International Audit of Research, Development and Innovation in the Czech Republic

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First Interim Report

Annex 1: Full report - September 14, 2010

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INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

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Appendix A Analysis of R&D Spending in the Czech Republic (WP a)

Author: Joanneum Research

1. Introduction

The main aim of Work Package A is to assess the public expenditures for R&D&I in the Czech Republic and comment whether they are effective and comparable with European level.

In the course of the very first months of the project the initial analysis focused on retrieving information on the patterns of R&D funding and R&D performance in the Czech Republic. In doing so, a baseline of knowledge regarding the current R&D investment levels of the different sectors, which allows to investigate further the use of public R&D expenditures and innovation activities in the Czech Republic - including different research institutions, institutional funding, adequacy of national priorities and funds allocated to private companies. The analyses presented in this First Interim Report rest upon the latest official Eurostat and OECD data and are hence based upon official statistics as provided by the Czech National Statistical Office and government sources.

In the next phase of this work package an in depth analysis of the national support schemes including themes and priorities and the analysis of diversity and critical mass will be established according to the steps laid down in the technical proposal. Therefore we will further exploit available national and international databases for additional quantitative analyses, make extensive use of the survey results, and conduct a series of additional qualitative analyses focussing on funding priorities and establishment of critical mass in R&D.

2. Development of R&D Intensity

In the last fifteen years, the Research and Innovation system of the Czech Republic was characterized by a continuous growth of investments in R&D. According to Eurostat the R&D intensity reached 1.54% of GDP in 2007 and 1.47% of GDP in 2008. Despite the recent decline in R&D intensity the Czech Republic exhibits one of the highest level of R&D investments among the New member States (along with Slovenia) and invested more than Ireland and remarkably more than the South-European member states (Spain, Italy, Portugal).

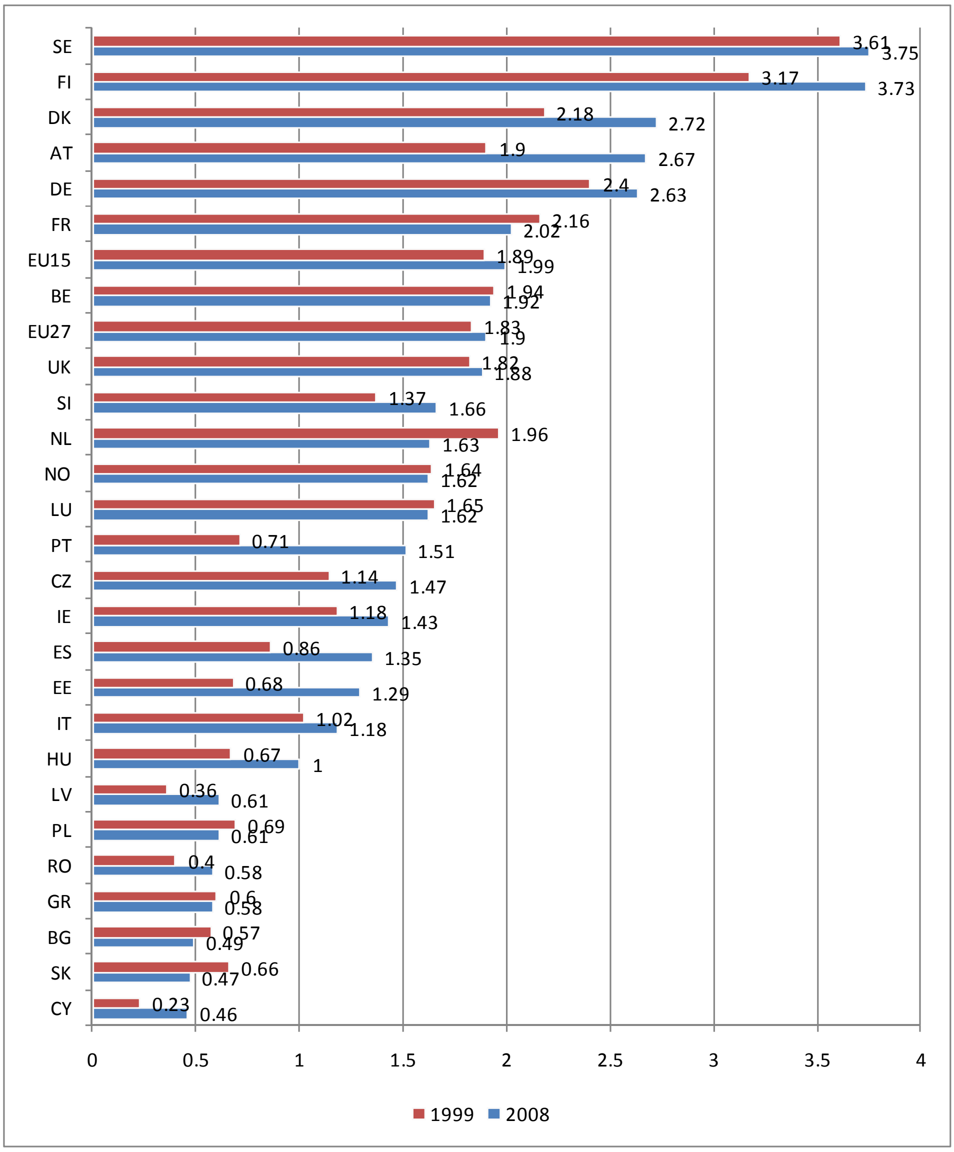
Whereas the gap of R&D intensity between the Czech Republic and the EU-27 has considerably narrowed, the distance of the Czech Republic from OECD average is still high.

However, despite a very high GDP growth also the growth of R&D intensity was among the largest within the EU27 member states as only Spain (which has not yet achieved investment levels of the Czech Republic), Denmark, Portugal, Estonia and Austria had shown higher growth rates in terms of R&D intensity (GERD/GDP).

In absolute terms, the increase of R&D investments was even more impressive. According to Eurostat total R&D expenditures have more than tripled in the last decade. In 1999 total R&D expenditures amounted to 641 Mio Euro whereas in 2008 total R&D

expenditures were 2169 Mio Euro (the latest year for which Eurostat provides data on the Czech Republic).

Figure 1: Development of R&D intensity of the Czech Republic



Source: Eurostat

3. R&D expenditures by sectors of performance and sources of funds

Whereas the overall R&D intensity provides a first indication of the level of research activities in a country, a differentiation by sectors of performance and sources of funds provides more detailed information about the state of R&D affairs in a country and its international competitiveness.

The definition of sectors are defined in the OECD Frascati manual (OECD 2002) and derived from institutional sectors and sub-sectors used in the national accounts. The Czech R&D survey (whose results are delivered to EUROSTAT and OECD) conducted by the national statistical office fully complies with the OECD Frascati manual and hence provides a good basis for international comparison of R&D activities in the Czech Republic. Hence, the following descriptive analyses provide information on current investment and performance levels, which differentiates between the following sectors[1]:

The Business Enterprise Sector (BES): is formed of all companies, organizations and institutions whose principal activity is market production of goods or services for sale to the general public at an economically significant price;

The Government R&D Sector (GOV): includes in the Czech Republic especially workplaces of the Academy of Sciences of the Czech Republic and other places of research under the competence of ministries (on 1 January 2007 the statute of most of these entities changed to public research institutions), institutions of central and local government, except for publicly managed higher education institutions; it also contains public libraries, archives, museums and other cultural establishments conducting R&D as their secondary activity[2];

The Higher Education Sector (HES): comprises both public and private universities and other institutions of post-secondary education. It also includes all research institutes, experimental facilities and clinics whose work is directly controlled or managed by higher education institutions or they are associated with them[3].

The Private Non-Profit Sector (PNP): includes all institutions serving households sector (referred to as the private non-profit sector), which comprises private institutions, including private persons and households, whose primary aim is not profit formation but providing non-market services to households. They include, e.g., associations of research organizations, societies, unions, movements, federations or foundations.

At present the Business Enterprise sector accounts for the highest share of R&D performance in the Czech Republic (62%) as well as for the highest share of R&D funding (52%). As regards R&D performance, both the Higher Education Sector (17%) and the Government Sector (21%) play a prominent role. The Private Non Profit Sector, as in all other European countries, is negligible in terms of R&D investment and performance levels and is hence not portrayed in particular in the analysis.

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[1] The definitions of sectors presented below stem from the methodological notes/fact sheet of the national statistical office and were provided by the Technology Centre.

[2] Note: All public research institutions irrespective of their institutional sector used in national accounts belong into the government sector in the R&D statistics. Before 2009 were some public research institutions included in the business enterprise sector due to the fact that their institutional sector was since 2004 identified according to the international classification ESA as – Nonfinancial enterprises (ISEKTOR 11). In order to maintain methodological correctness and comparability of data in time were all data in 2009 recalculated.

[3] Since 2005, in compliance with OECD methodology, the sector also includes teaching hospitals. This sector is not a separate institutional sector of national accounting but has been separately identified for its important role in R&D;

Table 1: R&D expenditures broken down by sector of performance and source of funding (2008)

Sectors of performance	Mio Euro	Share	Sources of funds	Mio Euro	Share
Business Enterprise	1342.3	62%	Business Enterprise	1132.1	52%
Higher Education	364.4	17%	Higher Education	25.2	1%
Government	454	21%	Government	895.6	41%
Private Non Profit	8.3	0%	Private Non Profit	0.1	0%
			Abroad: Foreign Companies, Int. Org. and Others	81.4	4%
			Abroad: European Commission	34.6	2%
Total	2169.0	100%	Total	2169.0	100%

Source: Eurostat

When looking at the development of the funding structure in the last decade, we witness that all relevant funding sectors have increased their R&D investments almost proportionally. Significant changes in the relative shares of funding only occurred more than a decade ago (see Figure 2).

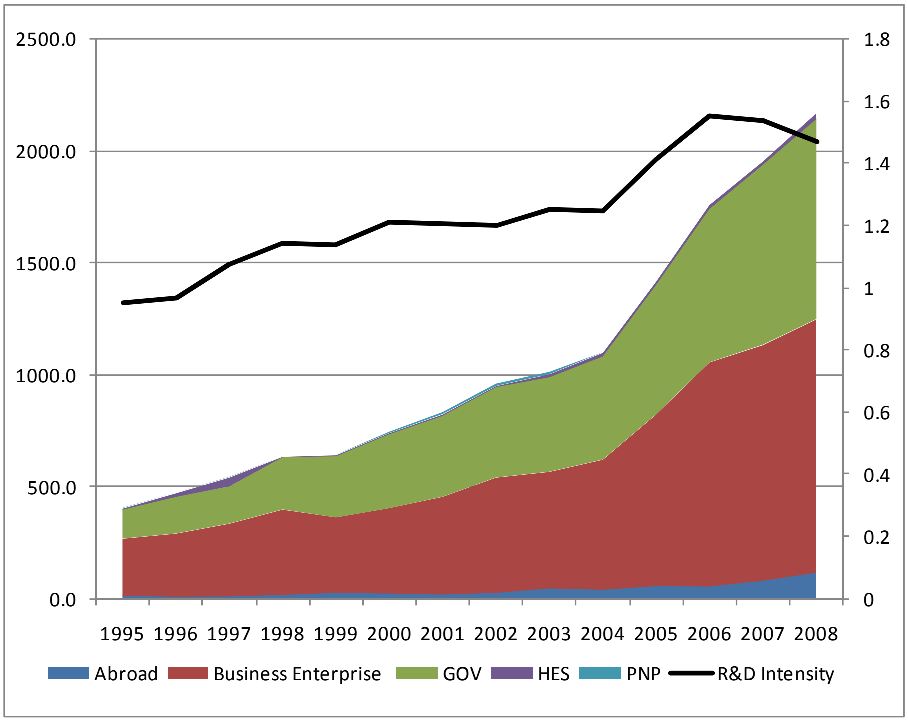
The Business Enterprise Sector, which accounted for 52% of total R&D funding in 2008 has increased its investments by more than 330% since 1999. The share of Business funded R&D has remained at rather constant levels. In the last decade, the highest value was reached in 2006 (57%), in the rest of the decade variations were between 51% and 54% of total R&D funding. As Figure 2 indicates, a serious break in the share of Business Funding of total R&D expenditures only occurred in the years 1998/1999 when the share of R&D funded by the Business Enterprise Sector declined drastically from 60% (1998) to 53% (1999).

The Government Sector accounted for 895.6 Mio Euro of total R&D funding in 2008, (41% of total R&D expenditures) and 21% of R&D performance[4]. As for the Business Enterprise Sector, the shares of government funding showed only slight variations since 1999 (+/- 3%). Hence, in line with the business sector, also the government sector has increased its spending on R&D constantly during the last decade. Investments rose from 273 Mio Euro in 1999 to 895.6 Mio Euro in 2008 (+328%).

Apart from the Business Enterprise Sector and the Government Sector, funds from Abroad are the third relevant funding source for R&D in the Czech Republic as funding from Higher Education Sector (HES) and funding from Private Non Profit Organisations (PNP) are negligible. In 2008 foreign funding sources accounted for 5% of total R&D expenditures of the Czech Republic or 116 Mio Euro, of which the major part is from foreign companies. Since 1999 the share of funding from abroad has varied between 3% and 5%.

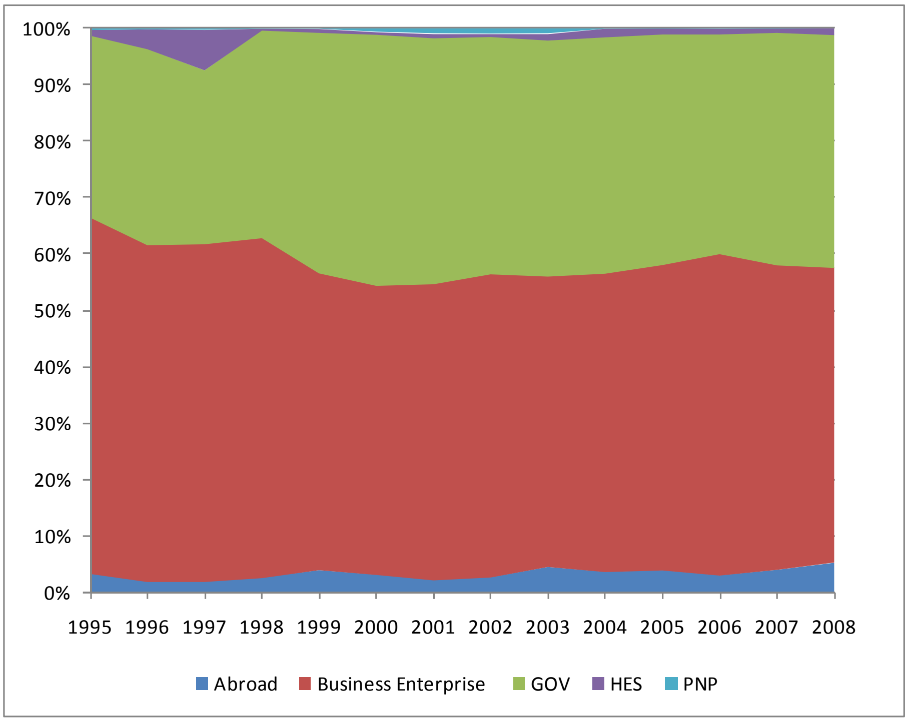
[4] The low ratio of R&D performance/R&D funding is due tot he fact that the government sector is the major funding source not only of the government sector entities but also of the higher education sector.

Figure 2: Development of total R&D expenditures by sources of funds



Source: Eurostat, calculations Joanneum Research

Figure 3: Shares of total R&D expenditures by sources of funds

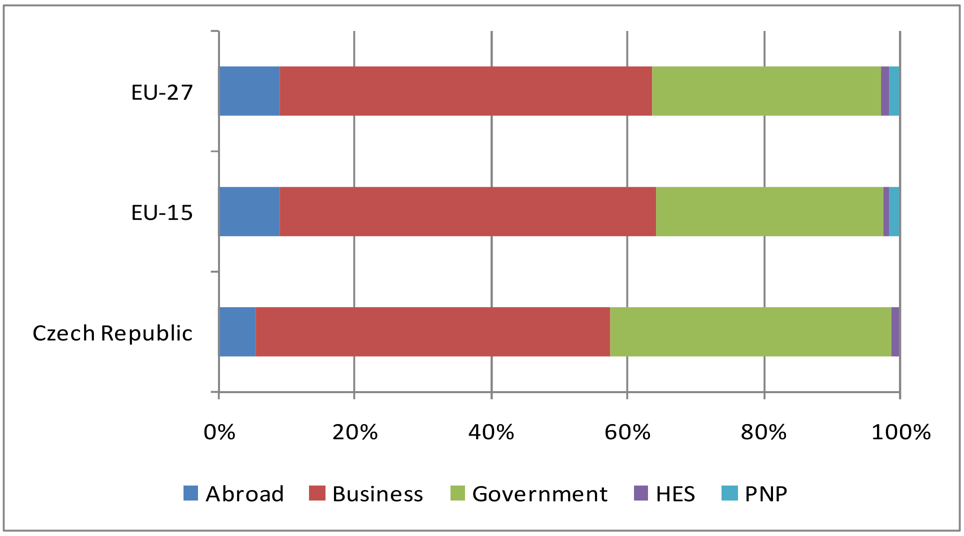


Source: Eurostat, calculations Joanneum Research

Overall, we witness that the Czech Republic exhibits a funding structure of R&D in which both the Business Enterprise Sector and the Government Sector contributed equally to a continuous growth in R&D investments.

As opposed to many new member countries, which have significant lower shares of R&D funding by the business enterprise sector, R&D funding data of the Czech Republic show, that there is an active Business Enterprise sector which performs and funds significant shares of R&D in the Czech Republic (62% of performance, 52% of funding). As a result, the funding structure of the Czech Research and Innovation system already resembles to a large extent that of the EU-15 and EU-27.

Figure 4: Funding structure of total R&D expenditures (EU vs CZ)



Source: Eurostat, calculations Joanneum Research

Today, the only major difference as regards the overall funding structure of the Czech Republic relates to funding from abroad. Compared to the EU-15 and to the EU-27 average, the level of funding from abroad is comparatively low, although the funding structure reveals that funding from abroad stem to a large extent from business enterprises (66% in 2008) and only 1/3 from European Commission funds. Until now the role of other international organizations is limited.

4. Funding structure of the three major performance sectors

Regarding the funding structure of R&D performed by the Business Enterprise Sector, it is evident that the vast majority of funding stems from own enterprise sources (see Table 2). Funding from abroad amounts to 6% of total funding and funding from the government amounted 13% in 2008. According to the OECD latest Economic Survey on the Czech Republic (OECD 2008), the existing tax break[5] for R&D has proved popular with private-sector spending on R&D, apparently increasing by about 20% between 2005 and 2006, whereas the average growth rate in the previous years (2000-2005) was considerably smaller in the range of about 11% per year. Hence, the OECD warns that

[5] In a comparative study of Price Waterhouse Cooper on the impact of R&D tax incentives on investments of private companies into R&D in the Czech Republic, the Czech Income Taxes Act is defined as follows: It enables companies to deduct up to 100% of R&D costs from their annual tax base in the form of a so-called R&D tax allowance. As the costs associated with R&D are generally regarded as tax-deductible, the eligible R&D costs can actually be deducted from the tax base twice. As there is a 21% corporate income tax rate in the Czech Republic for 2008, each CZK 1,000 of R&D costs will gain CZK 210 of tax benefit in 2008.

such an increase contains a degree of deadweight loss and creative accounting, which should be taken into account in any further measures.

Table 2: Funding structure of the Business Enterprise Sector R&D

	2008	2008	1999	1999
	Mio EUR	Share	Mio EUR	Share
Abroad	85.9	6%	19.5	5%
Business Enterprise	1077.8	80%	323.8	80%
Government	176.8	13%	57.0	14%
Higher Education	1.8	0%	2.6	1%
PNP	0.0	0%	0.1	0%
TOTAL	1342.3	100%	402.9	100%

Source: Eurostat, calculations Joanneum Research

Compared internationally, the share of Business Enterprise R&D funded by the Government is rather generous, 6% above EU-27 and EU-15 average. In the European Union similar levels of support are provided by Austria (10%), France (12%), Slovakia (13%), Poland (12%) and Spain (16%), which are notably except from Slovakia countries that have some form tax-incentives provided for private companies[6].

Paying attention to the different branches, we witness a) that R&D in the Business Enterprise sector is concentrated in some specific sectors, and b) that government resources devoted to Business deviate considerably from distribution of the private sectors` own funds.

At an aggregate level 59.2% of total BERD are to be found in the manufacturing sector and 39.1% in the services sector. The respective share of government resources devoted to the private enterprises is 35% for the Manufacturing Sector and 62.4% for the Services sector.

Within the service sector, the major part of government funding is devoted to the "Research Sector", i.e. companies that have specialised in the provision of R&D.

Interestingly, the strongest private research branch " Motor Vehicles, trailers and semi-trailers" which alone accounts for 23% of total BERD has not only a low level of R&D funded by government (1%) (which might be explained by the large size of this branch), but is also marginalized in absolute terms regarding government support provided to the Business Enterprise sector (1.7%).

We will look into the potential reasons for these patterns in the next stage of our analysis.

[6] According to ERAWATCH in 2009 eighteen out of the 27 Member States provide tax deductions for R&D investments to the domestic companies: Austria, Belgium, Czech Republic, Denmark (150% tax deduction scheme), France (Research Tax Credit), Greece, Hungary, Ireland, Italy, Lithuania, Malta (Research & Development Tax Credit Scheme), the Netherlands (WBSO: Research and Development (Promotion) Act), Poland, Portugal (SIFIDE), Romania, Slovenia, Spain and the United Kingdom (R&D tax credit).

Table 3: R&D performed in the Business Enterprise Sector by Branches and Shares of funding

	Share of Total BERD	Share of BERD fu
AGRICULTURE, HUNTING AND FORESTRY	0.3%	61.8%
MINING AND QUARRYING	0.2%	4.7%
MANUFACTURING	59.2%	8.0%
Food, beverages and tobacco	0.6%	6.6%
Food products and beverages	0.6%	6.6%
Tobacco products	0.0%	
Textiles, fur and leather	0.8%	5.4%
Textiles	0.6%	4.0%
Wearing apparel and fur	0.2%	4.1%
Leather products and footwear	0.1%	18.8%
Wood, paper, printing, publishing	0.1%	59.3%
Wood and cork (not furniture)	0.0%	3.6%
Pulp, paper and paper products	0.0%	35.1%
Publishing, printing and reproduction of recorded media	0.1%	76.0%
Coke, petroleum, nuclear fuel, chemicals and products, rubber and plastics	7.1%	6.0%
Coke, refined petroleum products and nuclear fuel	0.0%	3.3%
Coke and nuclear fuel	0.0%	
Refined petroleum products	0.0%	3.3%
Chemicals and chemical products	5.3%	7.0%
Chemicals and chemical products (less pharmaceuticals)	2.0%	10.2%
Pharmaceuticals	3.2%	5.0%
Rubber and plastic products	1.8%	3.1%
Non-metallic mineral products	1.3%	8.1%
Basic metals	1.2%	25.9%
Basic metals, iron and steel	0.8%	35.0%
Basic metals, non-ferrous	0.4%	8.0%
Fabricated metal products, machinery and equipment, instruments and transport	47.8%	7.8%
Fabricated metal products, except machinery and equipment	1.1%	15.8%
Machinery and equipment, n.e.c.	8.1%	23.6%
Engines and turbines, except aircraft, vehicle and cycle	0.4%	29.0%
Special purpose machinery	4.5%	31.3%
Machine tools	0.9%	23.0%
Weapons and ammunition	0.3%	39.7%
Office, accounting and computing machinery	0.1%	28.9%
Electrical machinery and apparatus n.e.c.	3.1%	7.0%
Electrical motors, generators and transformers	0.4%	18.9%
Electricity distribution and control apparatus (includes semiconductors)	1.0%	4.2%
Insulated wire and cable (includes optic fibre cables)	0.1%	0.0%
Accumulators, primary cells and primary batteries	0.0%	0.0%
Electric lamps and lighting equipment	0.2%	1.8%
Other electrical equipment n.e.c.	1.4%	6.9%
Radio, TV and communications equipment and apparatus	3.5%	7.7%
Electronic valves, tubes and components	0.6%	35.5%
TV, radio transmitters and line apparatus	2.4%	1.5%
TV and radio receivers, sound and video goods	0.5%	5.7%
Medical, precision and optical instruments, watches and clocks (instruments)	4.7%	10.2%
Medical appliances, instruments and control equipment	0.6%	27.9%

Instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment	1.5%	9.3%
Industrial process control equipment	2.5%	6.9%
Optical instruments and photographic equipment	0.2%	5.4%
Watches and clocks	0.0%	0.0%
Motor Vehicles, trailers and semi-trailers	23.2%	1.0%
Other Transport Equipment	4.0%	11.2%
Ships and boats	0.0%	
Railway and tramway locomotives and rolling stock	1.3%	5.0%
Aircraft and spacecraft	2.6%	13.7%
Transport equipment, nec	0.1%	22.9%
Furniture, other manufacturing nec	0.3%	2.6%
Furniture	0.1%	4.1%
Other manufacturing nec	0.1%	1.2%
Recycling	0.0%	78.3%
ELECTRICITY, GAS and WATER SUPPLY	0.2%	3.7%
CONSTRUCTION	1.0%	14.5%
SERVICES SECTOR	39.1%	21.6%
Wholesale, retail trade and motor vehicle repair	2.2%	15.1%
Hotels and restaurants	0.0%	0.0%
Transport, storage and communications	1.3%	1.7%
Telecommunications	1.3%	1.4%
Other	0.0%	12.6%
Financial intermediation (includes insurance)	5.1%	0.0%
Real estate, renting and business activities	28.7%	23.6%
Computer and related activities	8.2%	14.1%
Software consultancy and supply	6.2%	6.3%
Research and development	16.6%	26.3%
Other business activities	3.8%	31.9%
Architectural, engineering and other technical activities	3.3%	29.2%
Community, social and personal service activities, etc.	1.8%	72.8%

Source: OECD, calculations Joanneum Research

R&D performed by the Higher Education Sector is almost exclusively funded by the Government (91%) (see Table 3). Funding from abroad accounts for 4% of total R&D funds and self-funding via e.g. student fees etc. accounts for 4% of total R&D performed by the Higher Education sector. Most interestingly, funding flows from the Business Enterprise Sector towards the Higher Education Sector are still at very low levels and show little development since 1999, which is a confirmation of rather weak science-industry linkages in the Czech Republic. Compared internationally, the Czech Higher Education R&D exhibits the lowest share of funding from Business Enterprise Sector within the EU-27, the EU-27 average is at present at 6%.

