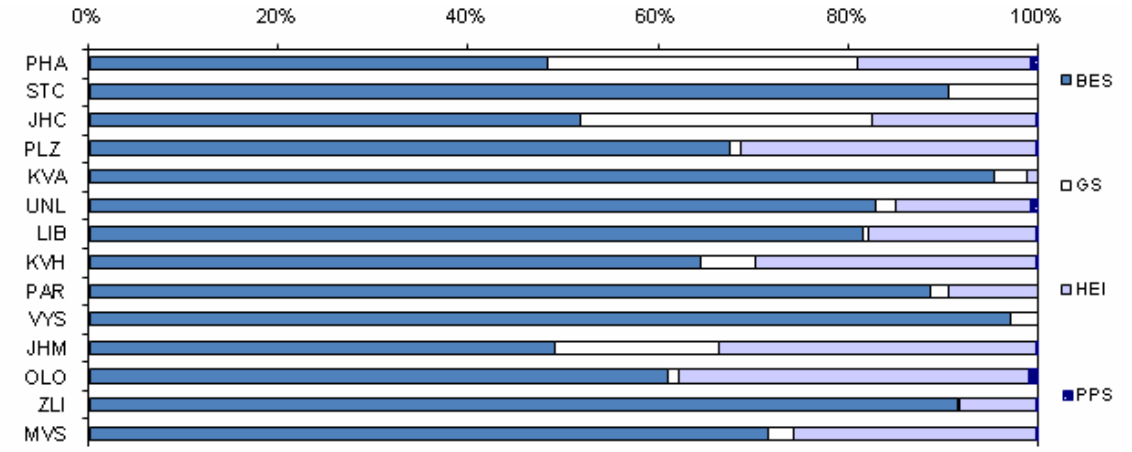
Table 12: R&D employment and expenditure and their institutional structure, CR

	% Total empl.		% GDP	
	2002	2007	2002	2007
Czech Republic	**0.52**	**0.94**	**1.20**	**1.54**
Praha	**1.36**	**2.43**	**1.74**	**2.70**
Středočeský	**0.60**	**0.89**	**2.94**	**2.76**
Jihočeský	0.34	0.58	0.62	0.94
Plzeňský	0.32	0.68	0.68	0.78
Karlovarský	0.06	0.05	0.13	0.11
Ústecký	0.11	0.24	0.29	0.30
Liberecký	0.34	0.70	0.85	1.09
Královéhradecký	0.27	0.54	0.55	0.79
Pardubický	0.48	0.88	0.99	1.36
Vysočina	0.18	0.25	0.40	0.36
Jihomoravský	**0.61**	**1.11**	**1.25**	**1.58**
Olomoucký	0.33	0.68	0.73	0.92
Zlínský	0.32	0.57	1.04	1.03
Moravskoslezský	0.27	0.50	0.60	0.77

Source: Czech Statistical Office – Research and Development indicators for the CR, own calculations.

The structure of R&D expenditure and employment according to institutional sectors reflects the nature of the regional innovation system either relying more on business sector or the government sector (Prague, South Bohemia, Hradec Králové, Southern Moravia), or the university sector (especially the Regions of Southern Moravia, Plzeňský and Olomouc). The uneven distribution of R&D results in individual regions reflects the uneven distribution of R&D capacities and resources. The highest number of patent applications submitted at the Industrial Property Office of the Czech Republic in 2000-2007 come from the Prague region (31.6%), followed by Southern Moravia (12.1%), Central Bohemia and Northern Moravia.

Figure 6: Sectoral structure of R&D expenditure in the CR (2007)



Source: Czech Statistical Office – Research and Development indicators for the CR, own calculations.

Regional distribution of **human resource quality** in the CR has been also very uneven. All the included indicators show again the dominant role of Prague (together with Southern Moravia region) with the above average share of S&T in active population (57.5% as compared with only 35.1% in the CR). Even if this share has been increasing in the country in average, the increase in Prague is markedly higher, mostly thanks to the role of more demanding jobs in knowledge intensive services (their share in total employment reached 44.2% compared to 25.7% in the CR), both in government and business sectors. In the Czech Republic an above-average share of employees in high-tech industry and in high-tech services can be found in Prague and the Pardubický region. The employment rate in medium high-tech sector is the highest in Central Bohemian, Plzeňský, Ústecký and Pardubický regions. The lowest employment rate in medium high-tech industries is in Prague, which is caused by the space, manpower and materials intensive production being forced out of the city and substituted by more advanced sectors of industry and services.

Prague region is also exceptional in terms of its educational structure, as the share of active population with tertiary attainment doubles the CR average (28.2% vs. 14.4%). Prague attracts exceptionally higher share of university students (37% of the CR total and 38% of all the pupils and students in the region). Prague is also markedly attractive for foreign university students (58% of the CR total) and offers above average opportunities for PhD studies (46% of the CR total), the quality of which is strongly supported by cooperation between Academy of Sciences and universities both in teaching (accreditations for the programmes are provided together with the cooperating university) and in joint R&D projects and workplaces. At all universities and most large faculties the highest share of students lives in the region where the universities are based or in neighboring regions. The character of the migration of university students is influenced to a great extent by the range of study fields offered in individual regions of the Czech Republic. The highest influx of university students is recorded for Prague and Southern Moravia due to both their central location inside the Czech Republic and the wide range of study fields being offered. From the point of view of a well-balanced development of regions there is a risk that students do not return to regions of their origin after completing their study. This internal brain-drain is one of the most serious reasons for regions lagging behind in comparison to Prague.

A major concentration of expenditure in transport engineering is clear in **industry-based division**, in particular in the production of motor vehicles. The share of this branch of industry in overall business expenditure on R&D in the processing industry is more than two-fifths and roughly half when including the production of other means of transport. The significance of this industry in the use of human resources in R&D is actually considerably lower at around a half. The research and development sector, which is specific, is dominant in service industries. Other branches of industry with prominent activity from the perspective of research and development include computing, in particular the creation of software and consultation in this field.

A parallel comparison of the industry-based structure according to expenditure and number of employees shows certain significant differences. For example, the manufacture of motor vehicles had a share of 39% in expenditure on research and development, whereas the share of employees is around half. The production and repair of machinery is the exact opposite. These differences ensue from the different demands of the individual branches of industry or sectors on financial and human resources. Other inter-sector differences can be found in patent and innovation activity or (in a more comprehensive view) in the effectiveness of innovation activities. The industry-based structure of economic activities in a given country can therefore strongly influence the values of aggregate information about, for example, the demanding nature of GDP or the labour force on research and development.[8]

[8] The so-called structural effect points to this problem, e.g. in an economy with a predominance of industries with lesser demands on research and development it is essentially impossible to achieve a more significant increase in the share of R&D expenditure in GDP without a shift in the structure to technology more intensive industries.