Table 4: Funding structure of the Higher Education Sector R&D

	2008 Mio EUR	2008 Share	1999 Mio EUR	1999 Share
Abroad	15.8	4%	2.7	3%
Business Enterprise	2.3	1%	1.0	1%
Government	331.0	91%	73.4	93%

Higher Education	15.3	4%	1.8	2%
PNP	0.0	0%	0.2	0%
TOTAL	364.4	100%	79.1	100%

Source: Eurostat

Also R&D performed by the Government Sector is to a large extent funded by government sources (84% in 2008). However, opposed to the Higher Education Sector, the government sector receives considerable shares of R&D funding from the Business Enterprise Sector (11% in 2008). Compared with 1999, the share has increased by 4% in 2008.

Table 5: Funding structure of the Government Sector R&D

	2008	2008	1999	1999
	Mio EUR	Share	Mio EUR	Share
Abroad	13.4	3%	3.3	2%
Business Enterprise	51.3	11%	10.7	7%
Governement	381.4	84%	141.3	91%
Higher Education	7.9	2%	0.2	0%
PNP	0.0	0%	0.0	0%
TOTAL	454.0	100%	155.5	100%

Source: Eurostat

5. Type of Research conducted and representation of Scientific Disciplines

Regarding the type of Research, the share in expenditure for fundamental research, applied research and experimental development was 30%-25%-45% (see Table below). This meant (since 2003) an increase in share for fundamental research from 25% to 30% and a drop for applied research from 30% to 25%. Experimental development is almost exclusively located at the Business Enterprise Sector, whereas the Government sector and the Higher Education Sector account for the largest shares of Fundamental Research. Interestingly, the Government Sector – which exhibits higher shares of funding from Business, also accounts for higher shares of Fundamental Research.

Table 6: Share of R&D activity type by sector of activity (2007)

	Business (BERD)	Government (GOVERD)	University (HERD)	Private Non-Profit	CR Total (GERD)
Fundamental Research	5%	78%	61%	12%	30%
Applied Research	25%	20%	33%	84%	25%
Experimental development	70%	2%	5%	4%	45%

Source: Eurostat

The representation of the main groups of scientific disciplines shows that strong differences between the different sectors of performance can be witnessed. The Business Enterprise Sector shows a strong specialisation in the field of Engineering, which has traditionally been the backbone of the Czech Economy and continuous to perform rather well, contributing to about a third of total GDP (see Rammer et al. 2007). The Government Sector shows a strong specialisation in Natural Sciences (62%) whereas the Higher Education Sector has a slight specialisation in Engineering. Social Sciences and Humanities account for about 15% of R&D performed in the Government Sector and the Higher Education Sector.

Table 7: Share of R&D activity by sector of performance and scientific discipline (2007)

	BERD	GOVERD	HERD	GOV+HERD	TOTAL
Natural sciences	16%	62%	21%	42%	25%
Engineering	76%	11%	37%	23%	57%
Medical sciences	5%	6%	20%	13%	8%
Agricultural sciences	2%	7%	7%	7%	4%
Sub-total NSE	99%	86%	85%	85%	94%
Social sciences	0%	6%	10%	8%	3%
Humanities	0%	8%	5%	7%	3%
Sub-total SSH	1%	14%	15%	15%	6%

Source: OECD (2010)

Overall the figures regarding the representation of the different scientific disciplines point first to the possibility that there is a structural mismatch in scientific orientation of the Business Enterprise Sector R&D and the Government and Higher Education Sector R&D which might prevent further collaboration between the different performance sectors and explain the low level of funding of HERD via Business Enterprises I.e.: The Business Enterprise Sector has concentrated about 76% of its research in the field of Engineering whereas the Government Sector (11% and the Higher Education (37%) account for much lower shares in this field. Secondly, further qualitative analyses needs to be performed regarding the role of Higher Education Sector R&D, as it strikes out that the Higher Education Sector has by far higher shares in Engineering than the Government sector, but has so far failed to attract considerable amounts of R&D funding from the Business Sector.

Regarding an international comparison concerning the type of research conducted and the representation of the different scientific disciplines one has to remark that several limitations hinder the use of this type of information for further investigations:

- For the category type of research conducted, one has to be aware that no clear delineation between basic and applied research can be drawn. As a matter of fact, scientific research institutions in the higher education sector throughout Europe exhibit by far higher shares of basic research than applied research and experimental development.

- As regards the differentiation between scientific disciplines one also has to be aware that these disciplines are defined in very broad terms, and hence not as precise as i.e. publication data. In addition only a limited number of EU member countries provide information on representation of scientific disciplines in their national R&D statistics. I.e., for the business enterprise sector only 11 out of 27 member states – almost exclusively new member states - provide this type of information[7].

[7] The following EU-member states provide information on representation of different scientific disciplines in the Business Enterprise Sector: Bulgaria, Czech Republic, Cyprus, Latvia, Hungary, Malta, Poland, Portugal, Romania, Slovenia, Slovakia.

Appendix B Bibliometric Analysis of the Czech Republic Research Output in an International Context (WP d, ii)

Author: CWTS

1. Introduction

In the context of this audit, the objective of the bibliometric analysis was to provide a good overall comparative picture of the quality of Czech research, identifying strong and weak areas of research and institutions, covering the time period 1993 – 2009.

It is important to note that this study covers publications output and citation impact measures. Publication output numbers are not synonym for productivity, and just as output measures derived according to the methodology described above are proxies of a certain overall output, so are productivity measures, as this completely depends on what you include in the formula to calculate productivity per researcher. Next, citation impact measures are by no means to be directly interpreted as synonym for 'scientific quality'. As citation impact measures express the influence of your work on that of other researchers, the large scale quantification of citation impact data points into international influence or visibility. CWTS does not support the idea that citation impact measures could be directly interpreted as *the* measure of scientific quality, as scientific quality is a much more multi-dimensional concept, that takes into account other aspects of scientific activity as well (e.g., as can be measured through peer review, dealing with issues such as numbers of publications in other sources as international journals, grants, prizes, editorships, etc.).

Yet another statement we need to make in this section relates to the general characteristics of this particular bibliometric analysis. Within the field of bibliometrics, and the applications thereof in the assessment of research, we roughly distinguish between top down analyses, mostly focusing on country level (comparison), research fields and institutions, and bottom up analyses (in which the focus is on institutions and research group level, and even more and more individual researcher level). Both approaches require different 'rules of the game', for example country level analyses hardly require any interaction with experts in the respective countries, while institutional analysis in the top down mode requires information on the level addressing the proper organizations. As the level of detail is low, and the insight limited to global characteristics of the science system under study, the character of this type of studies is descriptive of nature. In the bottom up approach, more profound insights are necessary to create more detail in the analyses. This requires more interaction with research managers and researchers, even to work floor level to construct valid sets of publications, directly forthcoming from the units under study. Issues like mobility, re-organizations, etc. become important to get a proper insight into the whereabouts of the institutes, groups, or individuals under study. Given the more detailed insights required during this latter type of studies, the results can be of a much more evaluative nature, thereby allowing for more far reaching conclusions as one could ever draw based on a top down, descriptive, macro level analysis such as this. From this, we state that this is not an evaluation of the Czech science system the way it is commonly understood. For a proper evaluation of the research on work floor level, one should collect data in a completely different manner, a process CWTS has a vast experience, thereby producing bibliometric statistics on (mainly) groups level, the results of which are transferred to peer review committees who judge the research performance of groups. In this process, bibliometric scores play an instrumental role, supporting the work of the committee, in which bibliometric data are only one of the pillars of the whole process.

2. The CWTS Information System and Methodology

This report provides a background document to the CWTS data deliveries. Its content briefly describes, in a non-technical fashion, the main features of the CWTS information system and methodology that was used to produce quantitative 'bibliometric' data for the Czech Republic's government on the Czech Republic's research performance within an international comparative perspective during the years 1993-2009.

2.1 CWTS Information System

The publication output data and citation impact data were extracted from CWTS's proprietary version of the database Web of Science (WoS). This source of information is specifically designed for statistical 'bibliometric' analyses of the worldwide research literature.8 The WoS database contains selected bibliographic information from all research papers published in about 12,000 'sources', including the paper's title and abstract, author names9, author affiliations, full text, reference list, document type, and other bibliographic identifiers such as the journal's ISSN number. Some 11,000 of these sources are fully covered peer-reviewed international scientific and technical journals, the remainder being journals and conference proceedings that are often only partially covered.

The CWTS/WoS database is an upgraded and dedicated 'bibliometric' version of the widely available online/offline 'bibliographic' versions of the database provided by Thomson Reuters Scientific to its customers. The CWTS/WoS database covers the years 1980 up to and including the most recent publication year (currently 2009). The WoS is one of very few international multidisciplinary databases that offer a broad and high-quality coverage of the worldwide research literature, and has effectively been the common source for all large scale comparative bibliometric studies over the last two decades. The only other comparable database is SCOPUS, a relatively recent source produced by the science publisher Elsevier of thus far unknown added value compared to the WoS. Numerous other databases have a limited disciplinary scope, often focusing on specific scientific fields or research domains, such as Inspec (for physics and electrical engineering), Medline (medicine and health care), to name a few.

The CWTS bibliometric information system integrates the CWTS/WoS database and a series of software routines and research performance indicators based on publication output and citation impact statistics (Section 2.6 provides more details about these indicators). Note that these indicator-based statistics may differ slightly from the results of similar citation analysis which are performed with other, on-line of off-line, 'bibliographic' (campus license) editions of the Web of Science, or CD-ROM versions of WoS predecessor databases such as the Science Citation Index, because of minor

[8] Thomson Reuters (Philadelphia) is the producer and publisher of the Web of Science (WoS). For the earliest years the data will be extracted from the predecessor of the Web of Science, the Citation Index, covering the Science Citation Index, the Social Science Citation Index, the Arts & Humanities Citation Index, and the 'specialty' citation indexes (CompuMath, Biochemistry and Biophysics, Biotechnology, Chemistry, Material Science, Neurosciences).CWTS owns a license agreement with the database producer, *Thomson Scientific* to supply WoS-based bibliometric information to clients worldwide on a commercial basis.

[9] Authors are institutional authors, i.e. a person and his or her institutional address at the time of the publication and listed in the heading or in a footnote of a research publication.

differences in coverage, definitions of admissible document types, time spans, or data upgrading by CWTS to improve the quality the WoS database (see Section 2.2).

2.2 Data pre-processing for bibliometric analysis

CWTS invests considerable resources and efforts, on a continuous basis, to upgrade the *Thomson Reuters Scientific's* bibliographic edition of the WoS into a CWTS bibliometric version thus improving the accuracy and comprehensiveness of the data. Part of this computerized procedure includes the cleaning and standardization of the names of organizations listed in the author affiliate address information.

Yet another step in the data processing is the 'unification' of the research output in the WoS for address information, both on country, city, and institutional level, and apparent errors need to be re-attributed before analysis. This relates to publications from 1990 onwards from the former DDR to Germany.

2.3 Defining the fields of science

Each source journal within the CWTS/WoS database is attributed to one or more Thomson Scientific Reuters-defined *Journal Subject Categories (JSC's),* a collection of journals covering the same, or closely related, research topics or areas. *Thomson Reuters Scientific* has assigned these journals to these categories according to the opinions of subject experts and inter-journal citation patterns (more about citations in Section 2.6.2). Each journal category is, basically, equivalent to a subfield of science. Wide-scope journals are often assigned to more than one subfield. The prestigious general journals with broad multidisciplinary scopes, such as *Nature* and *Science*, are assigned to a journal category of their own, denoted by *Thomson Reuters Scientific* as 'Multidisciplinary Sciences' and included in the CWTS system under the heading 'Multidisciplinary journals'.

The CWTS bibliometric information system offers customers the possibility to tailor research fields and design their own classification systems based on the groupings of the journal categories. In this study we have applied the disciplinary grouping of JSCs into about 40 main fields[10] of science resembling the classification scheme applied in the Dutch Observatory of Science & Technology (NOWT, see www.nowt.nl). An overview of the classification scheme applied in this study is attached to this report in the Annex 2, Appendix A.

2.4 Selecting benchmark countries

In this study, the choice was made to compare the Czech Republic's performance with the national output and impact of the following eight countries within Europe: Austria, Denmark, Finland, Germany, Hungary, the Netherlands, Slovenia, and Sweden.

2.5 Database year & publication year

All calculations and statistics refer to database years – i.e. the year in which *Thomson Reuters Scientific* processed the publications for its WoS database. These measurements differ from those based on publication years, which refer to the publishing date of the journal issue. Some 5-10% of the publications that were issued in publication year *t* are processed by *Thomson Reuters Scientific* for the WoS database in the following two years *t+1* and *t+2*.

[10] We here use the definition of fields based on a classification of scientific journals. Although this classification is not perfect, it provides a clear and 'fixed', consistent field definition.

2.6 Bibliometric indicators & analyses in this study

The package of quantitative indicators defined for this study comprises of a set of country level 'macro' indicators, comparing the research performance of the Czech Republic with other countries (see Section 2.4). These indicators can subdivided into two classes: publication output indicators and citation impact indicators. For a more detailed technical description we refer to Annex 2 to this report, Appendix B.

2.6.1 Publication output indicators

Each journal publication that is indexed by the CWTS/WoS database is fully attributed to all countries listed in the author address list of the publication. The same applies to all affiliate main organizations in the author address list as well as the corresponding (main) institutional sectors of each organization. A publication that lists different units of an identical main organization is counted only once (e.g. different research departments of the same university, or subsidiaries of the same parent company).

The publication output is equal to the total number of papers published by a country during the entire period under investigation. These papers relate only to research-based publications that are published in peer-reviewed international scientific and technical journals (see Section 2.1). Only publications reporting on original research findings are included – i.e. the document types 'normal article', 'letter', 'note', and 'review article'. 'Meeting abstracts', 'Corrections', 'Editorials' and other document types are not included. Apart from this selection, all publications are treated equally in the computations. In a very few cases publications are published in a journal that is not fully indexed within the CWTS/WoS database; such publications are not included in analyses (see Section 2.1).

2.6.2 Citation impact indicators

Each research publication may or may not be read by other scientists and scholars, and its contents may or may not be used in their follow-up research – either by the author(s) or by others. In the event this follow-up research is published in a research article in an international journal, the corresponding researchers and scholars tend to acknowledge the value of the research publication by adding its bibliographic details to in their list of relevant literature (the 'reference list'). These 'citations' to the previous literature can be used as measure of the (international) intellectual influence and scientific impact of a piece of published research.

Hence, the international scientific impact of a country or organization is calculated on the basis of the quantity of citations received by its research papers. A cited publication is assigned in full to all countries and regions included in the author address list. The citation frequency counts in this study refer only to citations that were recorded within the WoS-indexed set of international peer-reviewed journals.

A heavily cited research publication has made a significant impact on the (international) scientific community. Many publications are never cited. At aggregate levels, a significant positive correlation exists between citation impact frequency and scientific 'quality'. The number of observed citations obviously depends on the time span of measurement. The number of citations received also tends to be field-dependent.

The citation frequency distribution of research publications worldwide is also highly skewed: at high aggregate levels some 20% of the publications tend to receive about 80% of all citations. The top percentiles of most heavily cited publications reflect the best research worldwide. The share of a country within these top publications indicates its contribution to cutting edge research worldwide and provides a crude indicator of research excellence within a domestic science system. The publications in the top percentiles are determined separately for each subfield of science. Each publication is assigned in full to all countries included in its author address list.

The citation frequencies depend on the time-interval after the publication date during which the citations will accumulate and are counted. The accumulation of citations is counted within a pre-set time-interval – the 'citation window', which can be defined according to several operational criteria. These windows tend to vary from 1-2 years (short term impact, as measured in the infamous Journal Impact Factor) to as much as 10 years of longer (long term impact). A period of 4-6 years is generally considered to be of appropriate length in most fields of science to assess medium-term impact levels with a sufficient degree of validity. In this study the window was aligned to the publication window – i.e. the set of publication years and citation years are identical, and set to four years.

Citation counts may or may not include author self-citations – i.e. a citation to a paper is a citation given in a publication of which at least one of the authors (either first author or a co-author) is also an author of the cited paper (again either first author or a co-author). These self-citations were excluded in this study. In fact, when focusing on 'external' impact, the counts should always exclude the author self-citations.

Within the CWTS citation analysis, **field normalization** is applied. This means that every paper, and particularly its impact, is compared within its own environment first before it is compared with others. As citation practices differ among fields, it is necessary to create benchmark values for citation data, in order to do right to the specific character of a country's or unit's output profile. Within this field-normalized impact measurement, we take into consideration the type of document (as various types of documents have different citation characteristics), and the age of the publications (as stated above, older publications have had more time to collect citation impact) as well.

Another approach in citation impact analysis is a focus on the top of the worldwide literature, and the position in that top by a country, institution, or group. Contrary to an average based impact score', we determine the actual number of publications in the fields to which the journal belongs in which the papers were published, thereby focusing on the position among other top publications. To assess the number we found, we compare the observed number of highly cited publications with the top 10% value of the countries in this analysis (which we consider as an expected value). If the actual number exceeds the expected number of highly cited publications, the ratio of this comparison will be above the value 1, indicating a relative overrepresentation of the country among the top 10% most highly cited publications, whereas a score below the value 1 indicates an under-representation of the country among the top 10% most highly cited publications. In this specific analysis we only focus on articles and reviews, as letters are considered as a too heterogeneous type of scientific communication, being often of a different nature than articles and reviews, and in some fields very rare, thus creating statistical unreliability. The analysis of highly cited publications is based on single publication years, in combination with a fixed four-year citation window. This needs to be fixed, as this gives every single publication in every single year an equal chance to contribute to the top-down ranking per field, and makes annual analyses easier. Overall, all values are aggregated, leading to one score per country. For the years 2006-2008, citation windows of 3, 2, and 1 year (for respectively 2006, 2007, and 2008 publications) are simply too short to conduct valid citation analysis, as in most fields a citation window of three to four years is needed to reach the so-called 'peak in numbers of citations received'.

As discussed above, this field-normalized impact indicator (CPP/FCSm) is a particularly powerful indicator of citation impact. This 'crown' indicator relates the measured impact of a unit of analysis to a worldwide, field-specific reference value. It is the internationally standardized impact indicator. This indicator enables us to observe immediately whether the performance of a unit of analysis is significantly far below (indicator value < 0.5), below (indicator value 0.5 - 0.8), around (0.8 - 1.2), above (1.2 - 2.0), or far above (>2.0) the international (western world dominated) impact standard of the field.

We stress however that the meaning of the numerical value of the indicator is related to the aggregation level of the entity under study. It is necessary to give some 'exegesis of the 'crown' indicator. The higher the aggregation level, the larger the volume of publications and the more difficult it is to obtain a citation impact significantly above the international level. So for example, at the 'meso-level' (e.g., a whole university, or a large institute, about 500 – 1,000 publications per year), a CPP/FCSm value above 1.2, means that the institute's impact as a whole is significantly above (the western-) world average. Then, the institute can be considered as a scientifically strong organization, with a high probability of finding very good to excellent groups. Therefore, it is important to split up large institutes into smaller groups. Only this allows a more precise assessment of research performance. Otherwise, excellent work will be 'hidden' within the bulk of a large institute or faculty.

At the level of a research group a CPP/FCSm value above 2 indicates a very strong group, and above 3 the groups can be, generally, considered as excellent and comparable to top-groups at the best US universities.

2.6.3 Scientific Cooperation Analysis

Indicators for scientific collaboration are based on an analysis of all addresses in papers published by a research unit. Each paper is classified in one of three categories. First, we identified all papers authored by scientists from one research unit only. These papers are classified as 'no collaboration' or 'single institute', as they involve no collaboration or only 'local' collaboration. The remaining papers are classified as 'national collaboration' when all addresses on a paper are from one country only. Finally, papers containing addresses from at least two different countries are assigned to the collaboration type 'international'. For example, if a paper is the result of collaboration with both another Irish institution and an institute outside Ireland, it is marked as 'international'. Papers in each of the three categories are aggregated for each unit of analysis, and for each of these aggregated sets, impact and output indicators are computed.

The purpose of this analysis is to show (1) how frequently a research unit has co-published papers with other research units, and (2) how the impact of papers resulting from national or international collaboration compares to the impact of papers authored by scientists from one unit of analysis only.

For publications under each collaboration type, the impact is compared to the field citation average (FCSm), as described above. As an indication of the impact per type, if the ratio CPP/FCSm is lower than 0.8, the impact is said to be 'low', if the ratio is higher than 1.2, the impact is designated as 'high', while a ratio between 0.8 and 1.2 is called 'average'.

3. Results

3.1 Overall bibliometric results

In this section we will start from an overall perspective, describing the situation of the Czech Republic science system over the period 1993 to 2009. Before we could start analyzing the position of the Czech Republic's performance in an international context, we start with a description of the situation of the Czech Republic's research output. In Table 1, the standard bibliometric indicators are presented for the scientific production of the Czech Republic. An extensive explanation of the indicators is given in Annex 2 to this report, Appendix B. For the interpretation of the table, we will describe the overall scores for the Czech Republic over the full period 1993-2009.

Table 8 Bibliometric statistics for Czech Republic, 1993-2009

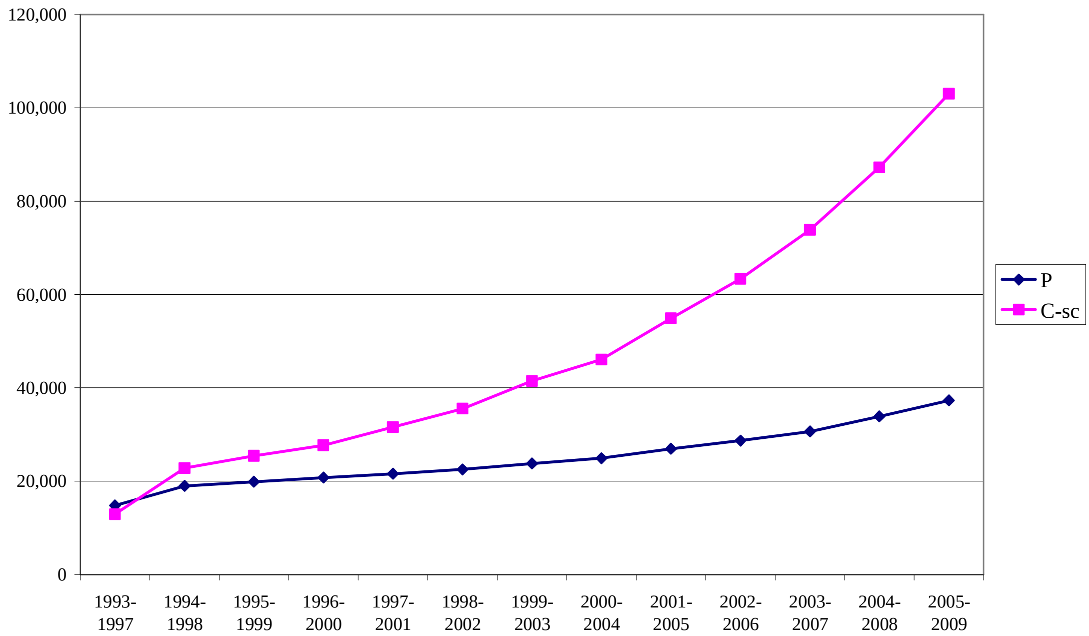
Period	P	C	C-sc	%no-cited	CPP	CPP-sc	CPP/FCSm	CPP/JCSm	JCSm/FCSm	%Self-citations
1993-2009	85,572	716,375	492,613	36.21%	8.37	5.76	0.64	0.88	0.72	31.24%
1993-1997	14,797	24,757	12,922	72.82%	1.67	0.87	0.53	0.82	0.65	47.80%
1994-1998	18,986	41,849	22,801	67.36%	2.20	1.20	0.53	0.82	0.65	45.52%
1995-1999	19,899	46,651	25,437	66.12%	2.34	1.28	0.54	0.82	0.65	45.47%
1996-2000	20,787	50,487	27,717	64.78%	2.43	1.33	0.54	0.83	0.65	45.10%
1997-2001	21,582	55,418	31,569	63.19%	2.57	1.46	0.57	0.84	0.68	43.03%
1998-2002	22,534	61,315	35,546	61.68%	2.72	1.58	0.60	0.86	0.70	42.03%
1999-2003	23,824	69,481	41,490	60.22%	2.92	1.74	0.63	0.88	0.72	40.29%
2000-2004	24,951	75,578	46,069	58.69%	3.029	1.85	0.65	0.89	0.73	39.04%
2001-2005	26,966	87,918	54,907	56.39%	3.26	2.04	0.67	0.90	0.74	37.55%
2002-2006	28,724	99,373	63,359	54.57%	3.46	2.21	0.70	0.93	0.76	36.24%
2003-2007	30,659	114,257	73,833	53.39%	3.727	2.41	0.75	0.96	0.78	35.38%
2004-2008	33,880	134,351	87,244	52.09%	3.965	2.58	0.78	0.98	0.80	35.06%
2005-2009	37,341	157,770	103,008	50.23%	4.225	2.76	0.79	0.98	0.81	34.71%

The total output of the Czech Republic during the period of analysis amounts a total of 85,572 publications and a total of 492,613 citations (excluding self-citations). In total, 36% of all publications that were produced by the Czech Republic were not cited at all in that period. The average impact is 8.37 citations per publication, while the mean impact after correction for stations is 5.76 citation per paper. Self-citing is a normal phenomenon in science, as scientists need to cite their one work when they build up a consistent output over the years. Furthermore, due to publication delays, scientists are citing their own work more often as external citations can only arrive after their publications have been made public. The percentage of self-citations is still within a reasonable band width (as we normally observe between 20-40% self citations in our studies). The field normalized impact score CPP/FCSm is 0.64, that is, 36% below worldwide average impact level. The publications appeared in journals with a low status in the field to which the journal belonged (JCSm/FCSm is 0.72).

The normalized indicators show that the Czech Republic is performing below the international level. However the trend analysis presents an increasing positive pattern in all the indicators. These trends are worked out in more detail below.

Figure 1 shows that both the scientific production (P) and the impact in absolute terms (numbers of citations without self-citations, C-sc) are both increasing during the period of analysis. It is remarkable to observe the sustained increment of the impact, developing at a much faster pace than the number of publications, thus indicating a remarkable improvement in the quality of the scientific publication output of the Czech Republic over time.

Figure 5 Output and impact numbers for Czech Republic, 1993-2009.



In the same line as in Figure 1, **Figure 2** shows how the percentages of papers without citations as well as the percentage of self-citations decrease over time (roughly 30% for both indicators. As both indicators cover specific aspects of visibility, through citation flows, either directly (percentage not cited) or indirectly (percentage not cited), these two indicators are important when we consider the research performance of scientists in the Czech R&D system.

The percentage publications not cited (within a five year period) decreases from over 70% in the early years of the period of analysis, to 50% in the period 2005-2009. This is a decrease of nearly 30%. The percentage self-citation decreases from nearly 50% in the early years of the analysis, to 35% in the later year blocks of the trend analysis. Thereby, this percentage ends at an international level of 'normal' level, as we often observe in our studies self-citations shares to vary between 20-40% in a five-year period.