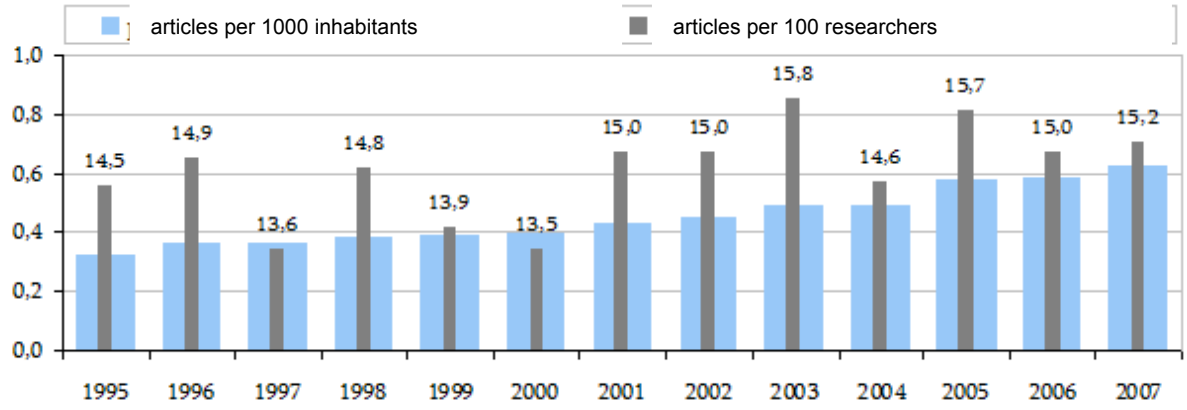
Table 13: Business enterprise expenditure R&D (BERD) and R&D personnel (FTE) by branches of manufacturing industries and services in the CR (in %)

	2001	2003	2005	2007
15–22 Food, textiles, wood	1.74	2.34	2.25	2.57
23–24 Coke, crude oil, chemicals	8.78	9.73	8.44	8.97
25 Rubber and plastics products	1.57	2.25	4.21	3.08
26 Other non-metallic products	3.81	4.58	3.25	2.16
27 Basic metals	2.47	1.61	2.46	1.98
28 Metallurgy	3.44	2.76	2.12	1.91
29 Machinery and equipment	10.86	11.43	12.62	13.61
30 Office equipment, computers	0.06	0.21	0.27	0.18
31 Electrical machinery	3.50	5.25	4.70	5.21
32 Radio, television equipment	4.26	5.89	7.70	5.92
33 Medical and optical instruments	2.09	3.10	2.58	7.96
34 Manufacture of motor vehicles	50.90	43.03	42.32	39.23
35 Other transport equipment	6.11	6.76	6.43	6.71
Manufacturing industry	100.0	100.0	100.0	100.0
50 – 52 Sales and repairs	4.04	8.33	7.12	5.63
60–64 Transport, communications	2.89	1.76	0.36	3.43
65–67 Financial intermediation	0.02	0.36	3.04	12.99
70–74 R&D, business activities	79.98	82.66	83.68	73.34
72 Computer and related services	8.32	24.53	26.61	21.02
722 Software and consultancy	8.04	18.50	19.99	15.80
73 Research and development	65.52	47.88	45.77	42.33
74 Other business activities	6.04	9.83	10.89	9.81
75–99 Public admin., other services	13.08	6.84	5.76	4.62
Services	100.0	100.0	100.0	100.0

Source: Czech Statistical Office – Research and Development indicators for the CR, own calculations.

Scientific and technical efficiency is currently low in the CR, which roughly corresponds to the level of development of the domestic knowledge base. The question is whether it is possible to expect a more significant efficiency shift in a short space of time with the resources available and at the given level of this development. The relative number of publications expressed per capita has risen significantly, but is still less than the level of the EU-15 (see figure 7).

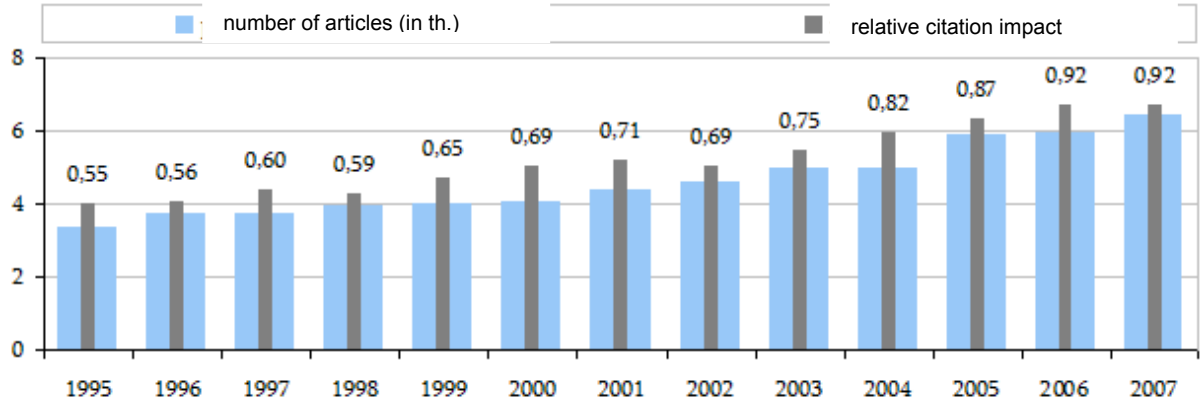
Figure 7: Scientific and technical articles in the CR



Source: Thomson ISI National Science Indicators, CZSO, RDC CR, own calculations.

The relative **citation impact** of Czech publications is also very low (in spite of rapid growth). This is expressed as a percentage of the impact factor for the relevant country and the impact factor of the group of countries (see figure 8). The average relative quotation impact of Czech publications is only about two-thirds of the OECD level. The position of individual fields of science in the CR is considerably different in this regard (however, the data are not comparable across individual disciplines). Technical specialisations (0.94) and biomedical sciences do fairly well (the best score is made by clinical medicine, 1.10), but the impact of publications from the social sciences is negligible. More specifically, computer sciences get underaverage citation impact (0.82).

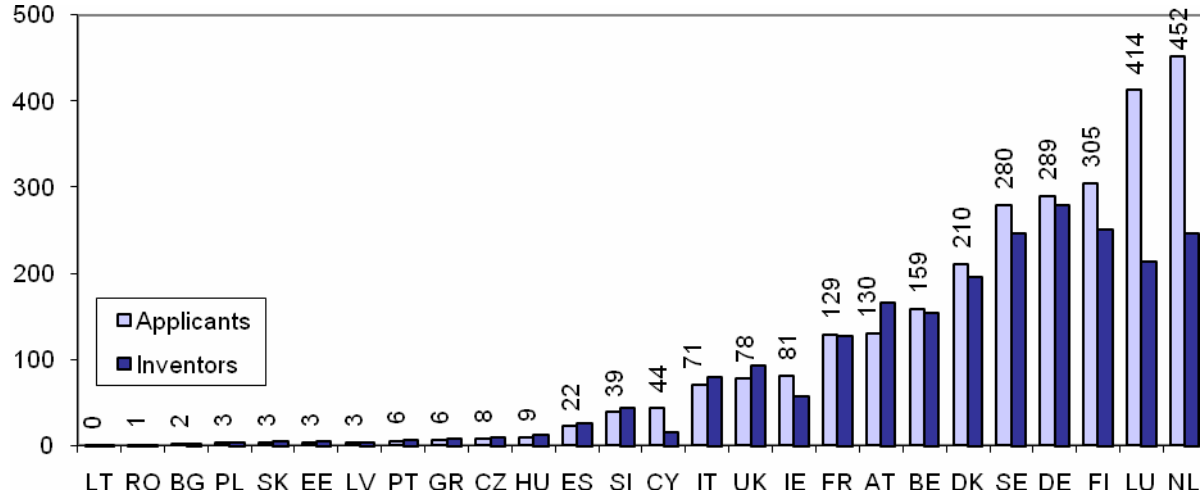
Figure 8: Relative citation impact in the CR



Source: Thomson ISI National Science Indicators, CZSO, RDC CR, own calculations.

An analysis of **patent activities** comes out even worse than that of publication activity. In spite of the fact that the Czech Republic has seen a respectable growth tempo in the number of patent registrations, its lagging behind more advanced countries has not fallen for this indicator. A growing difference is clear when distinguishing according to applicants and creators to the detriment of applicants. The reason for this could be the fact that the multinational corporations that conduct R&D in the CR that leads to patents tend to register these at their own parent head offices. One other explanation is that the output of local innovation activity is ceded to foreign organisations even before patent applications are submitted.

Figure 9: Number of patent applications at the EPO per million inhabitants (average 2004–2006)



Source: EPO; EUROSTAT – New Cronos, Population and Social Condition (at 30.5.2009), own calculations.

The unfavourable situation in international patent activity is caused by a whole range of factors. The lesser (economic) significance attributed to the protection of intellectual property itself when breaking into foreign markets is undoubtedly one such factor or the below average demands of economic activities on research and development and other innovation activity. The level of protection of intellectual property rights has been very poor in the Czech Republic for some time now (in particular its enforceability), which also corresponds to the generally low development of a knowledge society. On the other side of the coin, the Czech Republic is one of the countries with an above-average level of regulation for almost all aspects of business, which is a particularly unsuitable combination of characteristics with significant anti-innovation effect.

The Czech Republic has shown up a relatively low level of **international co-operation** in R&D&I projects so far, including the exploitation of opportunities offered by the European Research Area. Even if the involvement of Czech research teams in the international Eureka Programme is satisfactory, the participation in EU Framework Programmes does not reach the desired level yet. In addition, Czech research workers only scarcely work as coordinators of European projects.

Participation of Czech teams in the 6th Framework Programme of the EU (FP6) was somewhat higher than in the previous FP; however, the p.c. indicators place the country only at 22nd position in the EU-27, with the number of project coordinators being even the lowest. Development trends seem positive, in comparison with FP5, the total financial support in FP6 will almost double for the Czech teams (from 68 mil. to 125 mil. EUR). In terms of thematic priorities, less focus so far has been placed to the three best financed areas (Life sciences, Genomics and Biotechnologies; Information Society Technologies and Nanotechnologies, Nanosciences, Multifunctional Materials), as compared to more consistent success in sustainable development and the EURATOM programmes. Participation in the programmes supporting mobility of research workers has increased as compared to FP5. Contrary to the other new member states, which often participate in support or preparatory projects, Czech teams participate in demanding research projects (Integrated Projects, STREP projects and Networks of Excellence), and almost in the same proportion as teams from the EU-15. As to the sectoral structure, while participation of Czech universities is lower than it is the case for the EU-15 or the other new member states, participation of industry on the other hand is relatively high. Participation of Czech industry in aerospace and global climate change research has been quite successful.

As universities and academic research institutions are the most frequent participants in the FP, the distribution across the regions is very uneven because the academia type teams are mainly concentrated in the region of Prague (625 participations), followed by Brno in Southern Moravia region (150 participations). Thus almost ¾ of all participants in the CR come from only the two academically most important regions. The two regions with high share of academia teams (HEI and government research institutes) have also higher average requested contribution. About 64% of the requested contribution is spent in the region of Prague itself (15% in Southern Moravia). Prague (and the Southern Moravia region) has the highest share in research projects realized either by IPs or STREPs. Prague has 45 participations in the Network of Excellence (NoEs), which represents 7% of all Prague's participations in the FP6. On the other hand, Prague has the smallest share of participations (only 5%) in projects for SMEs (CRAFT and CLR). Participation in project for research infrastructures (I1 and I3) is considerably influenced by the national-wide decisions; again Prague shows the highest share of participation. Because of the sectoral structure of the knowledge base, Prague shows the smallest share of industrial participations (bellow 10%).

The data on country structure of regional contracts in FP projects show the dominant role of the largest countries (Germany, UK and France make together for 36.2% of foreign participants), followed by the triple with shares of more than 5% (Italy, Spain and Netherlands making together 20.5%). The thematic structure of the requested budget and contracts is concentrated into four priorities which together make about 50% of the totals for the Prague region. They include sustainable development, global change and ecosystems (43 contracts, 9% of budget), policy support and anticipating scientific and technological needs (40 contracts, 7% of budget), life sciences, genomics and biotechnology for health (37 contracts, 20% of budget), information society technologies (34 contracts, 14% of budget). Around 12% of budget goes to human resources and mobility, and to nanotechnologies and nanosciences, knowledge-based multifunctional materials and new production processes and device.

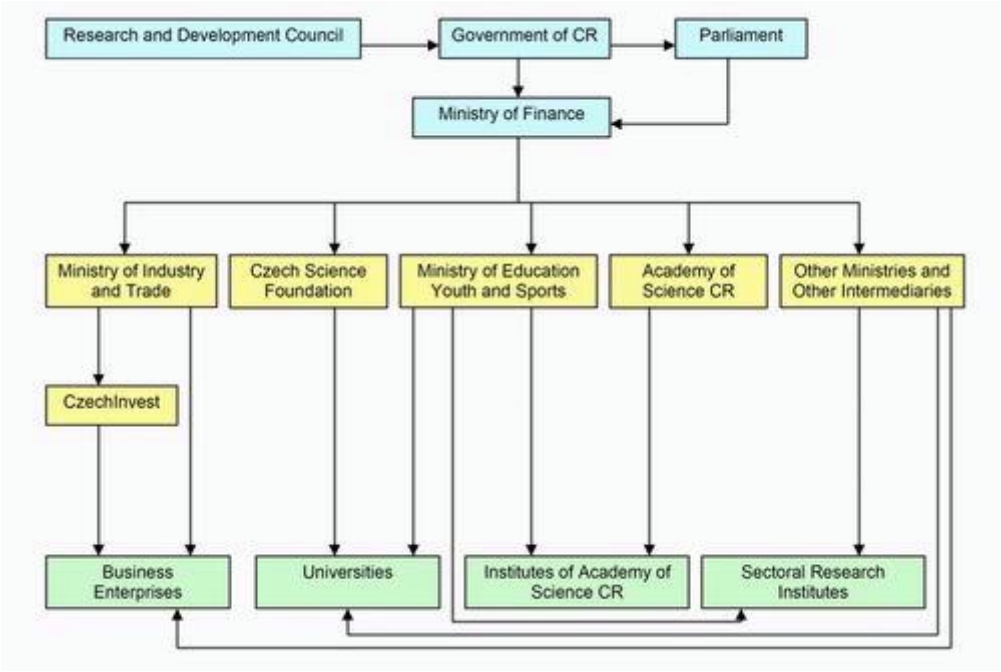
3.2 National policy for R&D&I support

Research policy priorities in the Czech Republic have been largely reflecting the catching-up process of the national innovation system and cross-country learning, mostly within the EU