So concluding we can state that these two indicators suggest that the output of the Czech Republic becomes more internationally visible over the period 1993-2009.

Figure 6 International visibility of the Czech Republic as indicated by percentages of publications not cited and self citations, 1993-2009.

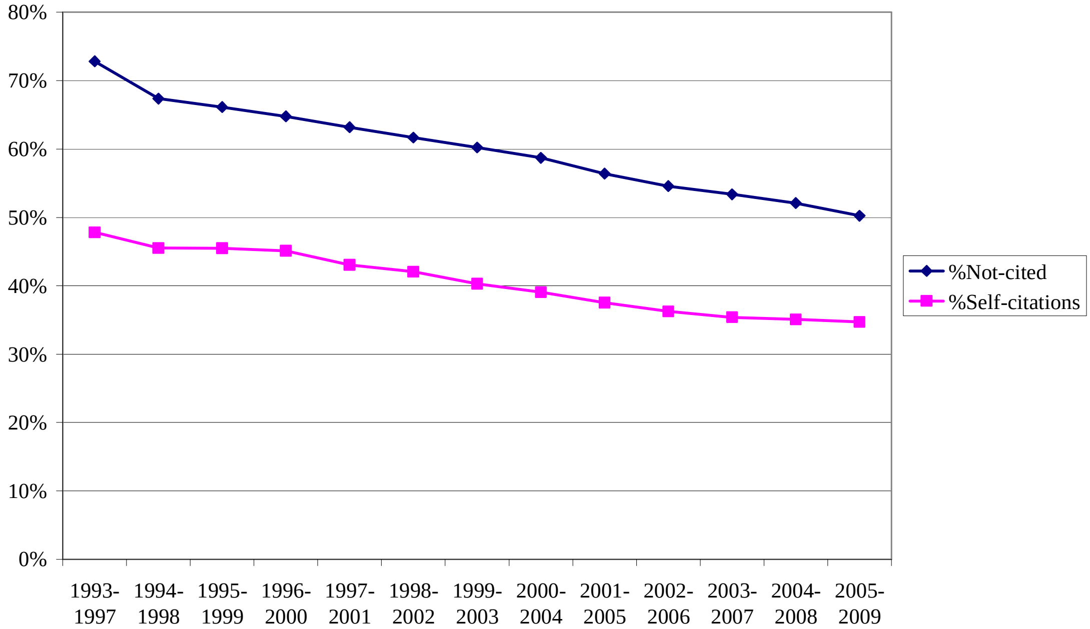
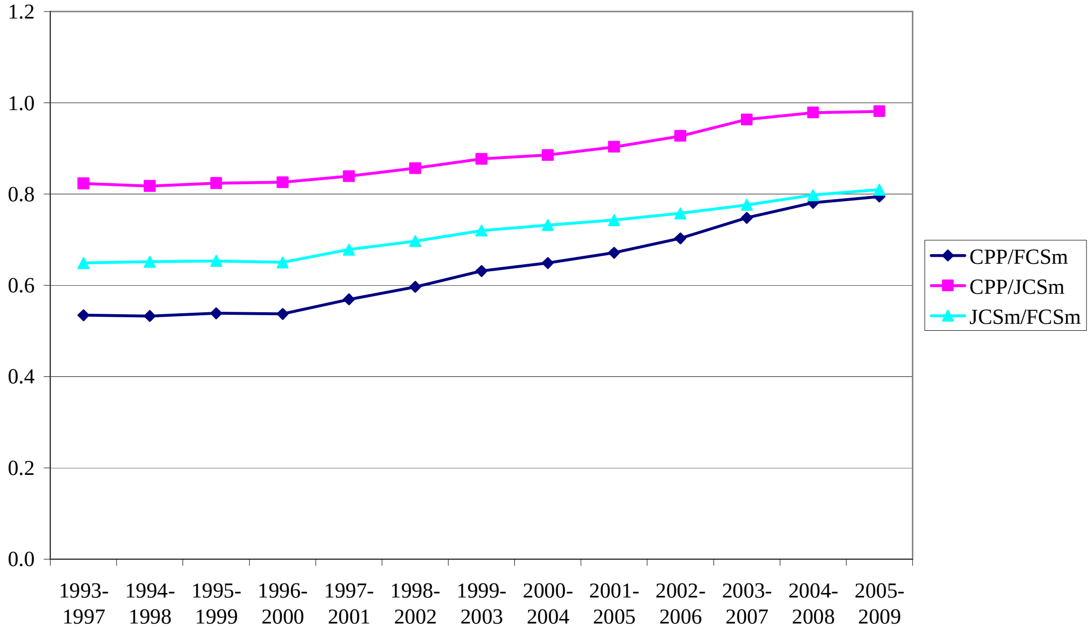


Figure 3 contains the trends for the three ratio indicators CPP/JCSm, CPP/FCSm, and JCSm/FCSm. For all three, we find that the values are still below the value 1 (international field impact level) during the full period, however we also observe a pattern of increasing values for all three normalized impact indicators.

It is important to note that the researchers in the Czech Republic have chosen for journals with higher impact throughout the period of analysis (compared to the previous period), so increasing impact levels are not due to publishing in mediocre or low impact journals. We observe an ambitious publication strategy.

The incremental pattern for the three normalized impact scores is particularly clear for the CPP/FCSm, and an interesting observation in the trend analysis relates to the period 1996-2000, as this period marks a change in the impact pattern of Czech publications.

Figure 7 Normalized impact scores for the Czech Republic, 1993-2009.



3.2 Research profile of the Czech Republic

In this section the research profile for the Czech Republic over the period 1993-2009 is presented. **Figure 4** shows this profile.

The largest field is Physics & materials science, covering over 18% of the total Czech output in the period 1993-2009, followed by Chemistry & chemical engineering (with over 16% of the national output of the Czech Republic). The 35% of the output in these two fields of the natural sciences makes the research profile of the Czech Republic a very traditional European continental profile, resembling the profiles of particularly Germany, France and Italy (contrary to a more Anglo-Saxon profile, in which the life and medical sciences play a more dominant role).

Clinical medicine covers only 10% of the national output, thereby further underlining the observed preference for the natural sciences (in similar large countries, like Denmark and the Netherlands, countries with this Anglo-Saxon profile, the contribution to clinical medicine can rise to shares varying between 25-30% of the national research output).

Other disciplines covering more than 5% of the national output are Basic life sciences, Biomedical sciences, and Biological sciences. In all of the abovementioned disciplines, we observe low impact scores, that is, representing values below the value of 0.80 on the indicator CPP/FCSm, the field normalized impact score.

In the profile we observe only a few disciplines with average impact levels, namely mathematics & statistical sciences, Environmental sciences and technology, and with a much smaller output, Literature, Management and planning.

Figure 8 Research profile of Czech Republic's research output, period 1993-2009

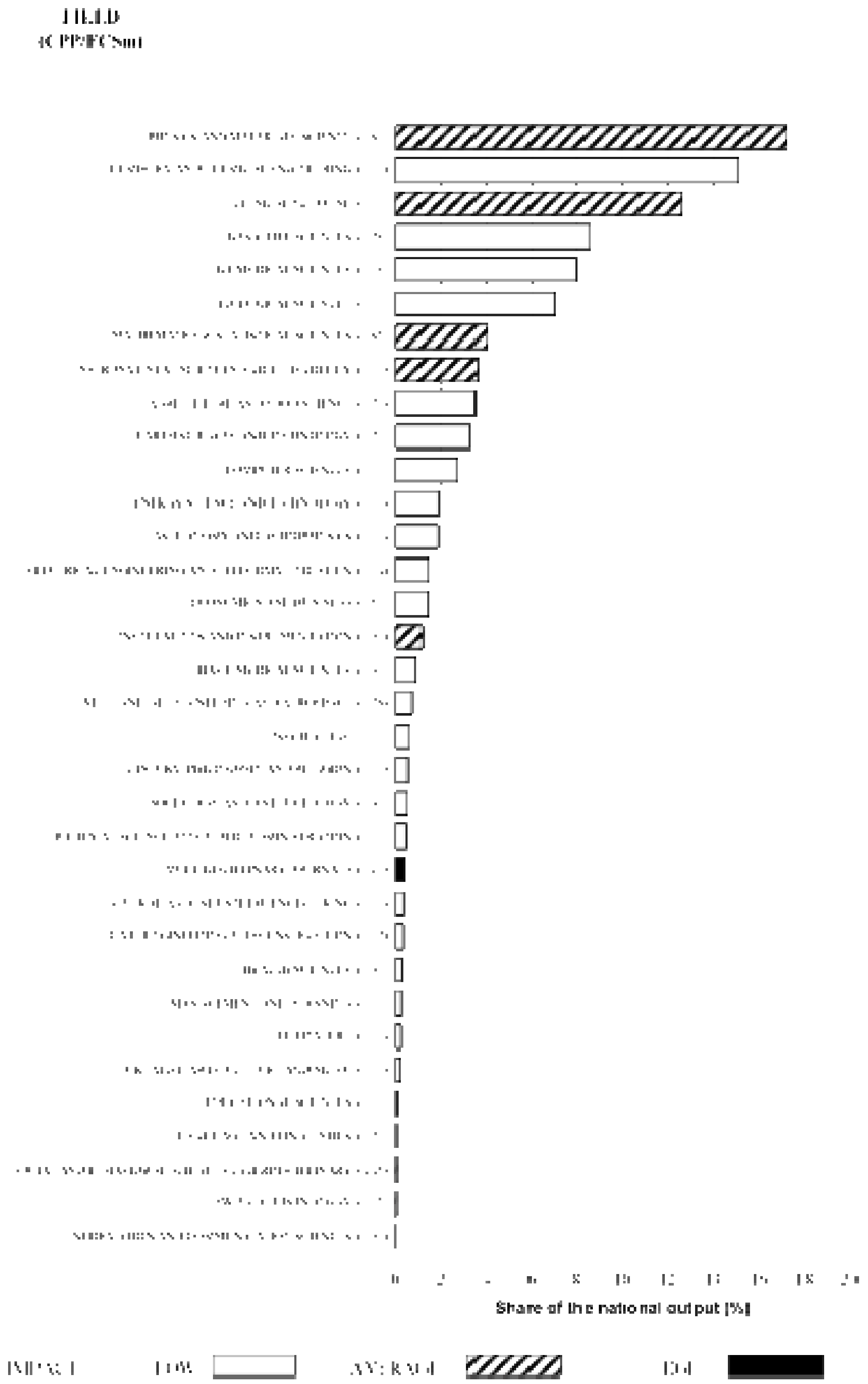
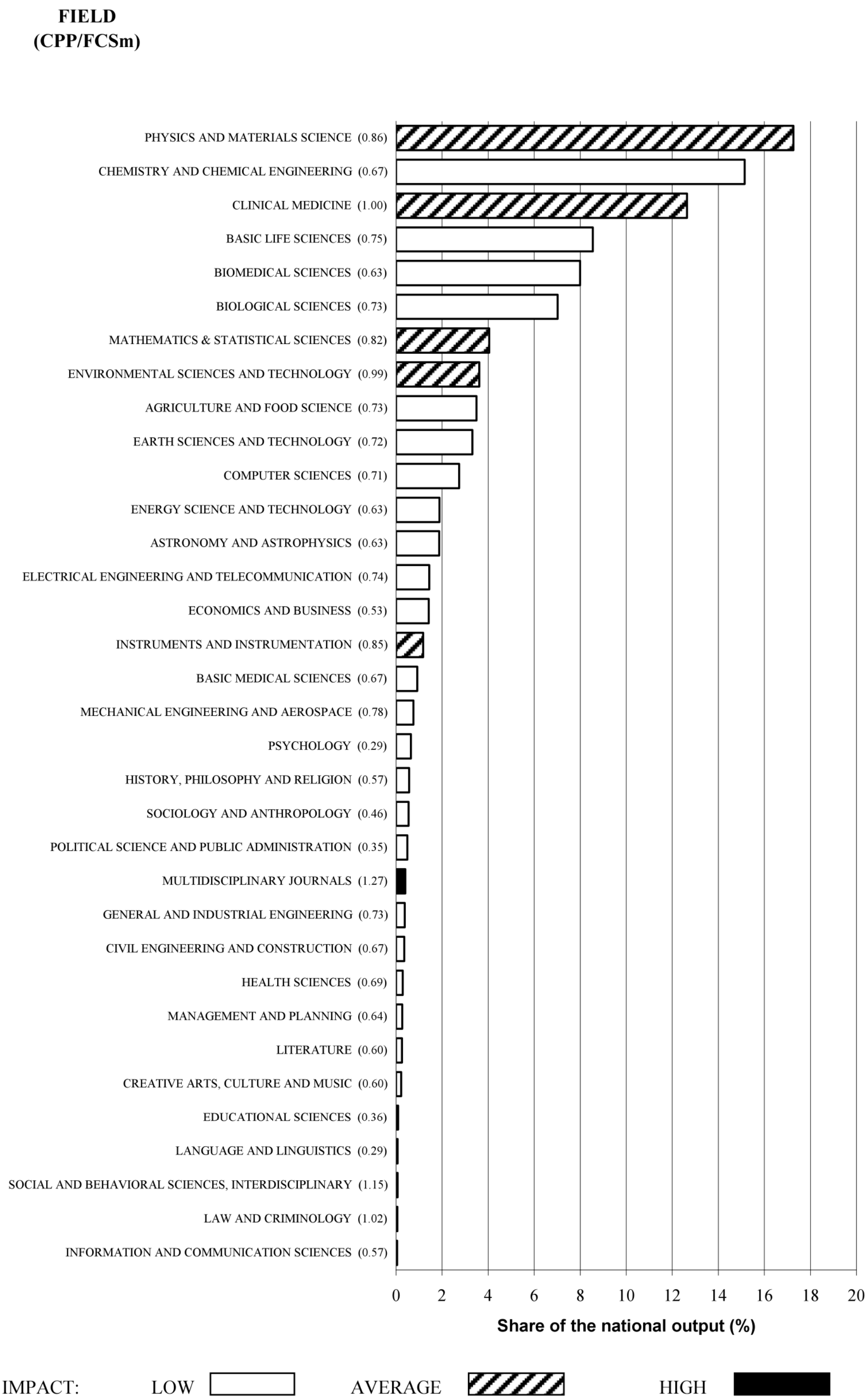


Figure 9 Research profile of Czech Republic's research output, period 2005-2009



In **Figure 5** we present the research profile of the Czech Republic representing the research output of the last period (2005-2009). The profile has a similar composition as the one describing the full period 1993-2009, with a few remarkable differences.

A first difference relates to the somewhat more modest volume of publications in the hard natural sciences related to physics and chemistry (Physics and materials science and Chemistry and chemical engineering), compared to the life and medical sciences related disciplines.

A second difference relates to the increased impact of two of the six largest disciplines in which Czech scientists are active in the period 2005-2009 (Physics and materials science and Clinical medicine). However, also the other top ranking disciplines in the profile display an increasing impact for Czech science. Other fields in which the impact has increased for Czech science are mathematics & statistical sciences, Environmental sciences and technology, Instruments and instrumentation, and notably, Social and behavioural sciences, interdisciplinary applications, all with average impact levels, while in Multidisciplinary sciences, a field that covers multidisciplinary top journals such as Nature, Science, and the Proceedings of the National Academy of Sciences of the USA, we note an even high impact score for Czech publications.

3.3 Scientific cooperation analysis on Czech research papers

Figure 6 shows the importance of collaboration for Czech researchers, as over two/third of the Czech output is somehow the effect of scientific cooperation.

Although over 30% of the Czech research output carries only one Czech address, most publications carry either two national and/or international addresses.

An important observation relates to the impact generated by publications forthcoming from national or particularly international cooperation. Publications resulting from international cooperation have an impact level twice as high as the publications resulting from national cooperation.

Figure 10 Scientific cooperation profile output and impact per type 1993-2009

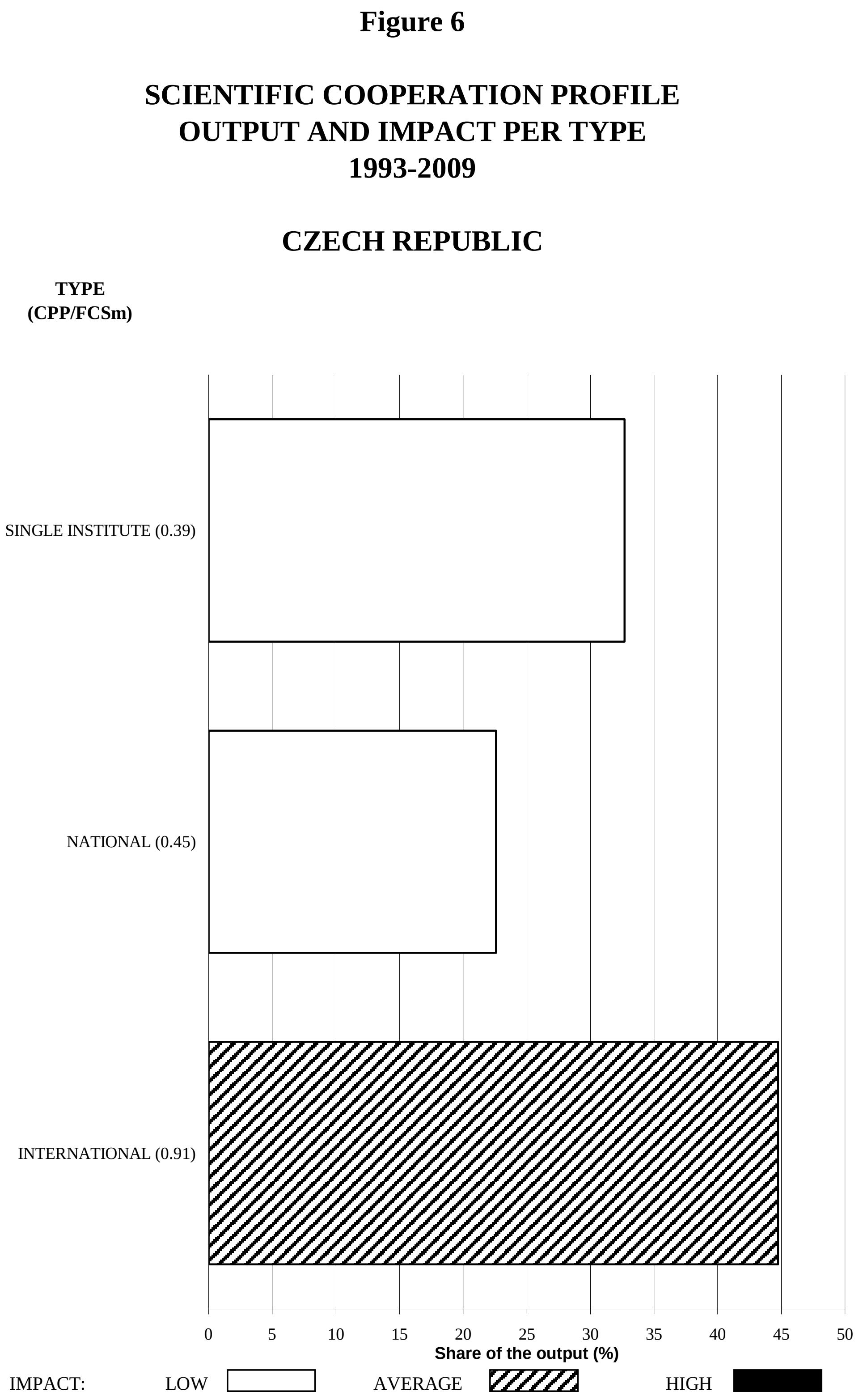


Figure 7 contains the development over time for the three types of scientific activity for the Czech science system.

In this graph, we observe an interesting and important development, namely that of the decreasing relevance of the publications resulting from activities strictly local, that carrying only one address (changing from 45% of the national output in the period 1993-1997 to 27% in the period 2005-2009), while on the other hand we notice a strong growth of publications that involve either national cooperation (a change from 15% to 27% of the Czech output in the two periods mentioned above) or international cooperation (which shows a much smaller increase, from 40% in 1993-1997 to 46% in 2005-2009).

Figure 11 The evolution of the three collaboration types, 1993-2009

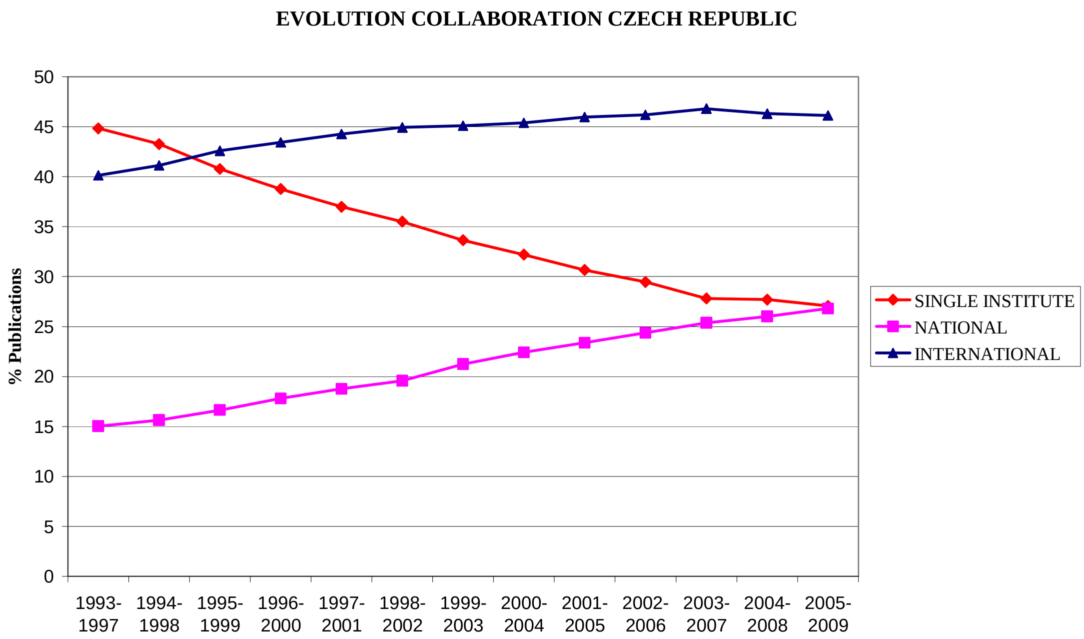


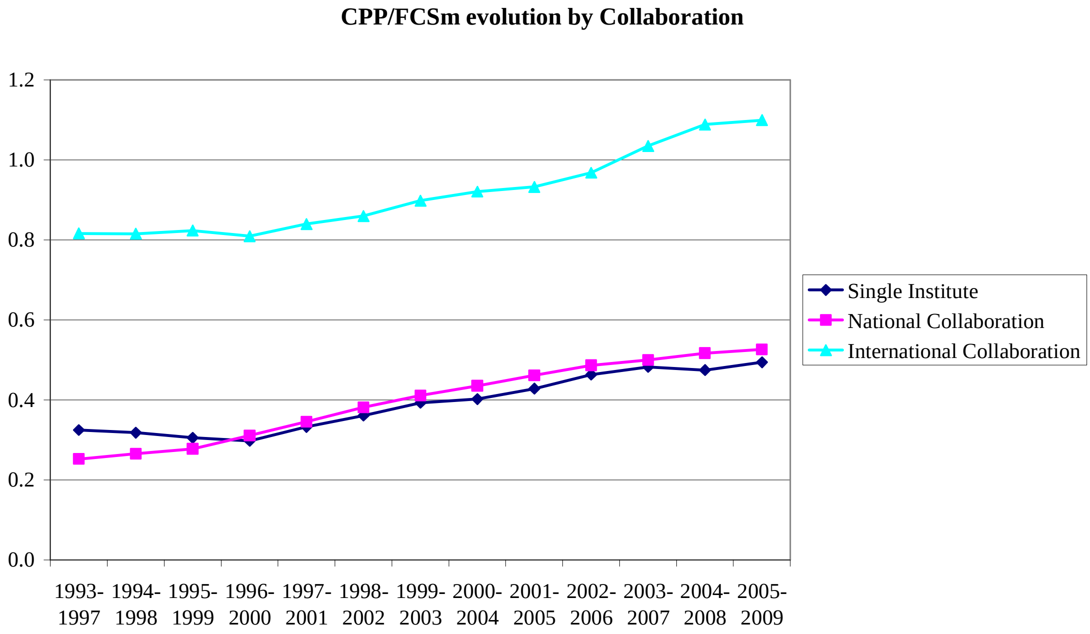
Figure 8 depicts the development over time for the three types of scientific activity for the Czech science system. In this graph, we observe increasing trends in the impact for all three types.

The highest impact is generated by the publications resulting from international cooperation (increasing from 20% under worldwide field average impact level in 1993-1997 to 10 % above worldwide field average impact level). This latter development is a common phenomenon, which we observe more often for other countries (van Leeuwen, 2009).

However, also the impact of the other two types of scientific activity show increasing impact levels, of roughly 75% below field average impact level to 50% below worldwide field average impact level. And although this is still below worldwide average field impact level, this is a twice as high impact, which is a clear indication of the process of change in which the science system of the Czech Republic is involved.

Please note that the change in development is occurring for both single address publications and international collaborative publications from the period 1996-2000 onwards, while the output resulting from national cooperation has increased form the first year block covered by the trend analysis.

Figure 12 Impact development of the three collaboration types, 1993-2009



3.4 Benchmarking analysis of the Czech output in an international context

Finally, in Table 2 we present the results of the comparison of the Czech Republic with eight benchmark countries (Austria, Denmark, Finland, Germany, Hungary, the Netherlands, Slovenia, and Sweden). The data in the Table cover the period 1993-2009.

The data in the table show that the Czech Republic's output is among the smallest output among this set of countries. The output volumes of the Czech Republic, Hungary and Slovenia are of a similar volume, compared to the other six countries in the comparison.

Next, we also observe that the number of received citations is small; only Slovenia received less citations compared to the Czech Republic.

With respect to the normalized impact scores, we find the Czech Republic again next to Hungary and Slovenia, two countries with a similar impact level, although the latter two countries tend to publish in journals with somewhat higher impact levels in the field to which they belong. Countries with high impact scores are Finland, Sweden, Denmark, and the Netherlands (with impact levels of 19%, 20%, 27%, and 30% above worldwide average field impact level, respectively).