landscape. The recent (and still ongoing) formalization of the related policy discussion has been fueled by the increasing pressure on the reform of the R&D system in general, and its more pronounced shift toward innovation outcomes (effects) in particular. So far the proposed reform focuses mostly on administrative aspects of the R&D&I system and processes (including the introduction of related legislative measures). No broader strategic framework or thematic focuses have been formulated for the system per se which would reflect the economic development and industry specialization specifics of the country. This missing strategic anchor of the R&D&I system in the CR (including the virtually absent policy mix dimension) just copies its absence in the policy-making structures themselves. The R&D&I competences are fragmented and principally rather autonomously assigned and undertaken by the key providers of public R&D resources and decisively influenced by the main recipients of these funds from academic sectors. No adequately authoritative body is responsible and therefore capable for fulfilling the conceptual, analytical and coordinating roles at national level. Consequently, the level of strategic intelligence in R&D&I policy is extremely low in the CR. It has been largely shaped by the imminent interplay of the involved interest groups (with chronically weak role of business sector constituency as compared to academics).

System of R&D&I support in the CR has been rather complicated (see figure 10). At the policy level, the key role is assigned to Research and Development Council which prepares a proposal for allocating public funds for R&D, including the division of funds among individual responsible bodies. This proposal is submitted to the government for approval and then incorporated by the Ministry of Finance into the proposal of the state budget. The R&D Council includes representatives of both public (universities, Academy of Sciences) and private research performers (Association of Research Organisations and individual large companies). The R&D Council has three thematic committees which provide further field-specific advice concerning the long-term orientation of R&D in their respective professional areas (Life Sciences, Non-Life Sciences and Engineering, Social Sciences and Humanities), plus a special Commission on the Evaluation of Research Results and a Bioethics Commission. The prime minister formally chairs the R&D Council, however, its agenda is mostly set and managed by the general secretary, i.e. public official.

Figure 10: System of R&D&I support in the CR



Source: ERAWATCH – Country profile.

At the operational level, once the proposal is approved by the government, the Ministry of Finance allocates the funds to the individual providers, with the Ministry of Education, Youth and Sports and the Academy of Sciences representing the largest providers of public R&D funds. The former has a special position among other ministries in relation to publicly supported R&D. It is responsible for the preparation of national R&D policy/strategy documents, as well as 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 represents the main body responsible for public support of 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 acts as important R&D funders (both in the form of project and institutional funding).

The **R&D support measures** available in the Czech Republic can be classified according to the key providers of the individual programmes (95% of public support in 2008): Academy of Sciences of the CR (24 %), Grant Agency of the CR (6.7 %), Ministry of Education (41.7 %), Ministry of Industry and Trade (13%), Ministry of Health (4.5%), Ministry of Agriculture (3.6%), Ministry of Environment (0.2 %) and other state bodies. R&D activities are financed from public funds institutionally (58 % in 2008) or through grants (project-based). The most important providers of institutional support include Academy of Sciences for its institutes (34.6 % of institutional support in 2008) and Ministry of Education mainly for (public) universities (51.2 %). Indirect support to R&D can be also provided through structural funds, with the exception of Prague region. (This limitation has been circumvented formally by proposed location of some projects within the OP R&D for Innovation close behind the border of Prague in the surrounding region of Central Bohemia.). Indirect fiscal support includes tax deduction of R&D costs. In 2007, two regions in the CR absorbed 72.4 % of the total public R&D support (57.6 % came to Prague, the rest to South Moravia). Thematic R&D programmes are practically absent in the Czech R&D landscape, although minor exceptions exist, but their financial significance is negligible.

Institutional funding is channeled primarily through the Ministry of Education, Youth and Sports as well as the budget of the Czech Academy of Science and also through the smaller budgets of a number of sectoral ministries. The grants are predominantly of a generic nature, i.e. without a distinct thematic focus. No support for research infrastructures of national significance exists so far. However, the proposal for reform of Czech R&D system published foresees the possibility of creating a dedicated funding mechanism for this type of infrastructures.

A major part of the institutional funding in the Czech Republic takes the form of research plans. This instrument represents the main multi-annual funding mechanism of research organizations (typically departments at universities, or a research team combining researchers from several departments, or a research centre of Academy of Science) which is presented in the form of a research proposal with concrete objectives but is used as the main source of institutional funding of most universities and of a major part of research institutes of Academy of Sciences. It is difficult to classify this type of funding as a pure institutional funding (it is meant to cover a major part of the running costs, but the recipients are expected to perform R&D activity and to present results at the end of the project). This type of funding represents around 75 % of the total public R&D funds classified as institutional funding, of this amount 45 % goes to funding of research intentions at the Academy of Sciences, 35% for funding of research intentions at the universities and the remaining 20% is distributed among public research institutes (8% of total), state research institutes (5% of total), private entities (4%) and the state (military and security services). The largest share of competitive grants is administered by Ministry of Education, Youth and Sport (25% of the total), Ministry of Industry and Trade (2 %), Czech Science Foundation (15%) and Academy of Sciences (10%). The remaining 15% is administered by a number of sectoral ministries (Ministry of Health, Ministry

of Environment, Ministry of Agriculture, Ministry of Transport, Ministry of Defense, Ministry of Interior etc.) or other public bodies (Czech Mining Agency, State Agency for Nuclear Safety).

The only **thematic R&D programmes** with amounts dedicated to research in a given field are minor parts of the National Research Programme II administered by Ministry of Education, Youth and Sports. These sub-programmes cover the fields of health and quality of life, ICT and socioeconomic research. In addition, four Czech sectoral ministries that have significant R&D budgets have also their R&D programmes - Ministry of Health, Ministry of Transport, Ministry of Environment and Ministry of Agriculture. These are in essence multi-annual thematic research programmes too, with competitive calls for proposals for funding of research activities in the given field, but at the same time, are used as a source of institutional funding for some selected research institutes controlled by the given ministries (e.g. National Institute of Public Health, Institute of Health Information and Statistics of the CR, Centre for Transport Research, Institute of Agricultural and Food Information, Research Institute of Agricultural Economics) and also as a means of funding policy research for the needs of the ministry. The budgets of these ministries therefore represent a mix of instruments (ranging from project funding, through policy research for the use of the ministry/procurement to institutional funding of given research institutes), an aspect which has been criticized by the Council for Research and Development.

Public support for private R&D includes competitive grants, again without any distinct thematic focus, managed by Ministry of Industry and Trade. The key programmes comprise Tandem, Impulse and Sustained Prosperity. The programme Tandem has specifically focused on supporting partnerships (collaborative activities) between public and private entities. The intersectoral linkages have, in the past, been further supported by several programmes funded from the Structural Funds under the OP Industry and Enterprise, namely the programmes supporting clusters, technology parks, technology transfer centres, as designed by the Ministry of Industry and Trade for the period 2004-2006. These programmes aimed mainly at business networking and promotion of innovation activities, so the relevance for these programmes for R&D activities was rather indirect. This, however, is likely to change in the near future with the OP Enterprise and Innovation (2007-2013) which should have a more direct relevance for R&D (technology platforms, regional growth poles based on R&D, broader spectrum of measures in favour of protection of IPR and commercializing R&D results etc.). Some activities in favour of commercialization of R&D results and protection of IPR are also planned under OP R&D for Innovation.

R&D policy in the field of human resources has, up to now, not included any explicit measures to make research careers more attractive or to attract researchers from abroad. This situation is likely to change with the recently approved Operational Programme Education for Competitiveness (ESF) which should, among others, provide funding for integration of Czech and foreign researchers in Czech R&D institutions, measures to support mobility between academia and business sectors, as well as measure to popularize science and scientific careers.

R&D support for the private sector has included 100% deduction of R&D expenditure from the profit base used to calculate corporate tax (since 2005). The deduction can be made on a range of expenses including purchases of capital goods that will be used in research activities, patent and trademark registrations and evaluations of research outcomes by certified companies. Notably, this measure applies only to in-firm R&D, i.e. outsourcing of research activities and purchases of intangible research outcomes produced elsewhere (a license, for example) cannot be deducted. So far the exploitation of the instrument has been rather limited. No indirect measures in the field of IPR are currently planned or discussed. The only IPR measures foreseen are the ones planned under OP Enterprise and innovation and also OP R&D for innovation, i.e. direct measures for protection of IPR mentioned above.

Key R&D&I policy documents and strategy evaluation

National Research and Development Policy (2004-2008) defines governance principles and is to provide framework information to the related institutions, organizations and re-

searchers for their strategic decision-making. The National R&D Policy adopted by the Government is implemented through National Research Programmes (I: 2004-2009, II: 2006-2011). Priorities in the National R&D Policy are outlined rather broadly - as thematic and systemic (horizontal) areas. The systemic priority areas include human resources; international cooperation in research and development; regional aspects of research and development; exploitation of research results in practice; research evaluation. Thematic priority areas include safe, reliable and ecological power engineering for the future; information and knowledge based society (see box 7); life quality and safety; new materials and technologies; economic and social needs of the CR. Moreover, the policy deals with R&D evaluation, human resources, international cooperation, exploitation/application of R&D results. Principles and visions of the Policy are based on openness, flexibility and transparency in both its preparation and implementation. The interconnection between R&D policy and policies for other areas is also emphasized. Financing R&D is mentioned as the main implementation tool of the Policy, legal environment as an important background condition and information and technical infrastructure as a prerequisite of a modern R&D development.

Box 7: Information Society – TP2

Thematic programme II (TP2) of the National Research Programme I was approved by the Czech Government in April, 2003. The target of the programme is to support basic knowledge-oriented research enabling the development of information technologies and to apply this piece of knowledge, and the technologies based on it, in the production, communication and management spheres. Programme is divided into 4 sections (sub-programmes) with the following objectives: **(1) Intelligent decision making, management and diagnostic systems:** to work out the metodics of a concept of transport telematic systems with reference to their architecture, telecommunication, navigation and management support, to develop technically improved sensors and means for interaction between man and machine, to work out methods of intelligent data and knowledge processing for securing actual needs of technical diagnostics, to develop methods of artificial intelligence necessary to secure smart functions of decision-making and control systems, **(2) Information and knowledge management:** to develop research oriented on problems of knowledge management with regard to the needs of Czech industry (also regarding competitiveness of export),to concentrate on modern information network implementation, especially Grid, and on the development of ways of their effective use in different sectors, to develop techniques supporting the creation of large information systems and long-distance access to them and also develop systems of telemedicine, to develop the means necessary for storing electronic medical documents and to complete the project of a unified identification chip card for citizens, **(3) Communication infrastructure and technology:** creating a polyfunctional communication network including security and data protection, implementing digital TV and broadcasting, rendition of interactive information services, using terrestrial digital TV, developing devices and equipment working on principles of quantum, statistic and wave optics and for optic communication, **(4) Computer modeling and a concept of systems and processes**: to develop the means for mathematical and computer modeling, simulation of systems and visualisation, modeling and description of complicated integrated monolithic circuits and systems, including complex systems on one chip, making use of software engineering.

Long-Term Principal Research Directions (LPRD) were adopted by a Government Resolution on 1 June 2005 - as an amendment to the National Research and Development Policy: Sustainable Development, Molecular Biology, Power Sources, Materials, Competitive Mechanical Engineering, Information Society, Security (in 2006 the direction of Social Sciences was added). The set of LPRD is to be updated in the process of preparation of the next National Research and Development Policy (2009-2013) - as stipulated in one of the measures of the National Innovation Policy (2005-2010).

National Innovation Policy (2005-2010) attempted at a systematic support for innovation effects of R&D activities. The existing National Policy for Research and Development (2004-2008) was to be harmonized with the NIP, i.e. amended accordingly. For years a model based on the exclusivity of science and separating research results from application has been in place. A low percentage of practically exploitable research results is a consequence. Although there is a number of institutions, activities and initiatives supporting technology transfer, they do not fulfill their mission adequately. There are barriers, mainly legal, material, financial and even mental, hindering setting up companies exploiting research results achieved at public research institutions. A technology/innovation agency systematically supporting applied research and assisting transfer of its results into practice has been missing in the CR. A traditional risk aversion and a low prestige of those who through courage and their own work achieved success are difficult to surmount in the Czech society. Another obstacle

to innovation is represented by the public administration itself – starting with not properly defined competencies and finishing with a missing innovation concept. Regional support to innovation is delayed and chaotic. Public financing of research and development is fragmented and is not based on priorities. Research not linked to practical results is financed in the first place. Enterprises are not motivated to invest in their own research and do not create a sufficient demand for innovative solutions.

Evaluation of the related policy measures and strategies was rather scarce. A group of eexternal experts representing the key stakeholders have been therefore been asked to assess the perceived strategies or barriers in the **national innovation system** in the CR. The criteria for evaluation have been divided into six themes according to the research methodology used in the IMPLORE project, undertaken for the European Commission, and was adapted to the particularities of CR. In addition to answers using the given scale (from absolute agreement to disagreement), respondents also have option of presenting their views and comments and to rank the individual criteria according to their importance (each time within the given theme).