Table 9 Bibliometric statistics for Czech Republic and the eight benchmark countries, 1993-2009

COUNTRIES	P	C+sc	C-sc	%not cited	CPP	CPP-sc	CPP/ FCSm	CPP/ JCSm	JCSm/ FCSm	%Self-citations
CZECH REPUBLIC	85,572	716,375	492,613	36.21%	8.37	5.76	0.64	0.88	0.72	31.24%
AUSTRIA	135,685	1,973,675	1,567,413	24.83%	14.55	11.55	1.05	1.07	0.99	20.58%
DENMARK	143,097	2,691,612	2,163,410	17.82%	18.81	15.12	1.27	1.14	1.11	19.62%
FINLAND	131,212	2,209,274	1,775,041	20.19%	16.84	13.53	1.19	1.09	1.10	19.66%
GERMANY	1,198,783	18,359,597	14,518,829	24.34%	15.32	12.11	1.06	1.07	1.00	20.92%
HUNGARY	74,171	797,784	592,208	29.40%	10.76	7.98	0.78	0.90	0.87	25.77%
NETHERLANDS	371,790	6,871,365	5,619,692	19.02%	18.48	15.12	1.30	1.11	1.17	18.22%
SLOVENIA	28,738	224,206	159,261	37.31%	7.80	5.54	0.72	0.87	0.83	28.97%
SWEDEN	272,022	4,934,775	4,002,460	17.97%	18.14	14.71	1.20	1.11	1.08	18.89%

Figure 9 presents a graphical display of the output and impact of the Czech Republic and the benchmark countries over the period 1993-2009. We use both the output volume (presented on the x-axis) and the impact score (as indicated by the CPP/FCSm, on the y-axis) for the analysis over the period 1993-2009.

Here we clearly observe the large difference in output between Germany and the other eight benchmark countries. On the other hand, we observe the differences in impact levels among the benchmark countries, as mentioned before.

Figure 13 Impact compared to World field average 1993-2009

Figure 9

**IMPACT COMPARED TO WORLD FIELD AVERAGE
1993 - 2009**

The Czech Republic compared with 8 benchmark countries

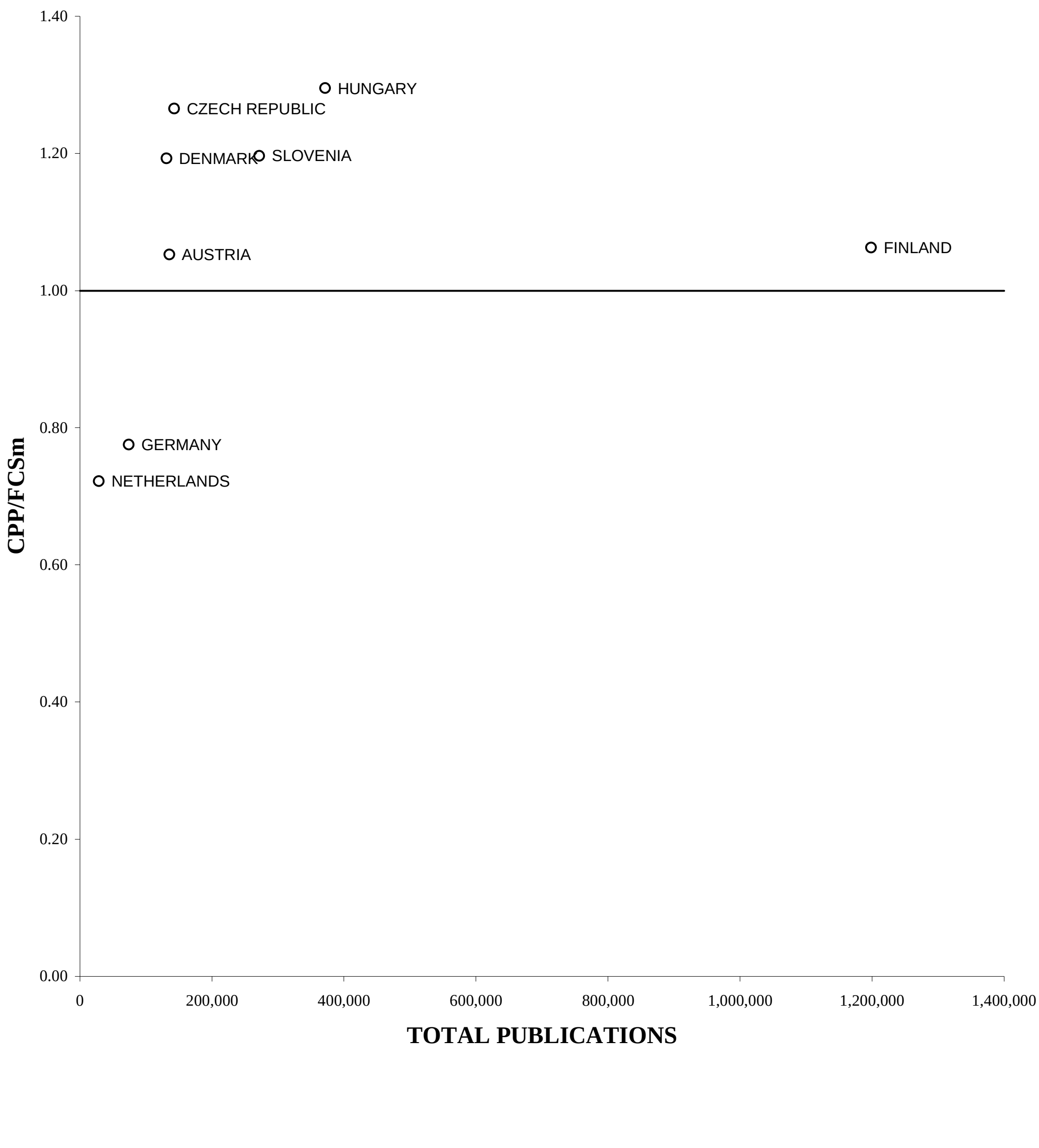


Figure 10 presents a graphical display of the output development of the Czech Republic and the eight benchmark countries.

All nine countries show an increase in the output, which is not clearly visible due to the abovementioned difference in output volume between Germany and all other eight countries. Therefore, we conducted an analysis on the relative development for every country from the first period 1993-1997 onwards.

This analysis is presented in **Figure 11**. This graph clearly shows that the three somewhat smaller countries in terms of output volume (the Czech Republic, Slovenia, and Hungary) display the largest growth in output in the period between 1993 and 2009.

For an overview of the annual output numbers, we refer to Annex 2 to this report, Appendix C.

Figure 10: Output development of the Czech Republic in comparison with the eight benchmark countries, 1993-2009

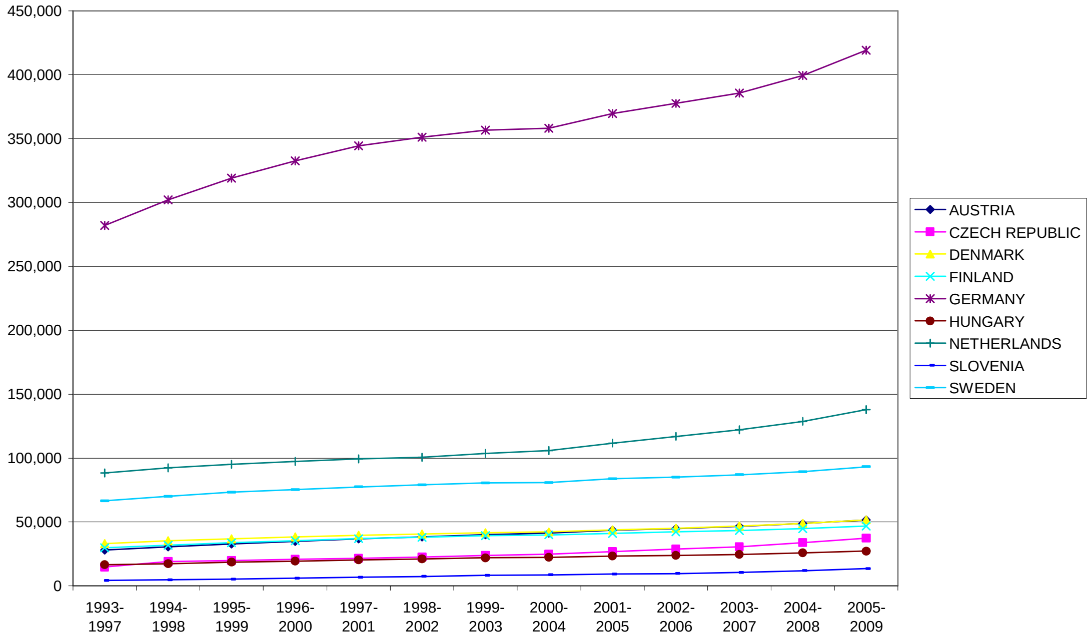
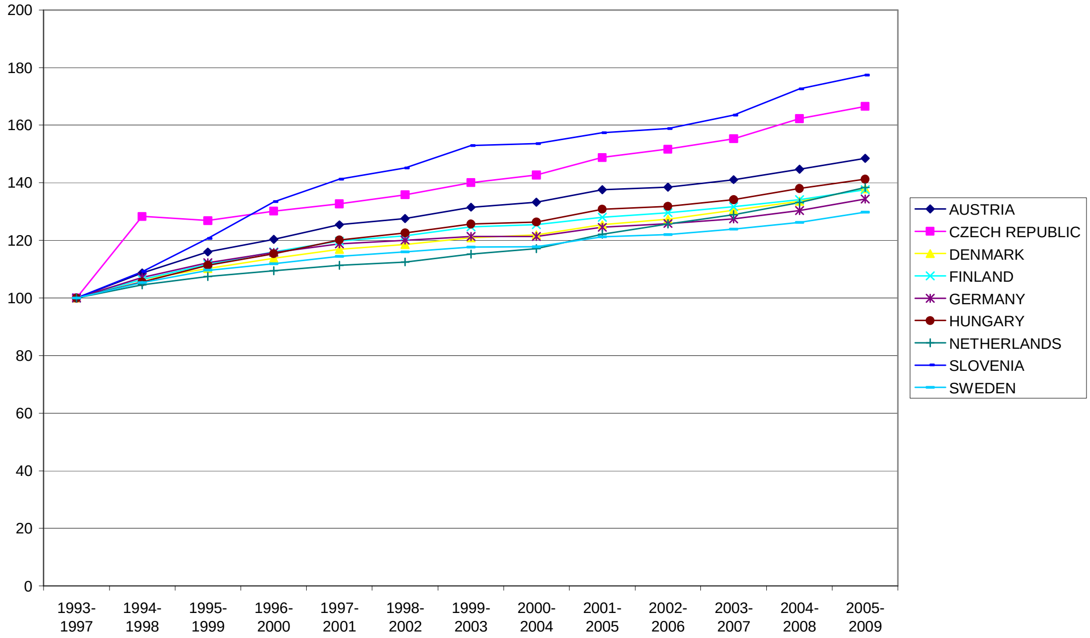


Figure 11: Relative output development of the Czech Republic in comparison with the eight benchmark countries, 1993-2009



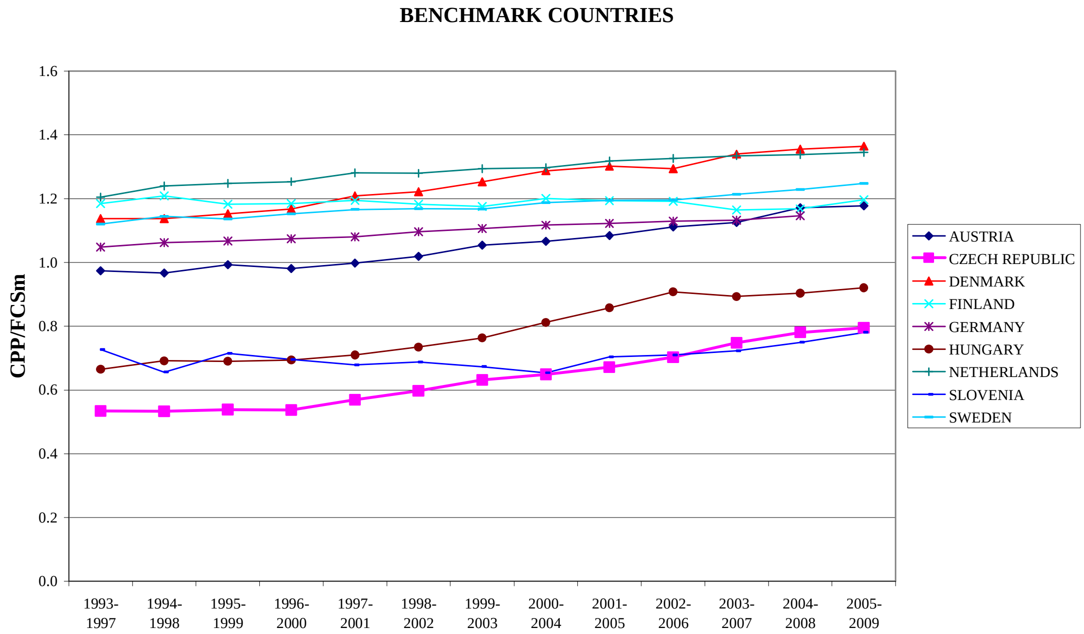
In **Figure 12** the development of the impact of the nine countries is shown in a trend analysis.

It becomes clear from the graph that the group of benchmark countries is split up into two sub-sets, with in the one group the Czech Republic, Hungary and Slovenia, and the other countries in the other group.

One could observe a slight convergence of the two groups, with the former group increasing its' impact position, towards worldwide average field impact level. On the other hand, the other six countries display this same increasing trend.

For an overview of the complete set of bibliometric indicators per country, for the full period and the trend analysis, we refer to Annex 2 to this report, Appendix D.

Figure 12: Evolution of the field normalized impact score CPP/FCSm of the Czech Republic in comparison with the eight benchmark countries, 1993-2009



In **Figure 13**, the most recent five-year period is displayed with respect to both output and impact.

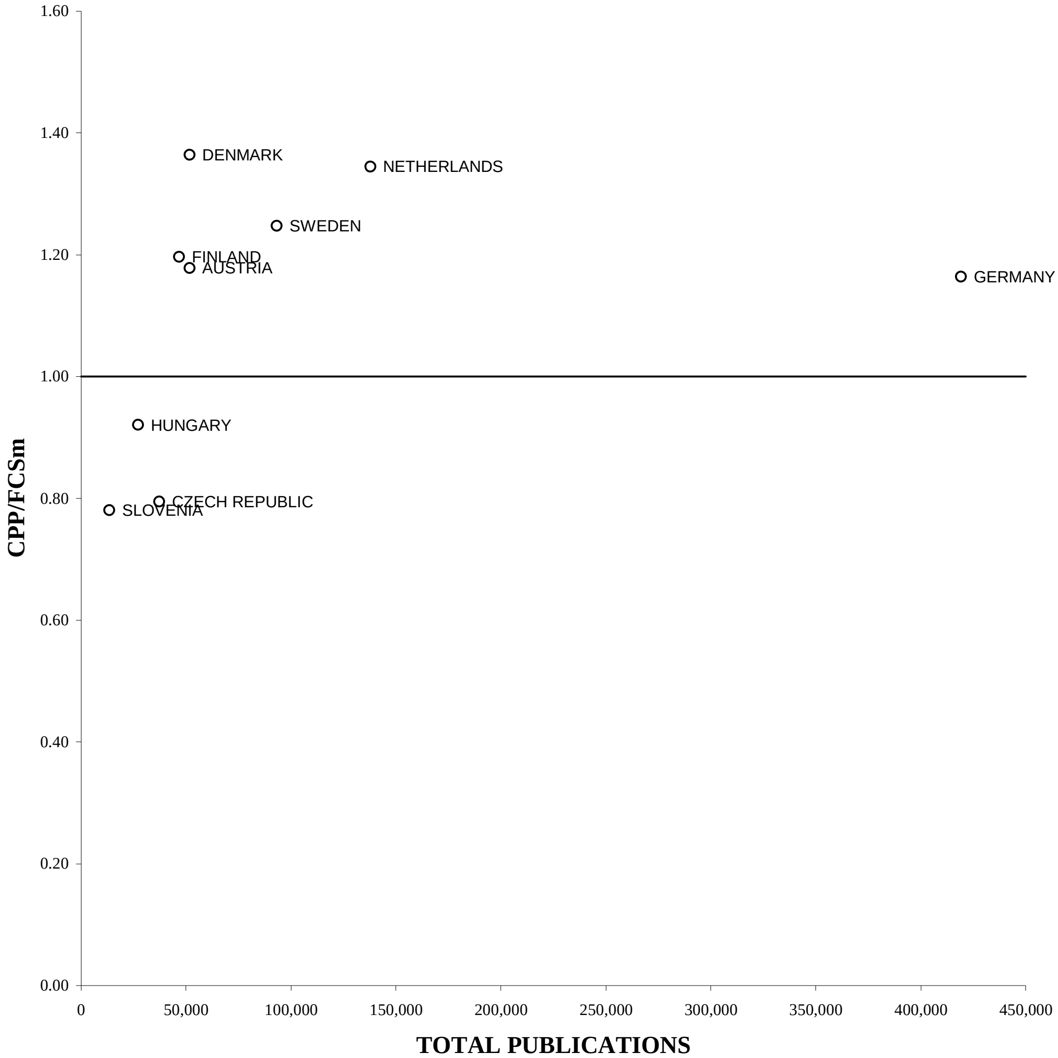
From this more recent landscape it becomes clear that the three countries Czech Republic, Hungary and Slovenia have improved their impact position, and moved more closely to the worldwide average field impact level.

On the other hand, we notice the (minor) changes in the set of other countries, where Denmark has improved its' position, just as Austria did.

Figure 13

IMPACT COMPARED TO WORLD FIELD AVERAGE 2005-2009

The Czech Republic compared with 8 benchmark countries



In Table 3 we present the results of the analysis on productivity, which here stands for productivity per capita. Here we used the population statistics retrieved from the OECD database on population statistics for eight countries. We used the 2010 data, covering population statistics over the period 1003-2008, as 2009 was not yet available). Furthermore, for Slovenia we had to retrieve the data from the Slovenian Statistical Office as this was not included from in the OECD dataset (we had to work with 2007 data, as more recent data were not yet available).

The choice was made to use population data rather than researcher input data, as this latter type of data is strongly influenced by definition issues: not in all countries, various types of researchers are equally treated. Yet another problem with labour force based productivity measures is the ignoring of the so-called through-put phase: when do certain investments in the science system, in the broadest context, give you a certain return in terms of output numbers, let alone impact measures? Therefore, productivity measures are here calculated as the mean annual number of publications per inhabitant over the period analyzed. So the productivity scores over 1993-2009 are based on more years, and a relatively lower number of inhabitants, compared to the more recent period (here we have less years, but an increased output, and an increased number of inhabitants). For both periods, we have compared the productivity scores (Delta P). Similarly we have compared the impact scores over the periods 1993-2009 and 2005-2009, equally long as the productivity measures are based upon.

In terms of productivity change, we notice that the Czech Republic has the third largest increase of the productivity per inhabitant, after Slovenia and Hungary (with increases of 59%, 58%, and 48%, respectively). Furthermore, the analysis of the change of impact shows that the Czech Republic has realized the largest increase in impact (an increase of 25%), followed by Hungary (with an increase of 19%).

Table 10 Bibliometric statistics for Czech Republic and the eight benchmark countries, on productivity based on population statistics, 1993-2009

	Productivity 93-09	CPP/FCSm 93-09	Productivity 05-09	CPP/FCSm 05-09	Delta P	Delta I
AUSTRIA	0.0010	1.05	0.0012	1.18	27.07	11.91
CZECH REPUBLIC	0.0005	0.64	0.0007	0.79	47.95	24.94
DENMARK	0.0016	1.27	0.0019	1.36	20.36	7.86
FINLAND	0.0015	1.19	0.0018	1.20	19.03	0.32
GERMANY	0.0009	1.06	0.0010	1.16	18.56	9.50
HUNGARY	0.0005	0.78	0.0007	0.92	58.03	18.77
NETHERLANDS	0.0014	1.30	0.0017	1.34	22.58	3.83
SLOVENIA	0.0008	0.72	0.0013	0.78	58.97	8.10
SWEDEN	0.0018	1.20	0.0020	1.25	14.11	4.29

In Table 4 we present the bibliometric scores while comparing the Czech Republic with other countries across the fields previously introduced. We calculated Activity Index scores. This Activity Index works as a relative/comparative indicator. For the Czech Republic we determined what share of the output was produced in which fields, and calculated average activity scores for the set of countries.

Please note that we did not base the benchmark Activity Index on the sum of absolute numbers of publications, but on the average of shares per country, thereby giving equal weight to every country's specialization. Furthermore, Tables 4 also contains the comparison of the impact development of the Czech Republic across fields over time. We express the change of the impact over time, comparing the full period 1993-2009 with the last five-year period, in order to indicate whether the Czech Republic has improved its international influence across fields. Particularly in combination with the comparison with activity across fields, this table can be seen as an important marker for the current situation of the science system of the Czech Republic.

It is important to mention a number of fields in which the Czech scientists have a relative strong position. These fields are Chemistry and chemical engineering, physics and materials science, biological sciences, to name few. In clinical medicine, the Czech scientists are under performers compared to their colleagues in the eight benchmark countries. With respect to the impact, we notice a strong increase of the research conducted in the Czech Republic related to the social sciences, and although the impact scores are still at an internationally low level, it is important to note the changes apparently going through the system, as the international visibility improves clearly.

Overall this is sign that the Czech science system is improving overall, creating a broader basis for a strong scientific performance.

For an overview of the annual number of publications per country and field combination, we refer to Annex 2 to this report, Appendix E.

Table 11 Bibliometric statistics for Czech Republic and the eight benchmark countries, across fields, 1993-2009

	Czech Republic	Mean relative activity 8 benchmark countries	Over/underactivity	CPP/FCSm 93-09	CPP/FCSm 05-09	Change Impact
AGRICULTURE AND FOOD SCIENCE	3.5	2.9	0.6	0.43	0.73	72%
ASTRONOMY AND ASTROPHYSICS	1.9	1.6	0.3	0.47	0.63	35%
BASIC LIFE SCIENCES	8.5	9.4	-0.8	0.64	0.75	17%
BASIC MEDICAL SCIENCES	0.9	1.2	-0.3	0.58	0.67	17%
BIOLOGICAL SCIENCES	7.0	4.6	2.4	0.59	0.73	23%
BIOMEDICAL SCIENCES	8.0	9.4	-1.4	0.53	0.63	19%
CHEMISTRY AND CHEMICAL ENGINEERING	15.1	9.3	5.8	0.59	0.67	13%
CIVIL ENGINEERING AND CONSTRUCTION	0.4	0.5	-0.1	0.67	0.67	-1%
CLINICAL MEDICINE	12.6	20.4	-7.8	0.76	1.00	30%
COMPUTER SCIENCES	2.7	2.6	0.1	0.74	0.71	-3%
CREATIVE ARTS, CULTURE AND MUSIC	0.2	0.3	0.0	0.59	0.60	1%
EARTH SCIENCES AND TECHNOLOGY	3.3	3.0	0.3	0.61	0.72	19%
ECONOMICS AND BUSINESS	1.4	1.2	0.3	0.22	0.53	140%
EDUCATIONAL SCIENCES	0.1	0.4	-0.3	0.30	0.36	22%
ELECTRICAL ENGINEERING AND TELECOMMUNICATION	1.4	2.1	-0.7	0.68	0.74	8%
ENERGY SCIENCE AND TECHNOLOGY	1.9	1.5	0.4	0.54	0.63	17%
ENVIRONMENTAL SCIENCES AND TECHNOLOGY	3.6	4.3	-0.7	0.82	0.99	21%
GENERAL AND INDUSTRIAL ENGINEERING	0.4	0.8	-0.4	0.65	0.73	13%
HEALTH SCIENCES	0.3	1.7	-1.4	0.52	0.69	32%
HISTORY, PHILOSOPHY AND RELIGION	0.6	0.6	0.0	0.34	0.57	67%
INFORMATION AND COMMUNICATION SCIENCES	0.0	0.2	-0.2	0.73	0.57	-22%
INSTRUMENTS AND INSTRUMENTATION	1.2	1.0	0.2	0.79	0.85	8%
LANGUAGE AND LINGUISTICS	0.1	0.3	-0.2	0.46	0.29	-38%

LAW AND CRIMINOLOGY	0.1	0.2	-0.2	0.81	1.02	26%
LITERATURE	0.3	0.2	0.1	0.86	0.60	-30%
MANAGEMENT AND PLANNING	0.3	0.8	-0.5	0.88	0.64	-27%
MATHEMATICS & STATISTICAL SCIENCES	4.1	2.9	1.1	0.88	0.82	-7%
MECHANICAL ENGINEERING AND AEROSPACE	0.8	0.9	-0.2	0.58	0.78	36%
MULTIDISCIPLINARY JOURNALS	0.4	0.7	-0.3	0.70	1.27	83%
PHYSICS AND MATERIALS SCIENCE	17.3	12.5	4.8	0.73	0.86	17%
POLITICAL SCIENCE AND PUBLIC ADMINISTRATION	0.5	0.3	0.2	0.14	0.35	157%
PSYCHOLOGY	0.6	1.3	-0.7	0.27	0.29	6%
SOCIAL AND BEHAVIORAL SCIENCES, INTERDISCIPLINARY	0.1	0.5	-0.4	0.65	1.15	76%
SOCIOLOGY AND ANTHROPOLOGY	0.5	0.5	0.1	0.25	0.46	82%

CPP/FCSm stands for the comparison of the actual impact (CPP, Citation per publication) with the field normalized average impact level (FCSm) related to the output

4. Conclusions

In this first Interim Report, we have produced a first impression of the current situation of the Czech Republic's science system, in an international context. The focus on the full period 1993-2009 provides a clear view on the situation the Czech Republic came from, and where it stands right now, being part of the EU, partner in European powerhouse Europe. The study so far clearly shows that the Czech Republic's science system has gone through drastic changes, as a new republic coming from a communist era. The opening of the country to Europe and the entrance to the European Union has created large opportunities for the Czech Republic.

In this study we have focused on the research performance of the Czech Republic from a top down perspective, thereby comparing the Czech Republic with a number of benchmark countries such as neighbour countries (Austria, Germany, Hungary) or countries of similar size (such as Slovenia), as well as some smaller European countries with a strong research performance (such as Denmark, Finland, the Netherlands, and Sweden). We analyzed the research performance of this set of countries over a longer period to be able to notice significant trends in the development of the Czech Republic in this international context. It is important to stress that the data used for the analysis were retrieved from the Web of Science, an internationally renowned bibliographic database of a multidisciplinary nature, covering mainly international journals. Therefore, English as a language of publication is the main focus of this study. This does not mean that other scientific output, such as publications in the Czech language or in German, is less valid, but it has another function in the scientific communication process between scientists and users of scientific knowledge.

The output in the journals processed for the Web of Science of the Czech Republic has nearly tripled over the period 1993-2009, while the number of citation received by researchers from the Czech Republic is more than six times more in 2005-2009 compared to 1993-1997. The impact of the publications from the Czech Republic has increased strongly, and although still somewhat below worldwide average impact level, the impact was at such a level that an improvement to a worldwide average level was not to be expected on such a short notice. In general we observe an increasing international visibility of the output of researchers from the Czech Republic, for instance as more and more publications of Czech scientists are cited in the international journal literature.