Policy supporting research and innovation. More than three quarters of the respondents expressed a negative opinion about the R&D&I policy in terms of coordination, systemic quality and long-term nature of the support measures. The problem of non-coordinated implementation of support activities as well insufficient linkage between research and innovation activities are perceived as the worst (nearly all respondents agree or rather agree with a negative rating). The short-horizon and non-systemic nature of the support policy is also emphasized in the comments of the respondents. In the case of public expenditure on research and innovation, the comments point out the problem of their inefficiency rather than their level as such. More than three quarters of the respondents see the problem of insufficient coordination between the administration and financing of R&D&I support as a problem, which corresponds to the results of the first part of the survey. The current form and realization of the national innovation policy (strategy) has also received very negative evaluation, which is also reflected in the greatly critical accompanying comments. Another problematic area is the implementation of long-term priorities and international cooperation. Insufficient political support to research and innovation activities, which is often limited to (pre-election) proclamative statements, is mentioned in particular.

Programmes supporting research and innovation. The barrier to implementation of support, which has received the worst rating, is non-transparent management, evaluation and financing of programmes. In their comments, respondents complain about frequent changes of conditions of programmes, administrative demands, their differences between the individual providers, unsuitability of criteria for providing support as well as for evaluation of the resource exploitation. More than three quarter of the respondents agree with the problem of a missing evaluation of innovation effects of programmes for research and development and the fragmentation of the expended resources and capacities. A smaller number of respondents see the insufficient consideration of the specifics of SMEs as a problem. Most of the respondents criticize the dilution of provided support as opposed to the need of its industry (field) concentration, disregard for the specific needs of innovation agents in the support programmes, and insufficient use of monitoring and evaluation to improve the efficiency of support. In the comments, this criticism is specified further, point out the scarcity of resources and thereby the need of their focus on a narrower range of progressive fields, while worries about the negative effects of such approach also appear. A major problem consists in the insufficient links between programme providers, their receivers and users of the results.

Academic sectors (universities and Academy of Sciences). The problem of insufficient motivation or support for commercialization of the R&D results is clearly perceived as the worst. Nearly three quarters of the respondents agree with the importance of this barrier. Dissatisfaction also appears very frequently in the case of cooperation with the business sector, while cooperation between the academic sectors themselves is perceived as negative to a lesser degree. More than three quarters of the respondents have a negative view of the

problem of poor participation in foreign projects and insufficient supply of researches. In the comments, the specifics of the above-mentioned problems are indicated – especially the shortage of high-skill human resources for research due to internal as well as external brain drain, institutional differences of the two academic sectors, which make their cooperation more difficult, the non-systemic nature of cooperation with the business sector. In the case of the academic sectors, objections appear again in the commercialization of the R&D results. Another significant weak point is the low attractiveness of studies in science and engineering fields for high-quality applicants. Insufficient differentiation of resources according to the quality of research institutes (including universities) is also noted. In the comments, the problem of studying engineering fields and the importance of the quality of their teaching on lower educational levels, as well as the problem of low financial enumeration of graduates are mentioned the most frequently.

Business sector. The most frequently mentioned problem is that of low expenditure and low absorptive capacity both in the case of research activities, as well as the ability to participate in support programmes. In total, these results mainly signalize a major barrier in low innovation demand, i.e. companies do not see innovation activities as sufficiently important for their competitiveness. In this case, the focus and effectiveness of support represent a fundamental problem, because even if resources are available, they will be used inefficiently. In the comments, the problem of insufficient support of modern technologies is mentioned specifically, as well as missing tax allowances for business spending on research and development purchased by other subjects (universities, for example). The greatest part of the respondents give a negative rating to the current support of cooperation between businesses and the academic sectors, as well as to the incentive for increase in the R&D&I spending in smaller companies. The implementation of fiscal incentives and support for start-up innovative companies is perceived negatively. In the comments, problems with the rendition of tax allowances are mentioned in particular (acknowledgement of R&D spending as tax deductible expenses on the part of financial authorities is so complicated, that smaller companies prefer not to undergo this procedure). The shortage of resources for specific needs (especially venture capital) is also criticized. A great unknown is the efficiency of the structural funds when used for support of business innovations. In the case of cooperation of companies with the academic sectors, the problem of insufficient protection of intellectual property in case of research supported from public resources also appears in the comments.

Regional innovation system. The greatest proportion of respondents consider the uneven development of innovation infrastructure and the missing regional dimension of the national policy of research and innovation support a problem, and in a smaller degree also the poor links between knowledge institutions and regional problems. In the comments, the current support of the creation and development of clusters is disputed, or their operation is not presently considered significant. Differences between regions in terms of the level of quality and functionality of regional innovation strategy are emphasized. Contradictory comments appear in the case of regional concentration of resources in research – their irregularity is partly seen as natural development, and partly as an unwelcome phenomenon, which needs to be resolved. The perception of the negative characteristics of RIS development is the strongest in the case of reduction of inter-regional differences in the R&D&I capacities and the motivation of regional agents to influence them. The support measures in cluster and innovation infrastructure development are perceived relatively positively. In the comments, objections appear to the proclaimed development strategies of the regions and the ability to implement actual projects with real contribution to regional development. The often formal demands of programmes without reflection of the actual needs are criticized (for example the exclusion of Prague from support from the structural funds, programmes for cluster support with a requirement on regional limitation). Consideration of regional specifics in the implementation of support programmes is being called for. Criticism appears due to the concentration of R&D&I capacities to Prague and Brno, which deepens the imbalance of regional development. Another problem is represented by the non-efficiency of the incubators and technology centres, which were mostly created with the support from the structural funds.

Box 8: Regional innovation policy framework in the CR

The history of regional policy itself has been quite short in the CR and its innovation focus remains very limited in regional development strategies and, above all, in policy practice. Only in January 2001, 14 self-governing regions were created in the CR. Attraction of FDI and development of industrial parks and business zones soon became the most distinct result of policy support which had most visible impact on the development in the regions. There is a noticeable change in the structure of FDI inflows into CR which can be seen in a gradual shift from low-cost, assembly plants in sector such as electronics to industries with higher value added such as automotive or precision engineering, to investment in strategic services (service centres – accounting and tax offices, call centres, IT support and repair centres) and, most recently, in applied R&D centres or technology centres. With the arrival of more sophisticated investors, the requirements for policy support shifted from the traditional hard instruments such as provision of infrastructure in industrial zones to soft measures such as development of local subcontracting networks, development of clusters and thematic networks, support to collaborative links with universities and research centres, as well as support for local start-ups and innovative companies through business incubators. However, in the Czech case the generally accepted recognition of the importance of local or regional approach in innovation and technology policy was still not fully accommodated and the need to involve local actors in the design and implementation of such policies had to face a number of challenges.