The composition of the research conducted in the Czech Republic shows a slow change in scope. As one of the former East block countries, with a traditional strong focus on the natural sciences and mathematics, the country's research profile is now slowly changing into a profile in which (bio)medicine and health sciences play a somewhat stronger role. Yet another important observation is, in relation to what we concluded on the overall performance of the Czech science system, namely an improvement of the impact in the most important fields in the national research profile.

The Czech scientists show an increasing trend of international involvement. Over the whole period, some 45% of all publications are the result of international collaborations. This part of the Czech Republic's output has remained relatively stable. The largest change in the Czech science system was the huge shift from publications with no collaboration at all, to many publications resulting from national cooperation, thereby showing that internal cohesion has improved in the Czech science system. In that light it is important to stress that these latter types of scientific activity also show an increase of the impact. This is an important observation, as normally the impact is generated by international cooperation publications, and of course this is partially the case for the Czech Republic, the publications resulting form national cooperation follow at least a similar pattern, thereby contributing to the strength of the system.

The comparison with a number of benchmark countries makes clear that the Czech Republic has still a long way to. The development of the Czech Republic is comparable with that of Hungary and Slovenia, one also observes a distance, particularly with respect to scientific impact with the smaller countries in the study. Countries as Denmark and the Netherlands, well-known scientific European powerhouses, outperform the Czech Republic. However, that is part of benchmarking exercise, as it has no use of comparing with only weaker actors. It is important to stress that the pace of the development of the Czech Republic in terms of the output development is somewhat faster compared to the benchmark countries, thereby bridging the gap between the leading countries in this comparison and themselves. In terms of impact, we also observe an upwards trend for the Czech Republic, although not as clear as the output development.

When we look at the productivity of researchers in the Czech Republic (calculated in terms of output per inhabitant), we clearly observe a positive trend. When we compare the full period 1993-2009 with the most recent period, the researchers in the Czech Republic are catching up strongly, together with their colleagues in Hungary and Slovenia. The improvement in output per inhabitant increases with roughly 50% for the researchers in these three countries. When we compare the impact development over the two periods mentioned, we find an even more important development, namely an increase of the Czech impact of nearly 25%, making this the strongest increase observed among the benchmark countries

The analysis of the research fields across the set of benchmark countries clearly shows a certain preference of the Czech Republic. The country is more active in number of fields traditionally belonging to their research profile, such as chemistry and chemical engineering, physics and materials science, biological sciences, and to a lesser extent, mathematics and statistics.

A field in which the Czech Republic is underperforming in terms of output is clinical medicine, which is partially due to the fact that the Scandinavian countries and the Netherlands are moving towards an Anglo-Saxon research profile for a longer time, a profile in which biomedicine takes a more prominent position compared to more classical European continental research profile.

In terms of impact improvement, we observe improvement in many fields. However, most striking observation is the overall strong increase of the impact of social scientists from the Czech republic, a clear sign that these researchers are catching up most strongly, thereby also indicating that the changes of the Czech Republic's science system are not only based in the natural, life and medical sciences, but are based across the whole system.

Literature

Moed, H.F., R.E. de Bruin and Th.N. van Leeuwen (1995). New Bibliometric Tools for the Assessment of National Research Performance: Database Description Overview of Indicators and First Applications. Scientometrics, 33, 381-425.

Nederhof, A.J., (1988). The validity and reliability of evaluation of scholarly performance. In: A.F.J. van Raan (ed) handbook of quantitative studies of science and technology. Amsterdam: North Holland/Elsevier Science Publishers, pp. 193-228.

Nederhof, A.J. & Visser, M.S. (2004). Quantitative deconstruction of citation impact indicators: Waxing field impact but waning journal impact. Journal of Documentation, 60 (6), 658-672.

Van Leeuwen, Th.N., H.F. Moed, R.J.W. Tijssen, M.S. Visser, and A.F.J. Van Raan (2001). Language biases in the coverage of the science Citation Index and its consequences for international comparisons of national research performance. Scientometrics, 51, pp. 335-346.

Van Leeuwen, Th. N, M.S. Visser, H.F. Moed, A.J. Nederhof, and A.F.J van Raan (2003). The Holy Grail of Science Policy: Exploring and Combining Bibliometric Tools in Search of Scientific Excellence. Scientometrics, 57 (2), 257-280.

Van Leeuwen, Th. N, (2009). Strength and weakness of national science systems: A bibliometric analysis through cooperation patterns. Scientometrics, 79, 389-408.

Van Raan, A.F.J. (1996), Advanced bibliometric methods as quantitative core of peer review based evaluation and foresight exercises. Scientometrics, 36, 397-420.

Van Raan, A.F.J. (2000). The Interdisciplinary Nature of Science. Theoretical Framework and Bibliometric-Empirical Approach. In: P. Weingart and N. Stehr (Eds.). Practicing Interdisciplinarity. Toronto: University of Toronto Press.

Appendix C R&D&I Governance & Management (WP b & c)

Author: Technopolis Group, Brighton

1. Introduction

This section of the report relates on the findings of the analyses covering the topics of WP b – State Administration of R&D and WP c – Policy Consistency of Evaluation of R&D&I Programmes. We started our analyses in May 2010 and for both of these WPs we will conclude our activities by February 2011.

The overall aim of WP b is to evaluate the processes involved in governing, managing and administering R&D&I policies. It focuses on programme design & management**.** This means considering all the levels of governance, decision-making and implementation from the level of the Research & development & Innovation Council (further: R&D&I Council) down to the process of providing individual grants and evaluating its efficiency and effectiveness.

In WP c, we analyse in-depth the way in which policy priorities are translated into policies and programme designs, to understand how designs relate to the interim and final evaluations of programmes' outcomes and impacts as well as their management efficiency and effectiveness.

In these first three months of the study, we have focused our activities on setting the background for our future analyses. We structured this report on our findings as follows:

- In the first section we sketch the historical background to the current R&D&I system. We looked into the structural evolution of the research support system over the time period 1990- 2008 and investigated the reasons for and scope of the major policy interventions throughout those years.
- The second section focuses on the 2008 Reform Plan and describes the failures in the R&D&I System that were perceived, the vision and main objectives of the reform plan, and the policy interventions and measures that it proposed, which were then implemented in the National R&D&I policy 2009 – 2015.
- We map the R&D&I Governance structure envisaged to be fully effective in 2012 in Section 3. We first describe the international framework in which we can discuss governance and subsequently provide details on the various interventions in the R&D&I system made by the National Policy for R&D&I 2009 – 2012. This includes a description of the roles and competences of the Governance Institutions and a view and first reflections on the national public R&D&I expenditure that is envisaged for 2012 and its consequences.
- In the last section of this report, we relate on the initial findings of our analysis related to the main processes in the administration of the R&D&I targeted support, i.e. the policy and programme design, monitoring and evaluation and project proposal appraisal processes. At this stage of the study, we predominantly focused on setting the scene for our future analysis by depicting the structure, rulings and current practices. Our analysis is therefore still at its very first stages and does not allow yet for any sound recommendations to be made.

2. Historical Background

In this section we describe the background to the current R&D&I Governance System and more specifically the structural evolution of the research support system over the last decades, and investigate the reasons for and scope of the major policy interventions throughout those years.

2.1 The period 1990 - 1998

In the decade following the end of the communist era, Czechoslovakia/ the Czech Republic underwent its transformation from a totalitarian, highly centralised system with a state-planned economy to a democratic society with a market economy. Government was strongly adverse to any sort of central intervention into economy, and overall in society there was a profound mistrust to governmental planning and quantitative goal setting.

From an economic point of view, the literature identifies three phases: the phase 1990-1994 that was characterised by a considerable decline in major economic indicators, the phase 1994-1996 where the country showed considerable economic growth, and a third phase of recession in 1997-1999.[11]

In relation to the Research and Development (R&D) system, major policy interventions in that time period were:

- The 'wild' privatisation of the research institutes performing industrial R&D (in 1990), resulting in most of these institutes ceasing their activities. In that time there were about 250 industrial research institutes; only 5% of them survived the 1990s. Some were incorporated as companies; others became private institutes and were later on given the special status of private (non-profit) research institutes
- The foundation of the Grant Agency in the Academy of Sciences (1990) and the Grant Agency of the Czech Republic (1992), constituting a first step towards competitive R&D funding
- The establishment of the Academy of Sciences of the Czech Republic in 1992, as a successor of the former Czechoslovak Academy of Sciences, founded in 1952. The establishment of the new Academy was accompanied by a sever cut (by half) of the funding resources, leading to the closing down of about 25 institutes
- The launch of competitive 'targeted' funding in the form of public tenders (1994/95)
- Partially successful attempts in 1994 and 1997 to change the mechanisms for institutional funding budget allocations.

The structural distinction of the communist era between "research" (the Academy of Sciences) and "teaching" (the Universities) was maintained.

In the 1990s, the R&D system was fully decentralised:

- Ministries and state agencies such as the State Office for Nuclear Safety or the Czech Office for Surveying, Mapping and Cadastre, as well as the Academy of Sciences all had an R&D budget and directly funded "departmental" research organisations that fell under their competence. Overall, there were 20 'funding bodies'.

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11 Bertelsmann Stiftung, *BTI 2010 — Czech Republic Country Report*. Gutersloh: Bertelsmann Stiftung, 2009

- The lack of co-ordination led to a fragmentation of R&D support through competitive funding, with Ministries launching multiple (small budget) programmes that had unclear – and often overlapping – objectives. Between 1995 and the turn of the century, over 65 R&D programmes were launched.
- The R&D Council was a purely advisory body, whose members were scientists

Budget allocations – both at national and 'funding body' level - were still very much determined by the index method used in communist times, i.e. funding based on the level of expenditures in previous years.

The main exception to this rule was the Academy of Sciences. In 1995, this institution made an attempt for internal reform based on quality assessment of the research. The system applied was one of peer reviews.

In terms of HR capacities in R&D, the socio-economic situation as well as cuts in R&D budgets (especially in relation to research institutes) caused a brain drain from research to industry. It led to what is now recognised as a generation gap in research.

2.2 The pre-accession period: 1998 - 2003

In this time period, the government(s) started implementing the necessary measures that would allow the country becoming a member of the European Union (in 2004). Multiple government actions were taken in the democratic and economic spheres – and R&D governance was no exception to the rule.

In 1998, an important step was made to steer budget allocations away from the close to automatic index system: as of 1999, institutional funding was linked to the presentation of strategic research plans. This new approach also opened the door for the re-integration into the institutional funding system of the industrial R&D research institutes that had survived the privatisation wave of 1990, recognising them legally as private (non-profit) research organisations.

The **first "National R&D Policy of the Czech Republic"**[12]**,** drafted and approved by the government in the year 2000, constituted a critical step towards the reform of the public R&D support system.

This document was drafted by the Ministry of Education, Youth and Sports and the R&D Council, in collaboration with representatives of the state administrative bodies, the Academy of Sciences and Grant Agency, and organisms representing the other major stakeholders (i.e. universities, private research organisations and industry).

Key systemic failures were identified in

- The *R&D capacity building*, i.e. the conditions for attracting and involving young researchers and their development and for responding to the regional needs for R&D capacity development
- Unsatisfactory *co-operation* within individual R&D sectors and between the various actors in R&D (institutes of the Academy of Sciences, universities, other public and private research organisations and industry), and
- Insufficient *international co-operation* and mobility of researchers.

The National R&D Policy paper furthermore stated, "The reasons behind a number of R&D shortcomings in the Czech Republic are the shortcomings in the management at all levels: in the system of the state R&D support, in the R&D

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[12] National Research and Development Policy of the Czech Republic, Attachment to the Governmental Resolution from January 5, 2000 No. 16

institutions and organisations, in the preparation and management of R&D programmes, in the preparation, selection, and organisation of R&D projects and grants, in inspecting and evaluation of the whole R&D system."

The main goals of this R&D policy were:

- To increase the efficiency and the outcomes of R&D, focusing on R&D results and the possibilities of their utilisation in all areas of society
- To ensure more complex links of the R&D policy with other governmental policies
- To concentrate state support on a smaller number of efficiently co-ordinated programmes and projects
- To improve the legislation of the state R&D support
- To heighten the demands on R&D, including a more significant differentiation of the quality of the research outcomes
- To increase the objectivity and the transparency of the distribution of financial means.

The first National R&D Policy started the process for an improved coordination of the research activities, based upon the identification and selection of research priorities that were intended to guide both the R&D programmes and the institutional research plans, and the development of national research programmes. It stressed the importance of evaluation of the R&D results and set it as the basic criterion for the distribution of the available funds. It also established ways for increasing the quality and efficiency of the state administration in R&D and posed the issue of a restructuring of the state R&D administration. It proposed three possible models for discussion in preparation of the new law on R&D:

- The *"centralised model"*, with R&D coordinated and managed by the Ministry of Education, Youth and Sport (MEYS) and the Research and Development Council remaining an expert and advisory body
- The *"decentralised model"* of the existing budgetary R&D chapters, significantly enforced thanks to coordination in the R&D policy implementation by means of a National R&D Programme. Coordination would be taken up by an R&D Office, which would organise the activities of the Council for Research and Development
- The foundation of a completely new *Ministry of Research and Universities*

It especially formulated the main requirements for a new R&D Act that would amend the legislation on state support to R&D and delimit rights, obligations and liabilities of both R&D support suppliers and research performers (for example, in relation to the utilisation of the results).

The new **R&D Support Act[13],** approved in **2002**, set the legal framework for the adoption of the centralised model, identifying in the MEYS the central administration authority responsible for R&D. The concept of an improved coordination of the public R&D support through the establishment of R&D Policies and National Programmes was further developed and an attempt was made to improve the efficiency of the R&D support system through the development of common planning processes and implementation procedures.

More in detail, the R&D Act indicated that

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[13] ACT of 14 March 2002 on support of research and development from public funds and on amendment to some related acts (R&D support act), Act 130/2002 Coll.

- National Research Programmes and (departmental) R&D strategies and programmes would reflect the long-term R&D trends and medium-term research priorities as well as respond to the systemic and thematic priorities set in the National R&D Policy. Departmental R&D Programmes were to be submitted to the MEYS and the Research Council for opinion and subsequently adopted by the Government.
- Apart from operational details such as duration and costs, draft departmental programmes needed to specify the goals of the programme and sub-programmes together with their rationale, an analysis of the present state in the Czech Republic and abroad, and an indication of the expected benefits.

The 2002 R&D Support Act also defined the schemes for public R&D support, the methods for support granting, the classification of the state budget R&D expenditures, the conditions for support granting, and the ownership of the R&D results. It furthermore described in detail the procedures to be implemented by all funding bodies for their R&D support administration. This regarded public tender management; the evaluation of research plans ("research intentions") for institutional funding, and the provision of information on R&D through the central Information System.

In **2003**, the government approved the **First National Research Programme**[14] (NPV I) for the time period 2004-2009, based upon the research priorities defined in 2002. Reflecting (also) to the Lisbon Strategy, it established 5 "thematic" programmes (Quality of Life; the Information Society; Competitiveness and Sustainable Development; Energy for the Economy and Society; Changes in the Modern Society) and 3 "cross-sectoral" ones, responding to the systemic priorities (HR for Research; Integrated Research; Regional and International Research Collaboration) – see Table 12, below. In total, 26 sub-programmes were defined; 7 ministries[15] and the Academy of Sciences were set in charge of their implementation.

Contemporaneously to the NPV I programmes, in 2004/2005 7 Ministries[16] launched in total 8 departmental R&D programmes, implementing their Conceptual documents for R&D[17].

Table 12: Thematic and cross-sectoral programmes & sub-programmes in the NPV I

	THEMATIC PROGRAMMES	Responsible
TP1	**Quality of Life**	
	Health of the Population	MoH
	First-quality and safety nourishment	MoA
	Inhabited areas and landscape for future	MoA/MoE
	Environment protection & natural resources	MoE

[14] Národní program výzkumu 2004 - 2009

[15] The Ministry of Education, Youth and Sport (MEYS), the Ministry of Industry and Trade (MIT), the Ministry of Environment (MoE), the Ministry of Agriculture (MoA), the Ministry of Health (MoH), the Ministry of Transport (MoT) , and the Ministry of Labour and Social Affairs (ML&SA)

[16] The MoA, MoE, MoH, the Ministry of Defence (MoD), the Ministry of Interior (MoI), the Ministry for Regional Development, and the State Office for Nuclear Safety

[17] Strategic documents describing the medium-term research priorities at departmental level, in response to the systemic and thematic priorities defined in the National R&D Policy

TP2	**Information society**	
	Intelligent systems for decision making, management & diagnostics	Academy
	Knowledge & Information Management	Academy
	Communication Structures & Technologoies	Academy
	Computer modeling, systems and processes	Academy
TP3	**Competitiveness for sustainable development**	
	Safe and efficient transport	MoT
	Production Systems and processes	MOI
	Construction	MOI
	New materials	MOI
	Emerging technologeis	MOI
	Use of natural resources	MoA
TP4	**Energy for the Economy & Society**	
	Safe & efficient use of JADERNA energy	MiT
	Use of coal and coal SUROVIN for energy & non-energetic applications	MiT
	Efficient use of energy and renewable energy resources	MoE
TP5	**Modern society and its transformation**	MoL&SA
	Performance-oriented, safe, European integrated society and its international linkages	MoL&SA
	Social cohesion, differentiation and national identity	MoL&SA
	CROSS-SECTORAL PROGRAMMES	Responsible
PP1	**HR for Research**	
	Promotion and support of young research workers	MEYS
	HR for Research	MEYS
PP2	**Integrated research**	
	Research centres	MEYS
	Information infrastructure for R&D	MEYS
	The support of targeted research projects	Academy
PP3	**Regional and international cooperation in R&D**	
	Regional cooperation	MEYS
	Programmes for international cooperation	MEYS

According to the 2004 report 'Analysis on the current state of research, development and innovation in the CR and comparison with the situation abroad', the Government approved the NRP I programme while ruling that between 2006 and 2009 no new projects would be launched. It hereby effectively limited the implementation of the NPV I to only 2 years instead of the 5 years planned. The report states that this decision was due to "certain drawbacks" of the NRP I.

The 2006 Analysis report[18] indicated several problems in the implementation of the NPV I, including the complexity of the administration and coordination of the programme due to the high number of providers involved, the inadequate

[18] 'Analysis on the current state of research, development and innovation in the CR and comparison with the situation abroad', 2006

administrative support for the coordination activities, and a lack of agency background.

2.3 The period 2004 – 2008

2.3.1 Policies

This time period was marked by a **fundamental shift in the R&D policy** focus towards innovation and applied research, stressing the role and importance of research for economic development and innovation. Illustrative for this new approach to R&D and R&D funding was the change in composition of the R&D Council in 2004, from an expert body for science into a representative body grouping all stakeholders (and including politicians).

In the same year (2004), the government approved the First National Development Plan 2004 – 2006 (NRP I) that coordinated the areas of support from the European Funds with the national R&D policy. The competent body for the coordination and overall administration of these funds was the Ministry of Regional Development. A major Operational Programme related to R&D was the OP Industry and Enterprise, administered by the MIT. It provided support (amongst other) for the set-up of Business Support Services Centres, R&D Clusters and Technology Centres as well as specific programmes aiming at a fostering of research-industry collaboration, business innovation and innovation infrastructures. In total, 16 EU-funded programmes were implemented in the Czech republic, for a total of about 80 billion CZK.

Another characteristic of this time period was the multitude of government resolutions and policy papers that all aimed at identifying or tackling **systemic and functional failures** in the R&D administration system, especially in relation to innovation.

- In 2004, a Resolution of the Government on the evaluation of R&D and its results[19] set the problems related to evaluation methodology and procedures on the foreground. Regular evaluation was made mandatory for programmes, projects and research plans. Most importantly, the document intended to boost the "evaluation culture" in the R&D system.
- In 2005, the Government published its first economic document The Economic Growth Strategy[20]. In this strategy document, five priority areas were defined, i.e. pillars that constituted "the foundations upon which competitiveness of the Czech economy rest". One of these pillars was Research, Development and Innovation. The document called for an improved university-Academy of Sciences collaboration and saw in human resources one of the fundamental problems in R&D. It stressed the importance of the establishment of technology platforms fostering research-industry collaborations and lamented the difficulties for two-directional mobility of experts between the private and public sectors and the absence of a system of effectively operating institutions dealing with transfer of R&D results. Last but not least, it pointed at the relatively low efficiency of state administration in the field of R&D, due to the decentralised nature of the support system and the underestimation of the importance to define priorities and programmes and draft conceptual documents. This document was not approved by the government, who took merely notice of it.

[19] Usnesení Vlády České Republiky ye dne 23. Června 2004 č.644 k hodnocení výzkumu a vývoje a jeho výsledků

[20] Economic Growth Strategy of the Czech Republic, 2005

- The National Innovation Policy (NIP) for 2005-2009[21], adopted by the Government in 2005, was a direct consequence of the Economic Growth Strategy. It was drafted by the R&D Council, the Ministry of Education and the Ministry of Industry & Trade after consultation of all main stakeholders, including the Confederation of Industry, the Association of Research Organisations, and the Association of Innovative Entrepreneurship. It addressed the main problems related to the innovation system in the Czech Republic and set the following four broad strategic objectives: to strengthen R&D as a source of innovation; to establish well-functioning public private partnerships; to secure sufficient human resources for innovation; to make public administration in R&D&I more effective

  The NIP identified 48 concrete targets and measures to reach these objectives. These included a change in the structure of public R&D expenditures (to the benefit of industrial R&D); new programmes focused on innovation-oriented R&D; the definition of new research priorities ("Long-term Main Directions of Research") with as a key selection criterion their future innovation potential; a strengthening of the weight given to of commercially utilisable results during the evaluation of projects and research plans and an allocation of R&D funds on the basis of this evaluation; and the establishment of a Technology Agency as the single institution in charge of applied and industrial research and the transfer of R&D results. According to the 2009 Innovation Policy Progress Report for the Czech Republic[22], most of the 48 targets were successfully implemented, especially those related to a strengthening of R&D as a source of innovation and the establishment of well-functioning public-private partnerships

- In 2005, the Government adopted the second National Research Programme 2006-2011[23] (NPV II), drafted by the MEYS. This programme followed up the NPV I and implemented a substantial part of the National Research and Development Policy. The mission of the NRP II was to boost the economic development of the Czech Republic and improve the quality of life of its population. Its objective was to realize the priorities of the National Research and Development Policy through four thematic and three crosscutting programmes in the period 2006-2011. For the priority setting, the research priorities identified for the R&D Policy were taken into account but a problem-oriented approach was taken, i.e. research was to be focused on areas of needs/opportunities. The programme was also expected to focus on applied research to be co-financed by the application sector (industry).

  A significant difference compared to the National Research Programme (2004-2009) consisted in a more centralized administration of the whole Programme: only two ministries (Ministry of Education and Ministry of Industry and Trade) funded research projects through the National Research programme. It was expected that this change would remove the methodological and administrative differences in the administration and management of the sub-programmes.

Table 13, below maps the programmes of the NPV II against the priorities set in the National R&D Policy for 2004 – 2008.

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[21] National Innovation Policy of the Czech Republic for 2005 – 2009, Prague, June 29, 2005

[22] InnoPolicy Trendchart – Innovation Policy Progress Report Czech Republic 2009, European Commission Enterprise Directorate General

[23] Národní program výzkumu II (2006-2011)

Table 13: Mapping of the programmes in the NPV II against the priorities set in the National Policy 2004 - 2008

Thematical Priorities of the National R&D Policy 2004 - 2008	Thematical Programmes NPV II
Safe, reliable and environmental-friendly energy for the future	Sustainable prosperity (TP1)
New materials & technologies	
Quality & safety of life	Health & quality of life (TP2)
Information & knowledge society	Information technologies for a knowledge society (TP3)
Needs of the Czech republic in the socio-economic sphere	Socio-economic development of the Czech society (TP4)

Systemic Priorities of the National R&D Policy 2004 - 2008	Cross-sectoral Programmes NPV II
Human resources	Human Resources (PP1)
International collaboration	International Collaboration(PP2)
Regional aspects of R&D	Support for the preparation and implementation of national policies, including technical support (PP3)
Use of R&D results in applications	
Evaluation of R&D	

Additional to these NPV II Programmes and sub-programmes, approximately 20 programmes were running in the time period 2004/2008, based upon the departmental research strategies ("Concepts").

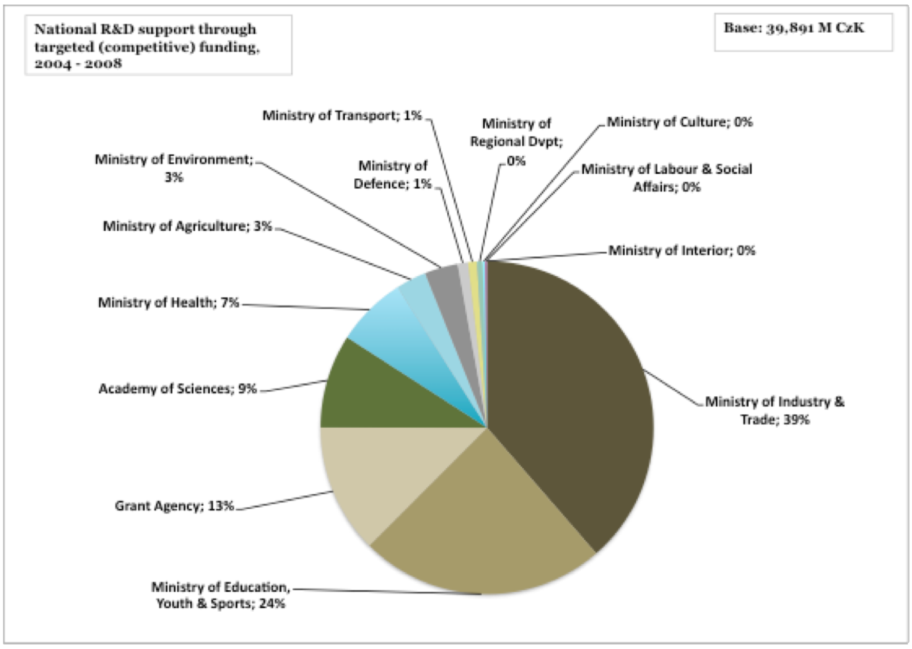
2.3.2 Trends in national R&D funding

The document "Analysis of the current state of RDI in the CR and comparison with the situation abroad in 2009" indicated that from 2003 to 2009, total R&D public expenditure rose by 78%, while R&D support provided by the Ministry of Industry and Trade increased more than threefold (mainly through targeted support).

Support provided by the Ministry of Education, Youth and Sport almost doubled (both targeted & institutional), while other ministries or entities saw a much less pronounced increase in their R&D funding budget: the Academy of Sciences of the Czech Republic by 61%, the Ministry of Agriculture by 57%, the Grant Agency (Czech Science Foundation) by 53% and the Ministry of Health by 49%.

The pronounced focus of policy-makers on fostering innovation and industrial R&D was visible also in the relatively high share of the national budget for targeted R&D funding that was allocated - in the years 2004 – 2008 - to programmes administered by the **Ministry of Industry and Trade** (39% - see Figure 14, below).

Figure 14: Distribution of the national budget for targeted (competitive) R&D funding over the funding bodies, 2004 - 2008



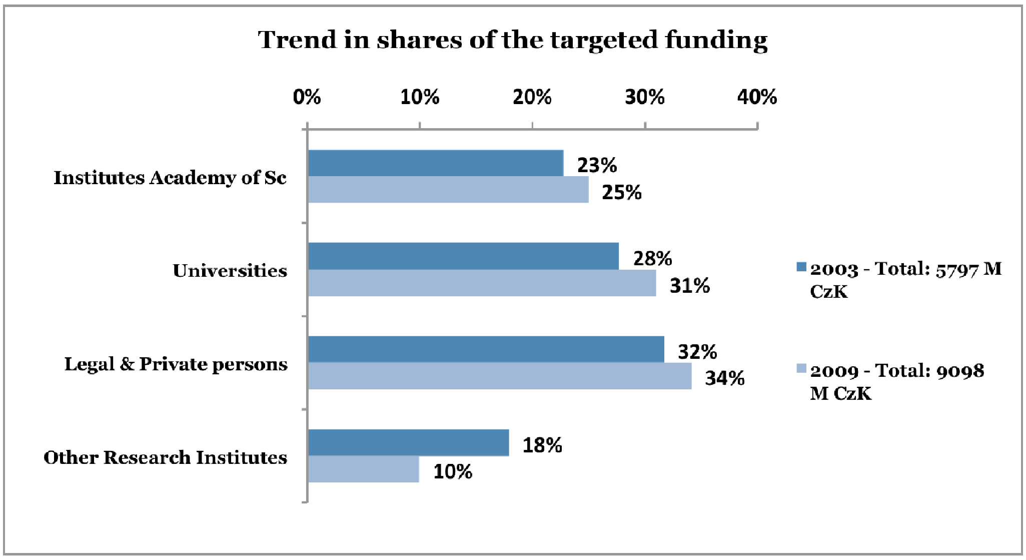
Source: elaboration of data in the Czech R&D Information System

The abovementioned "Analysis" report states that in 2009, beneficiaries of targeted funding were - ranked per funding (in M CzK)

- Legal & private persons (3103 M CzK)
- Universities (2819 M CzK),
- Institutes of Acad of Science (2271 M CzK), and
- Other institutions (905 M CzK).

Compared to 2003, support had risen for all categories since 2003, with the exception of the "Other Institutions" where stagnation is seen over all these years (and even a drop in 2009 compared to 2003) (see Figure 15, below).

Figure 15: Trend in stakeholders' shares of targeted funding, 2003 -2009

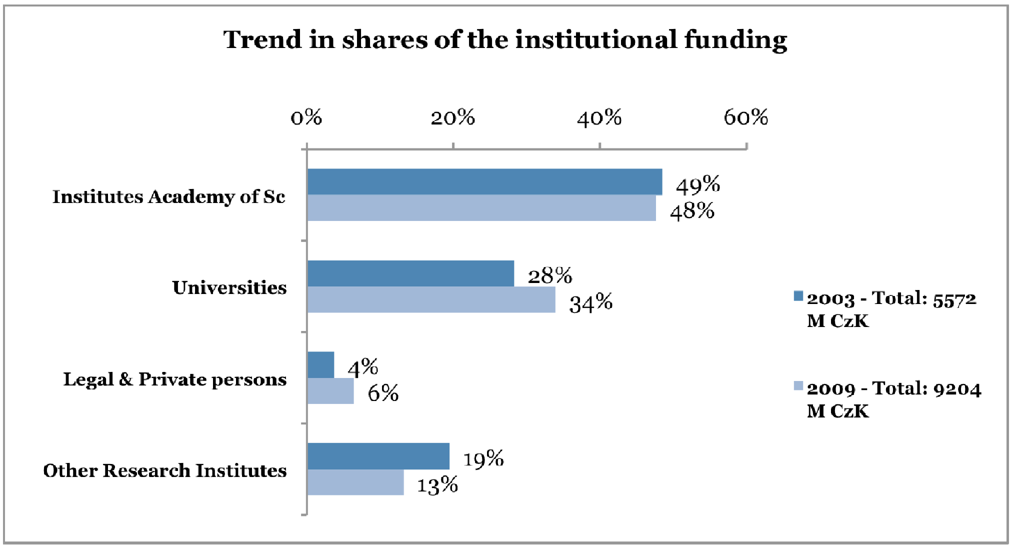


Source: based upon "Analysis of the current state of RDI in the CR and comparison with the situation abroad in 2009", R&D&I Council

In 2009, institutional funding went especially to the institutes of the Academy of Sciences (4332 M CzK) followed by the Universities (3085 M CzK). Other research institutions received 1202 M CzK; Legal & Natural Persons 585 M CzK. (see Figure 16)

The trend 2003-2009, based upon the figures provided in the report, is the one depicted below.

Figure 16: Trend in the stakeholders' shares of institutional funding, 2003 - 2009



Source: based upon "Analysis of the current state of RDI in the CR and comparison with the situation abroad in 2009", R&D&I Council

In terms of **scientific disciplines**, in 2009 the highest level of targeted support went to the field Industry (2384 M CzK), followed by Biosciences (1233 M CzK). A drop is to be noted for the funding in Medical Sciences, joined by ICT.

In relation to institutional support, in 2009 the areas of highest support were social science (1285 M CzK), physics and mathematics (1559 M CzK), bioscience (1429 M CzK), and industry (1494 M CzK).

In 2009, there was for the first time stagnation or reduction in institutional support for research programmes in several disciplines, i.e. in the fields of industry, agriculture, and medical sciences. These 3 fields of research however had seen a sharp increase in their funding in 2005, though. In fact, the largest relative growth in expenditure from 2003 was noted in the fields of agriculture and industry.

In the areas of social science, physics and mathematics, chemistry, Earth sciences, bioscience and information science there was continued growth in institutional support.

It is overall recognised that the measures introduced by the National Innovation Policy induced an improvement in the country's performance related to innovation.[24] However, measures aiming at legislative and structural changes in the administration of and support to R&D were not or only partially implemented. As a result, at the end of 2007, there were still **22 "budget chapters"** for the national expenditure in R&D (see Table 14, below.

Table 14: The 22 Budget Chapters for National Expenditure in R&D, 2004 - 2008

	Targeted (competitive) funding for R&D&I	Institutional support for R&D&I
Office of the Government (the Council)		
Czech Grant Agency	Grants	
Academy of Sciences	Grants & programmes	54 institutes
Ministry of Transport	Programmes	1 public research institute
Ministry of Environment	Programmes	2 public research institutes & 1 state contributory org
Ministry of Labour and Social Affairs	Programmes	2 public research institutes
Czech Office for Surveying, Mapping and Cadastre		1 state contributory organisation
Ministry of Culture	Programmes	10 state contributory organisations
Ministry of Education, Youth and Sports	Programmes	18 public HEI + 20 private research organisations
Ministry of Foreign Affairs		1 public research institute
Ministry for Regional Development	Programmes	
Ministry of Industry and Trade	Programmes	
Ministry of Interior	Programmes	2 state organisational units in security research
Czech Security Information Service		

[24] InnoPolicy Trendchart – Innovation Policy Progress Report Czech Republic 2009, European Commission Enterprise Directorate General

Czech Mining Office Board		
Ministry of Justice		1 state organisational unit
National Security Authority		
State Office for Nuclear Safety	Programmes	1 public research institute & 1 state organisational unit
Ministry of Defence	Programmes	1 state organisational unit & 3 state contributory organisations
Ministry of Agriculture	Programmes	7 public research institutes, 2 state contributory organisations
Ministry of Health	Programmes	10 state contributory organisations
Regional autonomous units of the CR (unstructured)	Competence of regions only	

The yearly analyses of R&D in the Czech Republic showed that one of the remaining barriers was the low research-industry interaction and cooperation. The necessity was felt for stronger policy interventions and an intensive policy debate started on the future constitution of the R&D&I governance system. The **Reform of the R&D&I system in the Czech Republic**[25], approved by the Government in 2008, was the outcome of these debates.

3. The Reform in 2008

In this section we proceed to an in-depth analysis of the 2008 Reform. We describe the failures the failures in the R&D&I System that were perceived, the vision and main objectives of the 2008 Reform Plan, and the policy interventions and measures that it proposed and which were then partially implemented in the **National R&D&I policy 2009 – 2015**[26]. Finally, we look into the main characteristics of the national public R&D expenditure envisaged for 2012.

3.1 Perceived Failures

The analyses of the R&D system in the Czech republic that were conducted in the years 2006/2007, together with 4 other analytical studies approved by the government, led to the perception of serious flaws in the R&D&I system that required urgent – and drastic – policy interventions.

The literature[27] tells us that failures impeding the operation of the innovation system - and thus requiring policy interventions - can be grouped into five broad categories: in addition to the long-recognised **market failures**, which lead to under-investment in R&D, there are

[25] Reform of the System of Research, Development and Innovation in the Czech Republic, 2008

[26] Národní politika výzkumu, vývoje a inovací České republiky na léta 2009 – 2015, 2009

[27] Erik Arnold, 'Evaluating research and innovation policy: a systems world needs systems evaluations,' *Research Evaluation*, Volume 13 Number 1, April 2004

- **Capability failures**, i.e. inadequacies in potential innovators' ability to act in their own best interests
- **Institutional failures,** i.e. failure to (re) configure institutions so that they work effectively within the innovation system
- **Network failures**, relating to problems in the interactions among actors in the innovation system
- **Framework failures**, i.e. regulatory frameworks, health and safety rules etc as well as other background conditions, such as the sophistication of consumer demand, culture and social values

The failures perceived in the Czech republic in the year 2008, such as they were mentioned in the Reform plan and its information sources such as the Green Book and the White Book, are listed and categorised in the table below. A comparison with the failures that triggered policy interventions in the preceding years (i.e. from 2002 onwards) shows that many previously identified problems were persisting – or at least, major improvements did not occur at the desired and necessary speed.

Table 15: Perceived Failures in the Innovation System, 2008

Perceived Failures	Description
Market failures	
Lack in R&D capacity	The number of researchers in the Czech Republic still lags behind the EU-15 countries and number of HEI graduates is not sufficient in the Czech Republic and the human resources skills neither correspond with the needs of a knowledge-based economy, nor the labour market demands.
Decline in R&D excellence	There is a growing backwardness in many disciplines - including several disciplines of natural and technical sciences generally considered successful in the Czech Republic
Little demand for innovation	There is an excessive reserve of the society towards novelties and unwillingness to take risk, which negatively reflects in an insufficient demand for innovative solutions
Insufficient exploitation of R&D results	There is an insufficient use in the Czech Republic of the outputs of research conducted in the Czech Republic for applied research, development and innovation
Insufficient investment in R&D&I	Public R&D funds in Czech Republic are not sufficient and their spending is not yet effective Private R&D spending still does not reach levels that are normal in EU-15 countries, with the Czech enterprises investing a lower portion of their turnover in R&D than the enterprises abroad Financing innovative activities by venture capital is practically non-existent in the Czech Republic.
Capability failures	
Little protection of R&D results	Utilisation of tools for intellectual property rights remains traditionally a weakness of innovation performance in the Czech Republic
Institutional failures	
Insufficient co-ordination and integration of research	The formulation of policies and strategies aimed at research, development and innovation still lacks a sufficient coordination and the public support for research, development and innovation is largely fragmented
Lack of R&D &I management competences	The importance of strategic management of research, development and innovation is not adequately appreciated. Besides an insufficient systematic evaluation of the effectiveness of support activities, there is a lack of determination of strategic needs for the development of the Czech Republic and the monitoring of demand for R&D from the application sphere is not done in a systematic manner There is a current failure of the R&D support system to

	administer the resources for R&D in an efficient and timely manner, setting at risk also the usage of the opportunities offered by EU funds in 2007-2013
Partial failure of policy measures	The introduction of a research plan-based institutional financing did not bring the necessary dynamics into the organisational structure of public research A uniform methodology for evaluating the research financed from public funds has been introduced since 2004, but distribution of funds is not yet a completely solved issue and it is not adequately connected with the results of such evaluation The gradually introduced system of evaluation increases pressure on research and development to produce results that are utilisable in economy and society, but the changes are still too small. The innovation infrastructure has not yet been satisfactorily developed and usually does not provide good services
Barriers for intra-research collaboration	Higher education institutions as well as other research organisations lack at present a corresponding system of management The research infrastructure in the Czech Republic is fragmented by size and often lacks adequate equipment
Network failures	
Barriers for industry-science collaboration	The infrastructure for transfer of knowledge from the public research to application sphere is practically non-existent The agreements on collaboration of researchers with the application sphere are mostly formal; the financial co-participation by private funds is missing
Barriers for intra-industry cooperation	Cooperation among companies in clusters is beginning to develop but the significance of clusters in the public and private sectors is not sufficiently appreciated at present
Framework failures	
Insufficient innovation culture	An adequate public awareness about the importance of research and innovation for the development of competitiveness and quality of life is still lacking.

3.2 Vision and Main Objectives

The Reform Plan stated as its vision "*To create an innovative environment through reforming the system of research, development and innovation in the Czech Republic in order to be held true that "Science makes knowledge from money, innovation makes money from knowledge."*

The core objective of the Reform plan was to simplify and increase the efficiency of the R&D support system so that public funds invested into applied research, development and innovation would lead to concrete economic or other social benefits. It set seven main objectives, indicating also measures to be taken:

1. To *simplify the support of R&D*, supporting institutions according to the results achieved and teams according to the projects undertaken. This implies an improvement of the evaluation system for public financed R&D
2. To *simplify the R&D&I support system and the administrative procedures*. The number of budgetary chapters (22) under which the Czech R&D is supported is significantly reduced and the paperwork requirements simplified. The latter will be achieved also through establishment of a single agency responsible for support to industrial research projects (the Technology Agency)
3. To encourage and support *excellence in research* and facilitate the *application of R&D results* in innovation. This will be achieved through an improved R&D evaluation as well as more emphasis on excellence in basic research and applicable results in applied research

4. To strengthen *research-industry cooperation*. To condition programme support of R&D upon the cooperation of public research with users of R&D results, based on co-financing from public and private resources. A proposal is made to extent the indirect support of R&D (tax relieves) to R&D results purchased by enterprises from (Czech) public research institutes and universities
5. To introduce a *more flexible organisational structures* of public research organisations in order to promote research-industry collaboration and create the conditions for their commercialisation of research results
6. To provide *qualified human resources* for R&D&I, including a simplification of conditions for hiring researchers from abroad
7. To intensify international collaboration in research, development and innovation, especially within the European Research Area.

Citing the Reform Plan, the measures proposed were based on the following principles:

- A simplification as large as possible of the structure of the state R&D support system, reducing the number of budgetary chapters and lowering paperwork burdens
- The support of excellence and high quality research, development and innovation and the transfer of decision-making on the ways of accomplishing the best results from the ministries to organisations in the case of institutional support, and to professional agencies – the Grant Agency of the Czech Republic and the Technology Agency of the Czech Republic - in the case of targeted support
- The support of mutual cooperation of research organisations and especially their cooperation with enterprises through the use of economic instruments and by establishing conditions for support granting in order to increase the benefits of research, development and innovation to the economy and society in both short- and long-term.

For its implementation, the Reform Plan required a set of legislative, financial and organizational interventions. One of the major actions to be taken was the drafting and approval of the **National Policy of Research, Development and Innovation for 2009-2015.** Together with a legislative mix, including a complete amendment of the 2002 R&D Act through a new law[28], this document further elaborates and partially implements the principles set by the Reform of R&D. The R&D&I Council, in collaboration with the Ministry of Education, drafted this policy paper; the Government adopted it in June 2009.

Another key document for the strategic framework for R&D&I in the Czech republic in the first following five years is the **National Strategic Reference Framework 2007-2013**, defining the modalities for the governance of the EU funds.

3.3 Policy Interventions and Measures

The interventions proposed by the 2008 Reform and partially implemented through the National Policy of R&D&I in the Czech Republic for 2009–2015 can be grouped into two categories:

8. Systemic interventions, aiming at an improved co- ordination and integration of the research and innovation system, and

[28] See the Collection of Laws 211/2009, Sbírka zákonů Česká republika, Částka 63

9. Programmatic interventions, describing programmes and policy measures needed.

3.3.1 Systemic Interventions

The above-mentioned policy documents proposed and led to a profound **structural co-ordination** of the R&D&I governance system in the Czech Republic. This was achieved especially through

- The establishment of a single coordination body at national level with responsibility over the entire area of R&D&I, through the transformation of the current Research and Development Council
- A reduction of the need for co-ordination thanks to the creation of Agencies that would have the sole responsibility for different typologies of research: the Grant Agency for basic research and the *Technology Agency* of the Czech Republic with responsibility for the public tenders for applied research, development and innovation. The competences of the latter would include both programme development and administration, excluding specific areas of cross-sectoral and sectoral research
- A reduction of the fragmentation of research, limiting the national R&D budget chapters from 22 to 11, i.e. four ministries in charge of "cross-sectoral R&D" and three in charge of "sectoral R&D"

Measures aiming at a **structural integration of research and innovation** included:

- Research, development and innovation will be taken as one sphere, from the preparation of the proposed state budget expenditures to information on the use of R&D results. The area of innovation will be supported in the same way and by the same instruments as research and development
- Research, development and innovation will be substantially more than ever linked with the university education that will gain importance mainly after 2015.

The need for an **improved co-ordination of the R&D&I policies** and their linkage with other policies was felt and led to the following measures:

- A strengthening of the responsibility of a central coordination body in the preparation and the implementation of policies focusing on R&D&I in order to secure the compatibility and interconnection of the R&D&I policies (e.g. health care, agriculture, national security, etc.) with industrial, regional and social policies.
- A joint National Research, Development and Innovation Policy will be established for the period after 2010, for which the Research, Development and Innovation Council will be responsible (and not two bodies as was the case until then – the Ministry of Education, Youth and Sport for the "science" policy and the Research and Development Council for the "innovation" Policy
- A strengthening of the production and utilisation of background, analytical as well as foresight and assessment studies for the preparation of conceptual and strategic documents and consequent policies
- A targeting of the public support to R&D&I according to the demands of sustainable development and the needs of the sustainable economic, social and environmental development of the Czech Republic, together with a clear identification of the amount of financial support per each priority. At the same time, stress will be put on interconnection of the basic research with subsequent phases of the innovation process. Contemporaneously there will be

an increase of the share of public support to R&D in the form of competitive funding

- Strategic management of R&D&I at all levels, based on systematic impact assessment of the National Policy as well as analyses of RDI. This implies a continuous realisation and updating of the National Policy by long-term support of systematic evaluation and assessment of the RDI system as well as a think-tank for RDI policy.

Finally, the policy documents set the base for the **coordination of R&D&I support planning and management.** An amendment to the R&D Act entailed a detailed description of legally binding processes and procedures for programme planning, approval and implementation

Evaluation was a core topic in these policy papers, stressing the role of evaluation to enhance both the quality of research and the improved integration of research and innovation, linking evaluation results to levels of – institutional - funding. Also the need for an improvement of the evaluation system in the CR and its use throughout the entire system was emphasised.

- An extended use of the evaluation of the R&D results as a tool to define institutional funding based on merit and to motivate researchers in applied research to focus on research that would be used in innovation and cooperation with private companies.
- An improvement management of knowledge thanks to a consistent evaluation of programmes and the expansion of the current RDI Information System
- Continuously evaluate the implementation and impacts of individual measures of the Reform of the Research, Development and Innovation System in the Czech Republic and the National Policy of Research, Development and Innovation in the Czech Republic for 2009 - 2015.
- Finalise the methodology of R&D evaluation and implement a system of continuous and objective evaluation of the support system to RDI at all levels.
- Evaluate the system of R&D&I with the involvement of a renowned and experienced international agency in order to secure an objective evaluation.
- The evaluation of R&D and its results carried out by the Council will be simplified to serve its purpose - the distribution of institutional R&D expenditures among the budgetary chapters

3.3.2 Programmatic measures

The National Policy for R&D&I 2009 - 2015 also foresaw the following actions in response to the perceived challenges:

- Policy-mix supporting the stimulation of collaboration in R&D&I, including both intra-research and research-industry collaboration.
  - The use of the EU-funded operational programmes to establish and develop large R&D infrastructures
  - Support for establishment and development or R&D&I infrastructure at the regional level in connection to the large R&D&I infrastructures on one side and to industry on the other. The goal is to create a dense and functioning network of entities providing a sufficient capacity for both individual research activities, and satisfaction of innovative firms' demand
  - Set up a programme of support to large projects encompassing the entire 'research – development – innovation' cycle
  - Support the cooperation of SMEs and research institutes by providing innovation vouchers for joint RDI

- Support the development of technology platforms at the national and the international level in order to increase the knowledge flow among subjects.

- Policy-mix to support innovation.
  - Support for the creation of strategies at the level of research institutes, focused on the use of R&D results and intellectual property rights
  - A change in the composition of the management boards of universities and research institutes, i.e. the incorporation of representatives of other sectors (industry, public sector etc.), thus strengthening their managerial governance and stirring up their third role – their cooperation with industry
  - Upon the beneficiaries of the targeted state support of applied research and development (applicants for the projects in R&D programmes) the law will impose an obligation to produce evidence that there is a system in place for the intellectual property rights protection, and transfer and commercialization of results
  - Set up of a programme focused on support of commercialisation of R&D results at universities and public research institutes, including support of spin-offs, patent applications, etc.
  - Set up a programme of support for innovation activities in SMEs with the focus on support of testing the operability of a prototype.
  - Assessment of the possibility to establish venture capital funds with private and public financial support
  - Support to the development of high-quality consulting services strengthening R&D&I activities in SMEs and the use of R&D results.

- Support to international collaboration in R&D&I.
  - Support for organizations providing information on possibilities of involvement in various European programmes as well as complex services enhancing the involvement of Czech research teams in international programmes.
  - Creation of favourable conditions within the research institutes leading to higher involvement of the research teams in international programmes.
  - Active participation in the development of European Research Area (ERA) and in activities of recognized international research institutes.

- Support for capacity building, i.e. the provision of qualified human resources for RDI.
  - Creation of a system of postdoctoral positions.
  - Creation of support programmes for research fellowships (in the form of grants) in research institutes both in Europe and worldwide, to the benefit of researchers and especially post-graduates and young researchers. The programmes will also secure that the researchers will return to their home research institute.
  - Support of further use of university graduates.' knowledge in applied R&D and innovation, or in knowledge-intensive sectors.

- The creation of an environment stimulating innovation in the Czech Republic.
  - Increase the quality of R&D&I promotion in media. The idea is to create a web portal providing current information on RDI (results, upcoming events etc.).

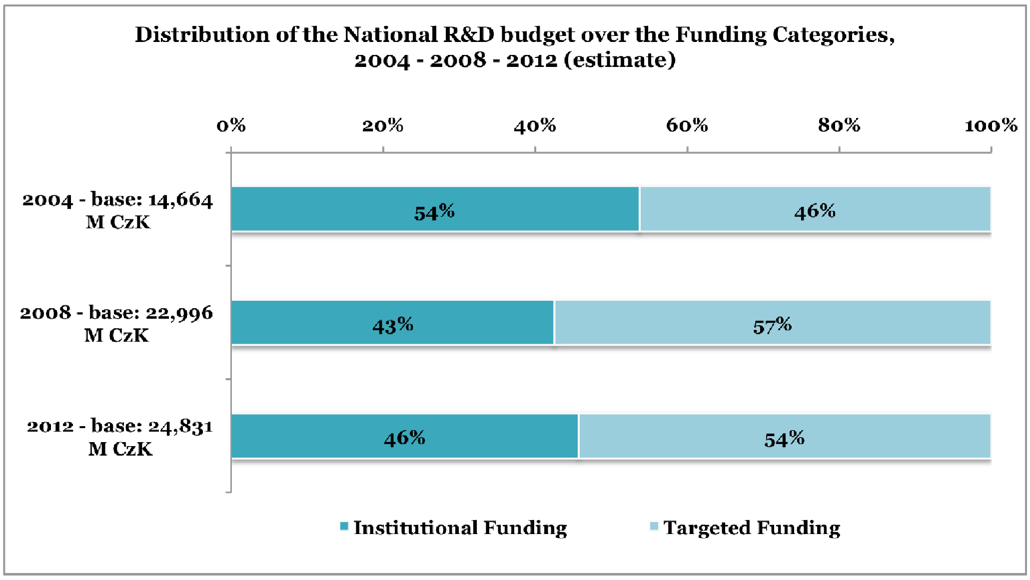
- Support activities focused on promotion of R&D&I and its contribution to society.
- Promote Czech R&D&I results abroad.

3.4 National Public R&D Expenditure in 2012

The National Public R&D Expenditure in 2012 is currently estimated at a total of 24,831 M CzK, i.e. 1,001 M Euro.[29] It is foreseen that more than half of this budget (54%) will be used for targeted funding.

When looking into the trend in shares of institutional and targeted funding in the national public R&D expenditure, we notice that compared to the situation in 2004, **the weight has shifted from institutional to targeted funding** (see Figure 17, below).

Figure 17: Trend in shares of Institutional and Targeted Funding in the National Public R&D Expenditure



Note: The national R&D expenditures details for 2012 show that only 65% of budget foreseen for the Institutional Funding category will actually be distributed over the eligible institutions. The other 35% is used for the co-funding of international programmes (27%, included in the budgets for the Ministry of Industry & Trade and the Ministry of Education) and for administration costs of the Academy, the Grant Agency and the Technology Agency. We are currently not having the needed data on these details for the years 2004 and 2008, so could not - at this stage of our study - make a more detailed comparison among the yearly national R&D budgets.