Following the decentralization of competences in 2001, the programming documents called Regional development strategy were formulated in individual NUTS3. However, they mostly lack a systemic approach to innovation activities and their integration into a comprehensive support of regional competitiveness. Apart from the weakness of the development actors at regional level (both the regional authorities and regional development agencies), the other obstacle to regional innovation policy is a general lack of co-operation and a weak application of the principle of partnership to regional development planning culture. This is most clearly demonstrated by a low involvement of the business community which often lacks organizations that would be representative of their interest and could act as an intermediary between the public sector and individual enterprises. Any business associations that exist in the CR are nation-wide organizations with very uneven regional roles. Moreover, there is a lack of awareness and understanding of the issue of innovation policy by regional policy makers. The elected regional representatives took from the outset were overwhelmed by the need to start execution of the most basic administrative functions. At the same time, the process of negotiation of transfer of new competences from the national level was still ongoing, sometimes being highly controversial and it has only been accomplished by 2005. The new regions had to fight the central administration for more financial resources and for more flexibility over their use, i.e. for a shift from state grants to more flexible own revenues. Consequently, the issues like innovation policy or R&D were, at least for the first years, clearly beyond the scope of majority of newly elected representatives. Moreover, the official competences of regions in the sphere of R&D (as enacted in the legislation) are marginal and the regions are often struggling to cover even the policy areas that are clearly assigned to them by the law.

The regional dimension of the R&D policy in the CR is included in the National Research and Development Programme as one of the system priorities; however, its outline is of just a very general and formal nature. Even though the underestimation of the regional structure of organizing the R&D process and the need for applying regional aspects in the R&D policy are both addressed, the proposed implementation reflects these needs insufficiently. Regional aspects of this policy are very difficult to grasp and, as a result, they are misunderstood and insufficiently enforced both at national and regional levels. The Harmonization NPR&D document covering the period of 2004-2008 with National Innovation Policy and other relevant documents of the EU and CR, put higher stress on regional aspects. This document proposes some new measures that are tied to structural funds, with regional aspects being only mentioned as a special assistance to regional institutions and small and medium enterprises in the regions when participating in EU R&D Framework programmes. More significant changes are expected from the National Research Programme III. The support is to be tied to structural funds, and especially to the OP Research and Development for innovation. The regional dimension of the R&D policy depends, to a large extent, on the activity of the entities applying for support. The state administration has only programme tools available - it may offer certain programmes, but their fulfillment depends on who applies for them.

The EU Structural Funds resources focused on R&D support should contribute to the development of infrastructure enabling through its sufficiently large and concentrated capacity to realize an excellent research. When deciding where to direct these sources, the sustainability of such infrastructure from the perspective of its effective operation after termination of support under SF must be necessarily taken into account. Considering the financial limits of public budgets, it is not possible to rely exclusively on public sources in financing this research infrastructure. The research infrastructure is to be profiled as excellent research centres open to both the educational and application spheres (Centres of Excellence), however, there must be mechanisms established for financing their operation. It is necessary to realize that only few top centres of excellence can be established in the CR, but the background of a high-quality university or other research organization must be provided continuously. Besides building the infrastructure for excellent research, it is necessary to use the EU Structural Funds resources to strengthen the potential of applied research in regions so that sufficient capacities are provided for realization of research according to the needs of regional development. With regard to mitigating regional disparities in economic development, the less developed and structurally afflicted regions must not be ignored. If it be to the contrary, the differences in economic level and development potential of regions could increase. It is also important to intensify the co-operation with other (mainly neighboring) EU countries in building the R&D capacities.

As the **most serious barrier** for development of a national innovation system in the CR was seen in the insufficient motivation or support of commercialization of the results of research in academic sectors. The frequently mentioned problem of poor cooperation between the academic sectors and companies is related to this characteristic. Low spending of companies on innovation activities reflects the currently inferior importance attributed to this source of competitive advantage (insufficient innovation demand). The area of research support, which is considered non-systemic and missing a long-term framework, is also perceived very negatively.

A. Policy supporting research and innovation
Public spending on R&I support is insufficient Long-term framework for R&I support for competitiveness is missing
B. Programmes supporting research and innovation
Too many programmes/activities lead to dilution of resources and capacities Unsuitable criteria and procedures in project selection
C. Academic sectors (universities and Academy of Sciences)
Insufficient motivation or support of commercialization of results Weak motivation between academic sectors and companies
D. Business sector
Low spending of companies on innovation activities Shortage of innovation-oriented companies capable of participating in programmes
E. Regional innovation system
Poor links between knowledge institutions and regional problems Regional dimension of the national policy for R&I support is missing

A clear setting of investment in research and innovations as important social and political priorities is the **most important strategy** for the development of a national innovation system in the CR. This viewpoint is mentioned as the most significant in the entire survey the most frequently. At some distance, it is followed by efficient support of commercialization of research results, attractiveness of science and engineering studies, differentiation of universities (faculties) according to the quality of their research and support of cooperation between businesses and the academic sectors.

A. Policy supporting research and innovation
Investment in research an innovation is an important social and political priority Implementation of long-term thematic priorities of R&I according to a national strategy
B. Programmes supporting research and innovation
Cooperation between NIS sectors required in support programmes Co-financing from public resources is a condition for public support programmes
C. Academic sectors (universities and Academy of Sciences)
Efficient support of commercialization of the results of research in academic sectors Studying science and engineering fields is attractive for high-quality applicants
D. Business sector
Support of cooperation between companies and the academic sectors Support of start-up innovative companies
E. Regional innovation system
Development of innovation infrastructure in the regions (TP, incubators) Reduction of regional differences in the level of research and innovation capacities

In the next part of the survey, respondents mentioned the main strengths and weaknesses, opportunities and threats for the Czech national innovation system (SWOT inventory). The characteristics, which appeared repeatedly among the answers, are listed in particular. In total, the most frequently mentioned opportunity as well as threat relates to the use of EU structural funds.

Strengths (what needs to be built on in future):

- Creative and innovative abilities of citizens, the ability to adjust to changing conditions
- Favourable educational structure (output of science and engineering graduates)
- High share of the youngest age group of researchers

- Growing awareness of the importance of innovations and cooperation between innovators for competitiveness
- Growing public as well as private spending on research, development and innovation
- Sporadic examples of positively evaluated support programmes
- Tradition and knowledge capacities of innovation-oriented industries (such as machinery)
- Professional and material capacities for research (especially in science and engineering fields)
- Developing innovation infrastructure (technology parks, incubators)
- Innovative performance of private research workplaces (especially in the industry)
- Ability of selected teams to achieve internationally comparable excellent results and their application
- Open competitive environment and export productivity
- Support of inflow of foreign direct investment
- Cooperation of domestic and foreign companies
- Change of focus of investment incentives towards the activities with higher technology intensity
- Examples of foreign companies with internal research and development
- Low cost of innovation activities