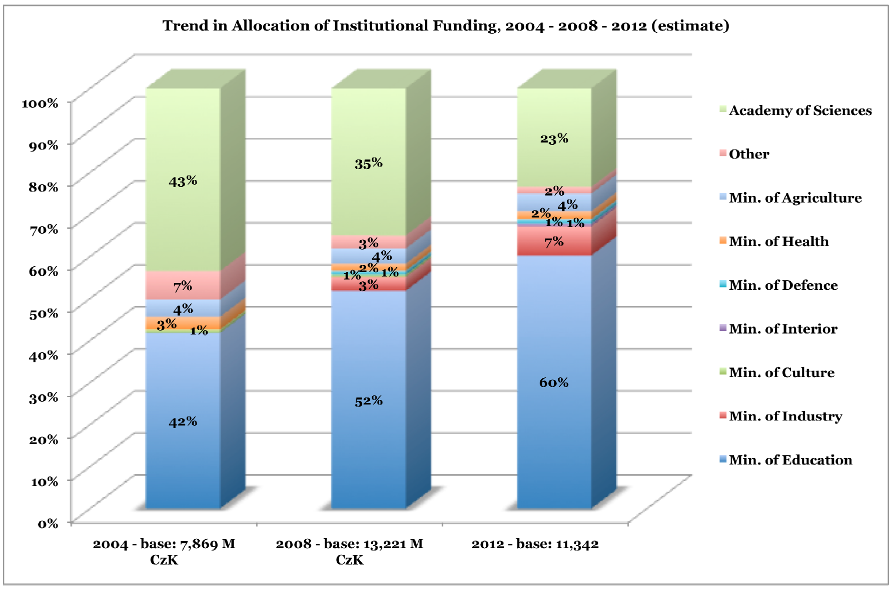
Source: State Budget expenditure on R&D in the years 2003 & 2004; Approval of the proposal for state budget expenditure on R&D for the year 2008; Approval of the proposal for state budget expenditure on R&D for the year 2010 with view on the years 2011 and 2012

[29] Source: Proposal for state budget expenditure on R&D for the year 2010 with view on the years 2011 and 2012, approved by the Government on June 29, 2009

In relation to the distribution of the Institutional Funding over the various funding bodies, Figure 18 shows that in 2012, the Ministry of Education is expected to be in charge of 60% of the institutional funding, while the Academy of Sciences will have at its disposal 23%.[30]

Comparing these figures with those related to the situation in 2004 and 2008, we see a **considerable change in funding distribution**, gradually evolving over the years from an equal distribution of the funding between Higher Education Institutions and institutes of the Academy in 2004 (both approximately 40% of the total) to a situation in 2012 where the institutes of the Academy will benefit – at the best – of half the budget of the Higher Education Institutions.

Figure 18: Trend in allocation of the Institutional Funding over the various funding bodies

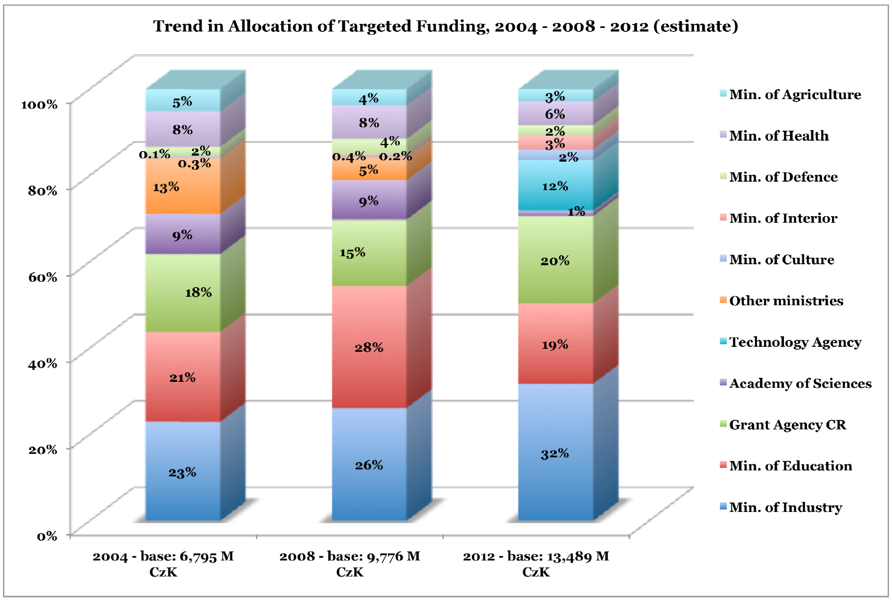


Source: State Budget expenditure on R&D in the years 2003 & 2004; Approval of the proposal for state budget expenditure on R&D for the year 2008; Approval of the proposal for state budget expenditure on R&D for the year 2010 with view on the years 2011 and 2012

Figure 19, below, illustrates the trends in allocation of the targeted funding over the different funding bodies.

[30] When considering exclusively the funding for research intentions/development of the institutions and Rewards for excellence in R&D - thus excluding any (co-)funding for international programmes as well as the administration costs of the Academy), the Ministry of Education will have at its disposal 58% of the total institutional funding and the Academy 28%. The Ministry of Industry will be in charge of 2%.

Figure 19: Trend in allocation of the targeted funding over the funding bodies



Source: State Budget expenditure on R&D in the years 2003 & 2004; Approval of the proposal for state budget expenditure on R&D for the year 2008; Approval of the proposal for state budget expenditure on R&D for the year 2010 with view on the years 2011 and 2012

There are two important findings:

- Compared to 2004, the share of the targeted funding at the disposal of the Grant Agency is expected to rise by only 2%. If we consider that the targeted funding administered by the Academy of Sciences in the previous years was focused on basic research – as the critics say, the overall share of targeted funding for basic research is expected to drop from 27% in 2004 and 24% in 2008 to 21% in 2012.
- There is a constant increase in the share of targeted funding allocated to the Ministry of Industry and Trade. This ministry saw its share rising from 23% in 2004 and 26% in 2008 to the estimated 32% in 2012. In 2012, the Ministry of Industry and Trade is expected to be in charge of nearly one third of the national budget for Targeted Funding i.e. 4,283 Mio CzK – the equivalent of approximately 170 Mio Euro. This budget is devoted solely to the ongoing implementation of the programme TIP that was launched in 2009 and is scheduled to continue until 2017.

4. The R&D&I Governance Structure in 2012

In this section we depict the R&D&I Governance Structure as envisaged by the National Policy for R&D&I in 2009 – 2015. The intention is that this system becomes fully effective as of 2012.

Subsequently we describe more into detail the various interventions in the R&D&I System made by the National Policy for R&D&I in 2009 – 2015 and its accompanying mix of legislative amendments. First, however, we need an international framework in which we can discuss governance.

4.1 Mapping of the Organisational Structure

Governance refers to the effective implementation of state supported actions and the management of research and innovation by organisations that have been allocated responsibilities from the state. In most OECD countries over the past two decades, there have also been a wider series of administrative reforms, which have been pursued with varying degrees of enthusiasm. Collectively known as the New Public Management[31] these reforms include

- Professional, management oriented leadership, decentralisation and increased local autonomy in resource allocation
- Management by objectives, using quantitative indicators
- Increased use of competition and markets, as well as privatisation
- Separation among customers and contractors in the production of public services
- De-integration of traditional administrative institutions
- A focus on the state as a producer of public services
- Increased use of incentives, contracting and local autonomy on wages
- Reduced costs and increased budgetary discipline[32]

To this list, we would add the use of evaluation as a key instrument, both in ensuring accountability and in fostering learning and therefore process improvement.

The New Public Management therefore combines ambitions from the era of top-down strategic planning, implemented through management by objectives, with a desire to understand and be responsive to needs. In practice, governance mechanisms need to combine the ability to plan strategically with a role in mediating among stakeholders to produce alignment among objectives. "Successful policymaking normally means compromising through a 'reframing' of stakeholders' perspectives and joint production of consensus."[33] So governance is

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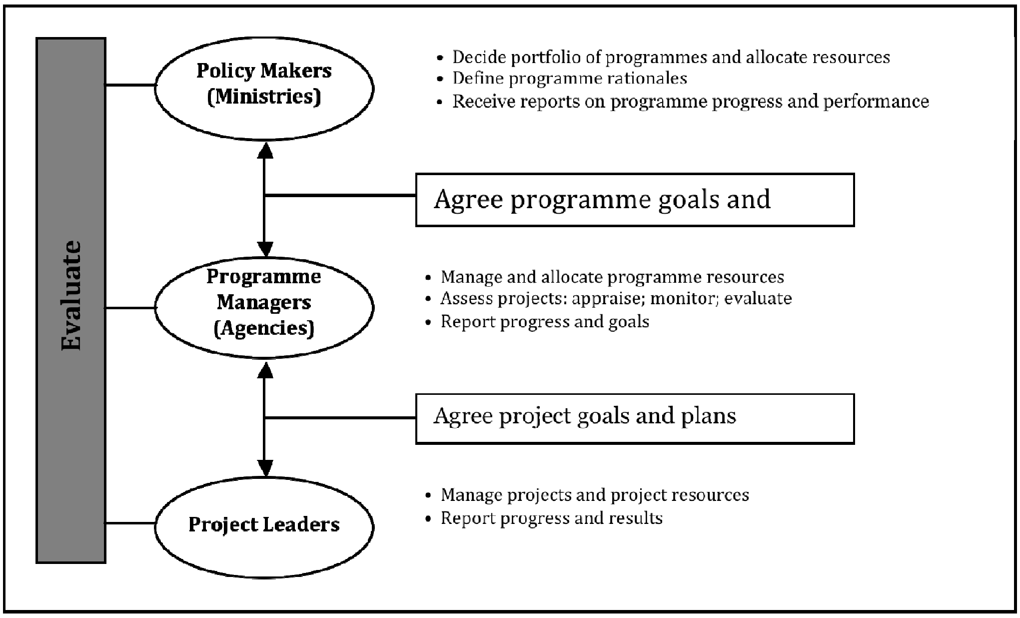
[31] An important focus is the PUMA (Public Management) group at the OECD. See www.oecd.org

[32] Tom Christensen and Per Lægreid, *Den moderne forvaltning*, Oslo: Aschehoug 1998

[33] Stefan Kuhlmann, 'Future governance of innovation policy in Europe – three scenarios,' *Research Policy*, 30 (2001), 953-976

not just about 'steering' but about creating arenas, to decide the right direction in which to steer.



An important way in which the New Public Management has been expressed in innovation and research funding has been through the use of programming in research and innovation activities conducted for socio-economic purposes. Policy makers (often in ministries), in effect, write performance contracts with programme managers, who act as **agents** in the delivery of policy goals. The programme managers in turn write performance contracts with project performers. Since the managers need the performers in order to deliver the policy goals, the performers often end up having a large say in, sometimes even controlling, the way resources are allocated[34] at programme level. This is especially true in research councils, but also – to a considerable extent – among innovation agencies. While this type of capture of agents by beneficiaries is not unique to research and innovation funding, it is a particularly strong feature of the area.

Our research shows that the above picture is an ideal model. In practice the borderlines and division of responsibilities between policy makers and agents differ from country to country. We refer to these type of governance issues and the necessary co-ordination between actors as the **vertical** dimension of governance.

International practice shows that several other dimensions are important for the practice of innovation and research governance[35].

First, societal actors and institutions outside the research community are likely to be increasingly involved in the governance of research and innovation. For agenda setting and prioritisation of actions, this implies a variety of stakeholders need to be involved. Given the wider perspective more strategic intelligence will be necessary to come to decisions and priorities.

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[34] See Dietmar Braun, 'Who governs intermediary agencies? Principal-agent relations in research policy making,' *Journal of Public Policy*, 13 (2), 1993, pp135 – 162

[35] Erik Arnold and Patries Boekholt, *Research and Innovation Governance in Eight Countries: A Meta-Analysis of Work Funded by EZ (Netherlands) and RCN (Norway)*, Brighton: Technopolis, 2003

Second, governance mechanisms are needed that handle the systemic nature of research and innovation and the need for policies to be coherent and co-ordinated across institutional boundaries. This implies horizontal co-ordination along three lines

- The co-ordination and attuning of different societal and economic goals of research and innovation. In policy terms co-ordination and attuning between research and innovation policies for stimulating industrial growth, for the better use of information technology, environmental preservation, a healthy population, good quality food, and so on
- The integration of knowledge creation (mostly basic research) and the use of knowledge for innovation. In an innovation system this could involve bringing together those actors that focus on different roles in the knowledge production chain. In policy terms this involves the integration of science, research and innovation policy
- The combination of knowledge from different science disciplines to tackle interdisciplinary research needs (e.g. bio-technology) and overarching societal problems that need such an interdisciplinary approach (e.g climate change)

Third, governance mechanisms will be needed that can handle change in the innovation and research funding and performance system – and in the reality with which it deals. Overlaps and boundary ambiguities accompany change, and it is not necessarily clear that eliminating these will improve system performance.

Fourth governance mechanisms should allow effective implementation of the actions decided upon.

Finally, some of the failures to which innovation systems are prone are the result of failures in governance. Governance systems need, therefore, to be sufficiently reflexive to allow such failures to be identified and acted upon.

Overall, the main functions included in research and innovation governance are

- Setting directions
- Providing a referee
- Horizontal coordination
- Coordinating the production of knowledge
- Generating and using strategic intelligence
- Vertical steering of agents towards socially desirable goals
- Enhancing the profile of research and innovation[36]

To map how countries in practice tackle R&D&I governance co-ordination and integration challenges, we use a simple model of research and innovation organisation and governance. This is ideal-typical, rather than representing any particular national practice (see Figure 20). In this scheme, there are four levels of policy co-ordination:

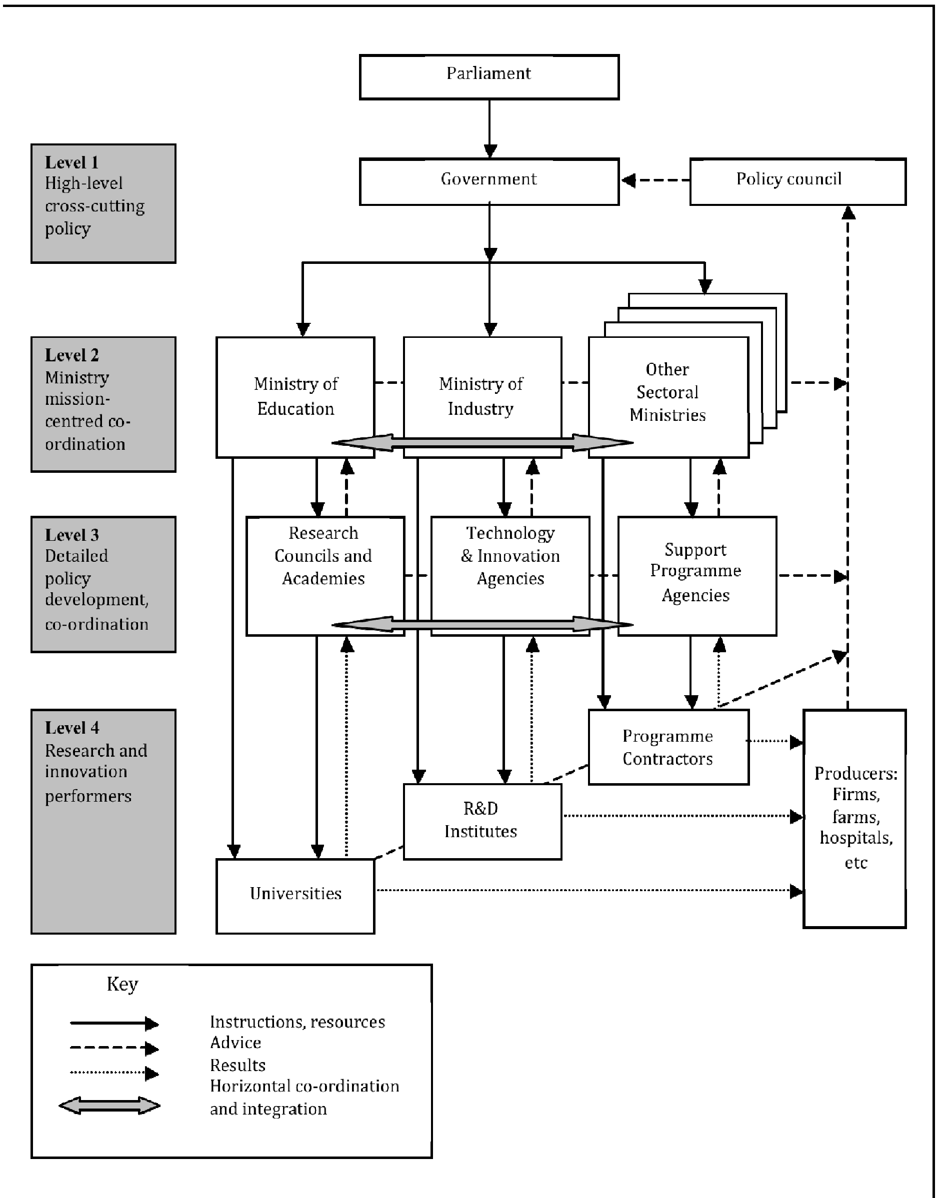
- **Level 1** is the highest level. This involves setting overall directions and priorities across the whole National Innovation System. It may be achieved through advice to government or by more binding means, such as decisions of a cabinet sub-committee

[36] *Ibid.*

- **Level 2** is co-ordination among ministries, whose sectoral responsibilities otherwise encourage them to pursue independent policies. In practice this level of co-ordination may involve administrative aspects, policy issues or both.
- **Level 3** is more operational, in an attempt to make the actions of funding agencies into a coherent whole. This level, too, can involve administrative co-ordination as well as more substantive co-ordination of funding activities, such as co-programming
- **Level 4** involves co-ordination among those who actually perform research and innovation. Co-ordination at this level tends to be achieved through self-organisation rather than using formal mechanisms

Despite the apparent complexity, the network of flows of information and resources shown is actually very simplified compared with what happens in reality.

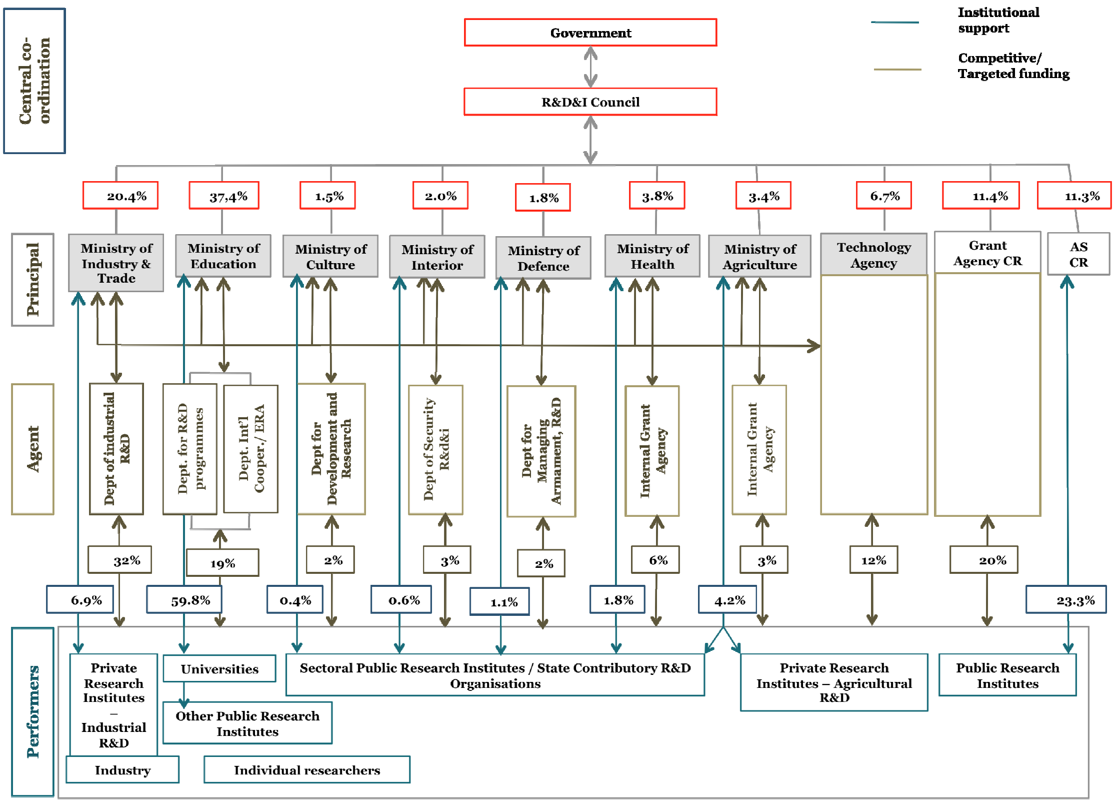
Figure 20: Generic Organisational Structure for Research and Innovation Policy



Source: Modified from Martin Bell, *Knowledge Resources, Innovation Capabilities and Sustained Competitiveness in Thailand: Transforming the Policy Process*, report to the National Science and Technology Development Agency, Bangkok, Brighton: SPRU, 2002

Figure 21, below, maps the organisational structure for public support to R&D&I in the Czech Republic that is envisaged for 2012. It focuses on the governance of **national** public R&D funding and is described more in detail in the sections below.

Figure 21: The Czech R&D&I Governance structure in 2012, for national public funding



Notes: Also the Technology Agency and the Grant Agency CR will receive some funding from the Institutional Funding chapter, covering operational costs. And in 2012, the Academy of Sciences will receive some targeted funding, related to the funding of the last projects in its research programmes. We did not mention these fundings in the graph below in order not to create confusion with the new institutional competences of these organisations.

Base: total national public expenditure in R&D&I: 24,830 M CzK; total institutional funding: 11,342 M CzK; total targeted funding: 13,489 M CzK

Source: Resolution of the Government in July 2009 nr 838, approving the proposal ofstate expenditure in the Czech Republic for research, development and innovation in the year 2010 with a view on the years 2011 and 2012.

The emerging norm in structuring R&D&I governance is what the Nordic region refers to as the 'two-pillar model'[37]. This concentrates resources and activity in the education and industry ministries and their respective agents, while leaving the

[37] Gustav Björkstrand, *NORIA Vitbok om nordisk forskning och innovation*, TemaNord 2004:502, Cophenhagen: NMR, 2004

other ministries to provide institutional funding and targeted support in parallel, in pursuit of their own missions. Benefits of this approach are that it: (a) integrates research and innovation policies with education and industry policies; (b) leaves other ministries free to define and pursue their own needs – either through their own funding and research performing systems or through the larger, more general-purpose structures provided by the research and education ministries; (c) avoids establishing an R&D&I funding structure that competes for budget with the ministries.

A disadvantage of the two-pillar structure is that it does not tackle the horizontal coordination problem between the education and industry ministry factions. This is usually left to a higher-level advisory council.

Figure 21 points to two special features of the structure of the Czech research and innovation governance system, compared with practice among many OECD countries, notably those that have tried to adopt the principles of the New Public Management.

- The R&D&I Council plays an unusual role in operating almost as a **virtual science ministry**, coordinating R&D&I Policies top-down and having a strong say in budgeting. The more usual OECD pattern is that such a body is advisory and provides an arena for policy discussion, but that the ministries have a strong role in implementation and keep control of their parts of the R&D&I budget.
- The Technology Agency operates **both** at the policy-making level that is normally the preserve of ministries **and** as agent, without at the same time having the same responsibilities as ministries do for a sector of society.

We cover these topics further in the sections below.

4.2 Roles & Competences of the Governance Institutions

4.2.1 The R&D&I Council

The 2008 Reform and the National R&D&I Policy for 2009 – 2015 envisaged the transformation of the R&D&I Council from an advisory body into the **central - and single - coordination body** at national level with responsibility over the entire area of R&D&I.

Co-ordination at this level is strengthened through an enforcement of the Council's competences – rather than a radical change. Following a transition period, the R&D&I Council is envisaged to act as a central body that takes decisions on R&D&I policies, defines the longer-term research priorities in alignment with the needs of society, controls the coherence of the R&D&I programmes with those strategies and priorities, and measures their impacts. As before, the Council will draft proposals for the total expenditure on R&D&I, aggregating individual budgetary chapters, and will propose budget allocations.

The enforced position of the Council is made explicit especially in relation to the development and implementation of **evaluation**, and the use of its results. In the 2008 Reform, the *"waterfall" principle* was heavily promoted, i.e. the idea of a hierarchy of performance contracts connecting through ministers, ministries and agencies with research and innovation project performance and each level in the hierarchy system evaluating the level below it. A key tool for these evaluations is the *central R&D&I Information System* of which the Council is the administrator and operator. The National Policy for R&D&I in 2009 – 2015 and the amendment to the R&D Act established that the evaluation results would *govern the funding allocations* in the field of institutional funding. As it is the central body with competence for the development of the evaluation methodology, the Council therefore ultimately directs the decision on budget allocations in relation to the institutional funding.

These – partially – new competences of the R&D&I Council led to a formal change in **its composition,** focused on the explicit representation of the two major lines of research (basic and applied) rather than a general representation of all stakeholders. The 2008 Reform states, "The Council will have 17 members – the chairman (the Prime Minister or the Deputy Prime Minister), 8 members of basic research, 8 members of applied research, development and innovation. Part of them will be prominent experts and will be nominated by selection from organisations of respective focus; others will be representatives of R&D bodies and institutions."

The Government nominates – and removes - the members of the Council for R&D&I on the basis of proposals by the chairman of the R&D&I Council. The members will be remunerated, hold office for a period of four years, and may be appointed for only two consecutive periods of office.

Bodies of the Council are the Chairman and the Board, i.e. the Chairman and three Vice-chairmen, elected from among the members of the Council. The task of the Board is to manage the activities of the Council for Research, Development and Innovation in between their sessions and coordinate the activity of the advisory bodies to the Council. The Council meets once a month. The Secretariat and the professional advisory bodies of the Council (the expert commissions) ensure the technical, organisational, and expert support to the Council. The secretariat, constituted by members of the Government Office (Department for research, development and innovation) determines operation principles of the Council and its working groups.

In terms of the **Expert commissions**, following the 2008 Reform the R&D&I Council established "temporarily" the following expert and advisory bodies[38]:

- An expert commission to draft priorities for applied research, development and innovation in the Czech Republic in individual areas of applied research, development and innovation
- A Commission to evaluate the results of research organisations and completed programmes
- A Commission on Bioethics, which shall prepare materials to resolve tasks allocated to the Council associated with the bioethical aspects of R&D

The 2008 reform states, "The Council will retain the possibility of appointing other advisory bodies."

Members of the expert and advisory bodies are selected from among the top experts for a given area of R&D&I and are appointed - and removed - by their chairperson on the basis of a proposal by the R&D&I Council.

Councils to advise governments on science and innovation are a long established phenomenon in many OECD countries, though their success is highly variable. Historically, the function of these councils has tended to follow contemporary thinking about the role of science and technology in innovation. Up to the 1980s, councils tended to focus on science and then started to take on technology questions, in line with the somewhat linear thinking of those times. More recently, innovation has tended to become more central so that councils aim to influence the

[38] Previously, there were 5 Commissions: 3 focused on research sectors (life science, technical and natural sciences, social sciences), 1 on bioethics, and the last one the Commission for Evaluation who formulated the rules for the research assessment exercise.

"innovation system" as a whole – including, but not only, science and technology. Councils appear to function based on one of three models

- A joint planning model (Japan), where the government uses the Council as a virtual "horizontal ministry of innovation", much as engineering companies build project teams by bringing together people across different disciplines.
- A co-ordination model (Finland, Netherlands Innovation Platform, to some extent Austria), where the intention is that the council should communicate horizontally across ministry responsibilities so as to align policies in support of innovation, without this alignment always being binding.
- An advice model (Canada, Ireland, Netherlands AWT, Switzerland, UK), where the government is happy to be proactively or reactively advised on research and innovation policy but does not want to be restricted by that advice.

As mentioned before, the R&D&I Council in the Czech republic plays an unusual role in operating almost as a virtual science ministry.