Weaknesses (what needs to be eliminated or corrected as a priority):
- Missing strategy of long-term development of the Czech Republic and strategy for efficient support of research and innovation
- Lower share of spending on research and development and education in GDP compared to the EU (pressure of fiscal imbalance)
- Dilution/non-coordination of support (departmentism) and capacities for research and innovations
- Insufficient linkages between the individual stages and cooperation of participants in the innovation process
- Insufficiently targeted support (selected fields, national technology platforms)
- Excessive, non-cohesive and inefficient administration of support programmes, missing feedback from previous experience
- In the selection of projects, the current results taken less into account, innovative benefits not identified
- Insufficient continuous evaluation, low demands (subjectivity) of evaluation of project results
- Insufficient links universities with practice (poor influence on the focus of teaching and research)
- Low interest in science and engineering studies among quality applicants
- Insufficiently differentiated system of financing universities and institutes of the Academy of Sciences according to research results in combination with a high proportion of institutional financing
- Low managerial skills in research and innovation activities, inefficient management in the academic sectors
- Low ability of implementation and economic exploitation of R&I results
- Low share of the middle-aged generation of researchers
- Excessive bureaucracy of doing business
- Insufficient private resources in research and innovation (specifically for small/start-up companies)
- Low innovation demand of companies and the public administration
- Tax non-deductibility of expenses on research purchased externally
- Low patent activity and protection of intellectual property (specific problem in the case of spin-off companies)
- Poor involvement of foreign companies in development of a national innovation system
- Insufficient development of regional innovation systems (quality of management and cooperation of innovation agents)

Opportunities (external influences/measures which can support innovative competitiveness):
- Efficient use of resources from EU structural funds
- Differentiation of support to research and innovation activities according to results
- Participation in international cooperation and mobility (within as well as outside the EU)
- Use of foreign experience in support of research and innovation
- Specifying strategic priorities with substantial public support (aiming at excellence)
- Development of selected progressive technologies (ICT, nano, bio, eco, energies)
- Development of new technologically progressive companies
- Partnership between companies and academic sectors
- Commissioning research of companies to external sources (universities and research workplaces)

- Participation of private resources in research and innovation
- Raising the extent and intensity of knowledge transfer of foreign companies
- Transfer of research and innovation capacities from old EU member states
- Attracting highly qualified human resources from Eastern countries
- Use of the potential of students and young researchers
- Involvement of regional innovation agents in regional development
- More efficient use of innovation infrastructure
- Use of the potential for development of other regional innovation centres (besides Prague and Brno)

Threats (which influences can disrupt the development of innovation competitiveness):
- Inefficient or unsuitable use of structural funds (preference of investment projects)
- Discontinuity/non- maintainability of some programmes after termination of public support (from SF)
- Insufficient priority of support of innovative competitiveness compared to support provided in other countries
- Non-detection of progressive fields and technologies
- External as well as internal brain drain
- Insufficient supply of human resources for research and innovation in progressive technologies
- Deterioration of the educational level and structure
- Aging of the population and related fiscal pressures on decrease of public support to R&I and education
- Growth of production and labour cost, specifically in research and development activities
- Decreasing interest, or departure of local and foreign investors in technologically demanding fields
- New competition from less developed countries with growing research an innovation capacities (in combination with poor protection of intellectual property)
- Ability to compete with low cost (without the necessity of innovations)
- Increase of inter-regional differences in innovation performance
- Fragmentation of research and innovation activities in the EU (non-functioning ERA)

Reform of the R&D system in the CR

At the conference Science and the Future of Europe in May, 2007, the prime minister presented the new government's main ambitions for the field of R&D. He emphasised the crucial importance of R&D for the future competitiveness of the CR and highlighted the need to: rationalise and simplify the R&D system (especially by reducing the number of funding bodies); increase its effectiveness; strengthen the role of evaluation; and increase the level of motivation for collaboration between public and private research. A new proposal for **R&D funding** for the years 2008–2010 was approved by the government in May, 2007, amending the government resolution from April 2007.[9] This proposal includes a higher increase in funding than was initially planned by the new government, which is clearly a positive sign in view of the need for a restrictive policy *vis-à-vis* the increasingly unmanageable public finance deficit. The budgeted increases are, however, lower than the original long-term budget outlook approved in 2005.

In November 2007, the prime minister presented his new project VIVAT which aims at increasing R&D spending by 7-8 % annually until 2010. This re-confirmed the crucial role attached to R&D by the government and its commitment to reforming the Czech R&D system. As a follow up to this event, the R&D Council announced its proposal for a thorough **reform of the R&D system** (on January 11, 2008). The key aspects of the reform are to be: 1) simplification of the system, including an introduction of institutional funding based on results; 2) reduction of the number of funding bodies (from current 22 to less than 10), incl. an introduction of a Technology Agency for applied R&D, and simplification of administration; 3) supporting excellence in R&D a ensuring the exploitation of results for innovation processes; 4) make the programme support from public sources conditional on co-funding of R&D activities from third parties (commercial partners); 5) more flexible organisational struc-

[9] Until recently one of the obstacles to the participation of Czech public R&D organisations has been the fact that VAT related to FP projects was not an eligible cost. This obstacle, which financially disadvantaged Czech researchers, was removed in August 2007 thanks to the amended Act no. 235/2004 on VAT which allows for VAT reimbursement for public R&D organisations on FP-funded projects.

ture of public R&D; 6) supporting the supply of personnel for R&D and innovation; 7) increasing the intensity of international cooperation in R&D.

It is expected that the reform steps will be introduced gradually. The reduction of the number of funding chapters will take several years (the running programmes will gradually be phased out) while the Technology Agency should formally be operational from 2012. Some of the measures to stimulate collaboration with industry will most probably have a quicker effect and are expected to have a significant impact on the behaviour of research organisations (e.g. existence of a technology transfer units at all research organisations that apply for funding from the Technology Agency). Some of the proposed measures proved to be highly controversial and stirred up a heated debate in the media. The academia criticises especially the allegedly overemphasised shift towards applied research and collaboration with the industry while other user groups (as well as some of the Ministries) criticise the reduction in the number of funding bodies which, it is suggested, may increase the risk of favouritism already acute in a small country and may reduce the options open to non-conventional research.

Due to the Reform, the preparation of the next round of National Research Programme (NRP III) has been postponed. Instead, the plan is now to prepare a new document, **National Policy for Research, Development and Innovation for the years 2009-2015**, which should be submitted jointly by the Council for R&D and Ministry of Education, Youth and Sports to the Government in 2009.On March 3, 2009, the Chamber of Deputies approved the amended Act no. 130/2002 on the Support of R&D from Public Resources, which is a part of a bigger package of a Reform to be subsequently introduced. Simultaneously, the reform of tertiary education was outlined in the White Book published in its draft version on May 18, 2008. It includes a number of issues that are pertinent to future of R&D in the university sector, such as strengthening their R&D activities together with differentiation between teaching and research universities, concentration of resources on a limited number of high quality research centres, strengthening the third role of universities (participation in technology transfer and economic development, more extensive collaboration with the industry and users of research results), and introducing managerial professionalism to the university operation.

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