International experience suggests there are at least three factors that influence the potential policy influence that councils can exert.

- The most influential councils involve the prime minister. A prime minister often acts as a "referee" in the system and can more easily impose the council's view on government as a whole.
- A second element of influence appears to be the presence of ministers. At least, it can be said that the absence of ministers creates a communications gap between the council and the government, increasing the chances that advice will be ignored.
- The third element appears to be the scope of the Council's legitimate concerns. It appears that the ability of some of the councils to affect innovation policy as a whole is limited by the fact that their legitimacy is only partial. Thus, for example, it is difficult for the Austrian Council or the Irish ASC to have the last say on policies that affect research in higher education when there are parallel bodies responsible for that sphere. The Finnish, Japanese and UK councils have clear legitimacy across the whole innovation system; the two of these in which the prime minister is active have strong influence. The Dutch Innovation Platform contains the Prime Minister, Economic Affairs and Education ministers, and while there are other bodies that advise on education and research, they have not established the degree of legitimacy currently possessed by the Innovation Platform.

The Czech R&D&I Council benefits from the presence of the Prime Minister – even though this may only be in theory. However, the absence of other ministers combined with the fact that it seeks to influence the R&D&I policy of those absent ministries may undermine its work. We will explore further the role of the newly reconstituted Council in the next stage of our work

4.2.2 Ministries & Agencies

At this second level of the R&D&I system, an **enhanced coordination and integration** is achieved predominantly by <u>reducing the number of ministries</u> with competences for R&D&I, limiting the national R&D budget chapters from 22 to 11.

- Three ministries (the Ministry of Defence, the Ministry of Health, and the Ministry of Agriculture) maintained their competence for the sector-specific R&D;
- Four ministries (the Ministry for Education, the Ministry for Industry and Trade, the Ministry of Culture, and the Ministry of Interior) were set in charge of "cross-sectoral R&D" and were expected to co-ordinate also the research

needs of ministries that 'lost' their competences for R&D&I. For this purpose, inter-departmental commissions were set up.

These ministries are responsible for the development of these 'cross-sectoral' and 'sectoral' research sectors and for the drafting of related R&D programmes. They have to submit draft versions of their programmes to the Government for approval, accompanied with a compulsory opinion by the Council.

Furthermore, the areas of competence for R&D support administration as well as the funding criteria were streamlined and equal for institutional and targeted (competitive) funding. This implied the following changes to the previous system:

- The responsibility for the institutional funding of private (non-profit) research institutes was now given to a Ministry depending on the focus of the institutes' research rather than on their legal forms as was previously the case.[39]
- There is a stricter ruling of what type of activities could be funded through institutional funding and "Public Auctions", i.e. the public tenders for R&D activities leading to outcomes for which the State is the sole user: the R&D&I budget is allowed to cover only those activities that lead to standards R&D outputs. As a result, 16 of the 25 state organisations previously funded by the Minister of Culture (including galleries, museums, libraries, etc) will no longer be eligible for institutional support for R&D as research is only one of their main activities and not the major one. Also the institutional support for specific research in institutions of the universities (i.e. that part of research that is immediately connected with education and in which the students participate) will be replaced by a targeted support (competence of the Ministry of Education).

Table 16, below, provides an overview of the competences for R&D&I in the various ministries.

In most ministries, programme management is the task of a sub-department within the department responsible for R&D. These sub-departments therefore report directly to the head of the department who then reports to the Minister. Exceptions to this rule are the Ministry of Health and the Ministry of Agriculture. In these ministries, internal grant agencies exist.

[39] Previously, institutional funding for private research institutes was competence of the Ministry of Education

Table 16: Overview of the ministerial competences for R&D&I

	Cross-sectoral R&D&I				Sectoral R&D&I		
	Min. of Industry & Trade	**Min. of Education**	**Min. of Culture**	**Min. of Interior**	**Min. of Defence**	**Min. of Health**	**Min. of Agriculture**
Competences for national targeted funding	Only up to 2017 and through one specific big programme (TIP).	Specific research in Higher Education Large R&D Infrastructures International cooperation	Research related to National & Cultural Identity Inter-departmental concept integrating also research falling under other support providers	Security R&D Inter-departmental concept integrating R&D that fell under competence of the Ministry of Justice, the State Office for Nuclear Safety, and the Czech Mining Office	Applied R&D for Defence	Medical Research	Agricultural Research
Competences for institutional funding	Private research institutes performing industrial R&D	Research in Higher Education Other Private Research organisations Other Public Research & State Contributory Organisations	As of 2011, 9 public research institutions	2 Public Research institutes engaged predominantly in security research 3 legal research entities previously competence of the Ministry of Justice, and the State Office for Nuclear Safety	1 state organisational unit & 3 state contributory organisations	10 Public Research institutes active in medical research	7 public research institutes and one 'state contribution institution' 13 private R&D institutes
Other R&D&I support	Operational Programmes (CzechInvest) Indirect support for R&D&I, e.g. tax relief (CzechInvest)	Operational Programmes					
Organisational Structure	Department(s) within the Ministry & Czech Invest	Department(s) within the Ministry	Department(s) within the Ministry	Department(s) within the Ministry	Department(s) within the Ministry	Internal Grant Agency	Internal Grant Agency

There also was a major change in the governance of targeted (competitive) funding through the enforcement of the role of the Czech Science Foundation (further: Grant Agency) and the **creation of a new central agency.** The competences of these agencies were defined reflecting the linear model of research: all targeted support for basic research was centralised in the Grant Agency, leading to the dismantling of the Academy of Sciences internal grant agency; for the support to applied R&D&I, the Technology Agency was created.

1. The Grant Agency (GA CR)

The main function of the Grant Agency is to provide, on the basis of public tender, financial support for research projects of *basic research* in five principal areas: technical sciences, natural sciences, medical sciences, social sciences and agricultural sciences. Interviewees informed that 'basic research' is considered to be research whose results are public rather than appropriated. Interviewees acknowledged that the distinction is difficult especially in technical sciences and medical and biological sciences. Furthermore, teams conducting a mix of applied and basic research risk falling between the Agency stools.

Support is provided through the funding of grant projects and other activities in the field of basic research by means of public tenders. There are 3 types of projects: 'standard', 'post-doc', and 'doctoral team' ones. At the international level there are bilateral and EUROCORES projects.

- Standard projects are for PIs. These are teams competing and the funding is from 3 to 5 years.
- The (solo) post-doc projects is for individuals that finished their doctorate no longer than 3 years ago
- Doctoral team projects are meant for the development of programmes for doctoral students. They are called only once in 3 years. They may be terminated soon as the agency cannot monitor the results, which it is obliged to do with the new law. They will probably be replaced by the new system for university funding.

Grants are provided to all kinds of Czech state and private research and development institutions and to private persons who are Czech citizens and reside permanently in the Czech Republic. The basis of the funds available is provided by the state budget, but contributions from other sources, such as the industry, foundations, private donations, etc., are also possible. The Grant Agency cooperates with more than 350 leading scientists working in the universities of the Czech Republic, the various institutes of the Academy of Sciences and other Czech research institutions.

The bodies of the Grant Agency are the Chairman, the Board, the Scientific Council (jointly constituting "The Presidium") and the Auditing or Supervisory Board.

- The Chairman represents the Czech Science Foundation in public and acts in its name in all matters related to it. He/she is appointed from among the members of the board and is removed on the basis of a proposal from the Council for R&D&I by the Government.
- The Board is the executive body of the Grant Agency. The five members of the Board are appointed and removed by the Government on the basis of a proposal from the R&D&I Council. It coordinates the activities of the ministerial commissions (the Discipline Committees - see below). It also approves the publication of public tenders, makes decisions on the conclusion of Contracts on the Provision of Support or on the issue of Decisions on the Provision of Support, submits the draft statute of the Grant Agency and its amendments to the Government for approval and presents the draft budget.
- The Scientific Council is a conceptual body of the Grant Agency and proposes to the Chairman the establishment and focus of ministerial commissions, groups of grant projects and their focus, evaluates the level of scientific expertise of the Grant Agency and proposes measures that are required. The scientific council consists of

twelve members, who are appointed from a number of experts and removed by the Government on the basis of a proposal from the Council for R&D&I.

- The Supervisory Board is monitoring body of the Grant Agency. It monitors the allocation of finances and the handling of State assets over which the agency has jurisdiction, discusses complaints concerning the approach adopted in appraising proposals, and submits – binding -opinions to the chairman. It consists of ten members who are appointed from a number of experts by the Chamber of Deputies on the basis of a proposal by legal entities dealing with R&D issues. The Supervisory Board responds directly to the Parliament, submitting an annual report documenting its activities to the Chamber of Deputies. The Chamber of Deputies may remove the auditing board of the Grant Agency of the Czech Republic if it repeatedly fails to approve the annual report.

Changes following the 2008 reform regarded especially the system of proposal appraisal that should lead to a more significant differentiation in evaluation of individual drafts in order to choose the best ones, and a modification of the rules for participation of researchers from institutions in the proposal appraisals in order not to raise mostly unjustified suspicion of an influenced evaluation.

2. The Technology Agency (TA CR)

The Technology Agency of the Czech Republic is to ensure the development and implementation of programmes for applied R&D, with a specific focus and attention for the implementation of R&D results in innovation.

It fulfils a double role:

- On the one hand, it acts as an executive agency for the seven ministries with competence for R&D&I, taking care - on their behalf - of the implementation and evaluation of R&D programmes and public tenders in areas "that do not strictly belong to these ministries' cross-sectoral & sectoral fields of competence". In this context it therefore takes the form of a **multi-principal** intermediate research funder, acting as an intermediary for several sponsoring ministries. The Council and TA CR will be required to comment on the draft versions of these programmes prior to their discussion in the Government. After approval of the programme by the Government, the Council will include the funds for the programme implementation into the budget of the Technology Agency
- On the other hand, it also has the competence for the development of R&D programmes, in particular those directly tackling the research priorities defined by the R&D&I Council. In this case it has the form of a **mono-principal intermediary**, working for a single policy-making organisation, i.e. the R&D&I Council.

It should be mentioned that this double role of the Technology Agency was the outcome of a compromise between the original intention to create an agency responsible for *all* targeted support programmes in the sphere of applied R&D and the need felt by the Ministries to maintain an R&D budget and competences in their fields of expertise. According to the 2008 Reform, the (original) proposal for the establishment of TA CR is based on the model that has proved right in many countries, including Finland (Tekes), Sweden (Vinnova), Estonia (ESTAG), Ireland (Enterprise Ireland – Agency for the development of the indigenous business sector), Hungary (Agency for Research Fund Management and Research Exploitation), the Netherlands (NWO and TNO)

As was the case for the Grant Agency, the bodies of the Technological Agency are the Chairman, the Board, the Scientific Council and the Supervisory Board. Competences, activities, modalities for the nomination of its members and the reporting processes of these bodies mirror those in the Grant Agency.

4.2.3 The Academy of Sciences

In the 2008 Reform, the Academy of Sciences saw its future competence for R&D limited to the distribution of Institutional Funding among its institutes. It would no longer have the legal competence to develop R&D programmes and the internal Grant Agency started the process of dismantling.

The Academy of Sciences of the Czech Republic was established in 1992, as a successor of the former Czechoslovak Academy of Sciences (founded in 1952). It considers as its main mission to "promote basic research in a wide spectrum of natural, technical and social sciences. This research - highly specified or inter-disciplinary - makes an effort in building knowledge on international level by respecting actual needs of Czech society and culture."

Organisational structure

The main governance bodies of the Academy of Sciences are

- The Academy Assembly is the highest body of the Academy of Sciences of the Czech Republic. It has 256 members, two-thirds of which represent (all) institutes of Academy and the remaining third being representatives of universities, state administration, business circles, and other notable personalities. The Academy Assembly is responsible for the top priority decisions related to the Academy as a structure of the institutes, the evaluations, as well as their everyday scientific life
- The executive body of the Academy is the Academy Council, headed by the President of the Academy of Sciences. It has 17 members.
- The Council for Sciences has 30 members and is primarily engaged in setting science policy of the Academy.

Members of each of these Academy bodies are elected for a four-year-period.

The Academy Evaluation Committees, experts in respective science sections of the Academy, perform an independent assessment of the quality of research and research objectives of the individual Academy institutes.

The Academy currently manages 54 research institutes and 5 supporting units, staffed by a total of 7,771 employees, of whom 4,395 are researchers with university qualifications. The institutes are organised in 3 Scientific Divisions:

- The division of Mathematics, Physics, and Earth Sciences groups the sections
  - Mathematics, Physics and Informatics - six institutes, three in physics and three in mathematics and informatics.
  - Applied Physics - seven institutes.
  - Earth Sciences - five institutes.
- The division of Chemical and Life Sciences includes the sections
  - Chemical Sciences - six institutes.
  - Biological and Medical Sciences - eight institutes.
  - Bio-Ecological Sciences - four institutes.
- The division of Humanities and Social Sciences groups
  - Social and Economic Sciences - five institutes.
  - Historical Sciences - six institutes.
  - Humanities and Philology - six institutes.

It also has its own publishing house, Academia, which produces scientific literature, professional journals and publications for the general public, both in Czech and in foreign languages.

Finally, the Academy has been assigned financial responsibility for 71 specialised Czech scientific societies associated with the Council of Scientific Societies.

Funding Sources

The Academy of Sciences is financed primarily from the state budget.

However, the data reported below, deriving from our trend analysis on the funding structure of the Academy (covering the time period 2000-2009), indicate that the Academy and its institutes are taking steps into becoming a more commercial-oriented research institution, in line with the developments abroad. They are also making an effort in bridging the gap between research and industry and are more frequently involved in collaborative research than was previously the case.

One should notice that these findings regard the Academy of Science as a whole. An in-depth analysis, at the level of individual institute, to determine the extent to which this overall performance may be influenced by the excellence in performance of some research institutes compared to others goes beyond the scope of this audit.

Table 17, below, illustrates that over the last 6 years, the 'direct resources of the institutes'[40] has grown as a source for funding. In 2009, it accounted for 23% of the Academy financial resources, compared to 17% in 2003 and in the year 2000 and showed a growth rate of 2.40 since 2003, compared to a growth rate of 1.62 of the institutional funding and 2.09 of the targeted funding.

Table 17: Trend in funding sources for the Academy

	2000	**2003**	**2009**
State budget chapter (institutional funding)	65%	67%	60%
Total Targeted funding	18%	15%	18%
Of which: Grants – Grant Agency of the CR	*51%*	*49%*	*36%*
Grants and projects – other chapters	*49%*	*51%*	*64%*
Direct resources of institutes	17%	17%	23%
Total (in M CzK)	100%	100%	100%
	4,280.6	5,422.3	9.885

Source: Academy of Sciences Annual Reports 2000, 2003, 2009

The Academy has two main categories of funds: the Non-Investment Funds covering operational costs, and Investment Funds covering predominantly the acquisition of instruments and equipment and the construction of buildings. The ratio Non-Investment Funds/Investment Funds was fairly stable throughout the period 2000 – 2009, i.e. 88/12.

However, the sources for the funding changed:

- The Academy has become increasingly dependent on Institutional Funding to cover its Investment Funds - institutional funding accounted for 90% of the Investment Funds in 2009, compared to 75% in the year 2000
- One fourth of the operational costs were in 2009 covered by the 'direct resources' (compared to 19% in the year 2000). This implied a reduction of the importance of

[40] In the Academy's Annual reports, "direct resources of the institutes' include Main activity orders, Sales of goods and services and Licences

institutional funding for this cost category: it currently covers 55%, compared to 65% in 2000

As a result, in 2009, 80% of the institutional funding was used by the Academy to cover its operational costs, and 20% for its Investment Funds; resources from the targeted funding, instead, were nearly all (93%) used to cover the operational costs.

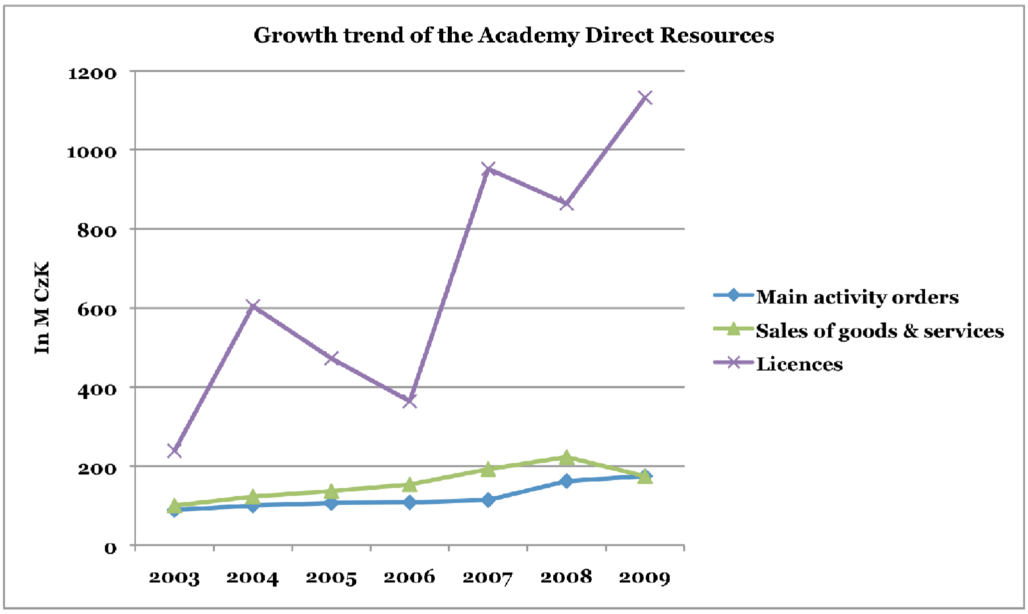
In relation to the funding from Targeted R&D support sources, it is interesting to notice the growing importance of funds from R&D programmes established by the ministries compared to grants from the Grant Agency (shares were respectively 64% and 36% in 2009, compared to a 50-50 ratio in the years 2000 and 2003). This seems to indicate an increased involvement by the Research Institutes in collaborative research, be it with other research organisations or industry.

Finally, the trends in the funding resource "Direct resources" merit special attention. In 2009, these were made up for 50% by the income from licences. In that year the Academy declared a licence income of 1131.9 M CzK, i.e. 45.28 M Euro, the total amount of 'Direct resources' amounted at 2,228.5 M CzK.

This was clearly not an alone standing unique event: Figure 22, below, illustrates the remarkable increase in licence income over the last decade.

It also shows the steady but more modest increase in incomes deriving from 'main activity orders' and 'sales of goods and services' (the former especially in 2008 and the latter since 2006), indication of the Academy's growing activity in contract research.

Figure 22: Growth trend of the main voices in the Academy Direct Resources



Source: Academy of Sciences Annual Reports

In its Annual Report for 2009, the Academy also refers to various actions and achievements in relation to Intellectual Property management implemented during that year, and reports on the creation of three spin-off companies by its institutes.

- The *Institute of Organic Chemistry and Biochemistry* established
  - The company IOCB-TTO, s. r. o., headquartered in Prague, which concentrates on searching for suitable projects, assisting in the protection of intellectual property rights, managing the procedure between the national and international patent applications, seeking partners and investors, on licence negotiations, contracts with partners etc., and
  - The international company Mendel Therapeutic, s.r.o., based in Brno, which focuses on the transfer of results achieved in the field of research of non-pyrogenic glycopeptide immunotherapeutics into clinical practice.

- The *Institute of Experimental Medicine* founded the company BiotechInvest, s.r.o., based in Prague, to accelerate the transfer of biotechnologies in the area of biomedicine.

5. The Administration of R&D&I Targeted Support

In this section we report on the initial findings of our analysis related to the main processes related to the administration of the R&D&I targeted support, i.e. the policy and programme design, monitoring and evaluation and project proposal appraisal processes.

In this stage of the study, we predominantly focused on setting the background for our future analysis by depicting the structure, rulings and current practices. This analysis is therefore still in an initial phase and does not allow yet for any sound conclusions to be drawn.

5.1 Policy & Programme Design, Monitoring & Evaluation

Literature tells us that there is a need for **logical consistency across the programme cycle**, to maximise the chances that interventions reach their objectives. Clearly, this type of consistency requires an articulated programme design and development model.

The model based on a hierarchy of performance contracts connecting through ministers, ministries and agencies with research and innovation project performers dominates current thinking about policy and evaluation. Such a hierarchy implies a process in which broad policy decisions made at high levels are broken down into constituent actions and sub-actions. Programme design should incorporate explicit links to higher-level policy. As a result of this, programmes and programme portfolios should have an explicit 'middle' logic, connecting individual activities and programmes with higher-level goals. Assessment criteria to be used in project selection should be firmly and explicitly anchored in the programme logic. Performance indicators need to be quality assured and to derive from the programme logic.[41]

In general, performance contracts and their associated indicators are supplemented by evaluation studies from the ministry level and downwards, so that each level in the hierarchy evaluates the level below it. Thus, ministries evaluate agencies; agencies evaluate programmes; programme managers evaluate projects.

5.1.1 The Processes Established by Law

Our current analysis, described in the sections below, shows that in the Czech Republic, the processes for programme design, monitoring, and evaluation (defined in the amended Law 130) are based on the waterfall principle: the Ministries are expected to develop Conceptual documents and describe how their R&D&I strategies will support and implement the National Policy as well as cover the Research Priorities. Subsequently, they draft ministry-specific programmes, implementing the Conceptual documents.

Previously to the Reform in 2008, the Ministry of Education who had competence on R&D and was therefore the author of the National Policy for R&D, also developed a National R&D&I Programme that directly implemented the national strategies - in addition to the 'Departmental' Programmes.

[41] Erik Arnold et al., "Chile's National Innovation Council for Competitiveness – Interim Assessment and Outlook", OECD, April 2009

The R&D&I Council strongly co-ordinates the programme design, monitoring and evaluation process: it is the body in charge for the development of the national policy and the identification of the research priorities, and ministerial conceptual documents and draft programmes require the approval of this body before they are submitted to the Government for approval. In the case of programmes that are drafted by the Ministries but will be implemented and managed by the Technology Agency, also the approval of the latter is required.

In terms of monitoring and evaluation, the Ministries are in charge of collecting the results of the project monitoring and evaluation activities (drafted by the Programme Councils or the other competent advisory bodies) and deliver a report to the R&D&I Council. The latter is expected to monitor the implementation of the National Policy and evaluate the results.

Programme design

By Law, the draft Conceptual documents should include:

- A SWOT analysis
- A brief description of the characteristics of the state of research in the field, nationally and internationally
- Indication on how the strategy responds to the goals of the National Policy
- A general outline on how the strategy will be implemented, including the thematic priorities of applied research and development in the sector, current and future programmes, and the planned use of resources
- Proposed solutions to moral and ethical problems in research

Draft Programmes are expected to contain

- The expected duration of the programme
- The total expenditure for programme implementation, overall and per individual year, identification of the expenditures to be covered by pubic funds, the highest admissible level of support per project and its justification
- A specification of the programme goals, together with their justification and the method of their achievement, and performance indicators,
- A comparative analysis of the current situation in the Czech Republic and abroad, and the expected impacts of the programme
- The possible division into sub-programmes
- The requirements for the applicants‘ eligibility and the methods and criteria for proposal appraisal

The Law also specifies that the acceptance, implementation, and result evaluation of all programmes will be based on the following principles:

- The evaluation of the programmes of research and development against pre-set clearly defined objectives, including the implementation of achieved results
- Ensuring co-financing of applied research and development programmes by public-private funds (with the exception of those where the state or region will be the only user of results) and giving preference to projects featuring research-industry collaboration
- The appraisal of project proposals in terms of their alignment with the programme objectives. Key criterion will be the innovativeness, originality and potential impacts related to the programme objectives. The professional history will be a criterion of limited importance– and never in relation to an individual or only partly of the team
- The support of teams, not individuals or entire institutions

Monitoring & evaluation

The Government Resolution No. 644 of 23 June 2004 – reported in the law of 2009 that amended the Law 130/2002 - pointed out that the administration bodies were to secure, within their own scope, an evaluation according to government-approved material, i.e. observing the general principles of evaluation indicated below:

- Evaluation is periodic and repeats itself after a particular period (i.e. not only input evaluations of the proposal, but also continuous evaluation and final evaluation).
- A concrete goal is to be established beforehand (of the program, project, research intention, institution…), which for each case may be specific and is to be achieved within a specific time, and for which the decision may be made as to whether it was satisfied or not.

Evaluation criteria were to be

- Known and binding beforehand
- Clearly formulated (in such a way that they do not mutually conflict)
- Quantifiable, measurable, rateable
- Related to the given goal

The resolution stated that these principles are valid for input evaluations (evaluation of proposals) as well as for continuous and final evaluations.

In practice, all administration bodies, at the various levels in the system, are expected to evaluate the performance and results of the activities funded on a close to yearly basis.

- Administration bodies funding R&D&I projects are obliged to evaluate at the end of the projects the compliance with project goals and use of funds, and the effectiveness of project expenditure. If the project lasts more than 2 years, the evaluation must be performed at least once during the term of the project. The Programme Committees are in charge of these evaluations and produce a protocol for the administration body, listing the results.
- Contemporaneously, all project co-ordinators are requested to perform a yearly 'self-assessment', inserting the results of their project activities into the central Information System
- It is currently unclear to what extent the administration bodies are also expected to perform a yearly evaluation of their administrative efficiency in the form of monitoring reports. However, an ongoing monitoring of the overall effectiveness of the R&D&I activities funded and the achievement of the goals listed in the Concepts and programmes is currently requested
- **The Law** imposes on the R&D&I Council to produce regular annual analyses of the existing state of research and development in the Czech Republic and a comparison with the situation abroad and submit them to the Government of the Czech Republic. The published data and time series (usually the last 5 years) are used for development of strategic documents focused on R&D and innovations and for assessment of the effectiveness of programmes and implementation measures. The Analysis of R&D is divided into nine parts:
  - Basic indicators of research and development
  - Analysis of R&D support from public funds
  - Analysis of R&D information system data
  - Bibliometric analysis of R&D results
  - Patent applications, granted patents
  - Use of venture capital
  - Competitiveness, innovations
  - Implementation of the National Research and Development Policy

  - Evaluation of participation of the Czech Republic in the 6th and 7th EU Framework Programme for Research and Development
  - Remarkable achievements in research and development.
- The R&D&I should also continuously evaluate the implementation and impacts of individual measures of the Reform of the Research, Development and Innovation System in the Czech Republic and the National Policy of Research, Development and Innovation in the Czech Republic for 2009 - 2015.

The Technology and Grant Agencies have slightly different rulings.

Technology Agency

The beneficiaries have to provide progress reports by 15 January each year and re-specify their budget needs for the coming year of they need to make changes (within the granted budget). The rapporteur will assess these annual reports – and has freedom to ask for expert help if needed. The law gives them 60 days to do this. He can do both a financial and a technical check. The law prescribes what has to be done, e.g. at least 5% of projects have to be audited on-site. Before the end of the project the project performers have to provide an implementation plan. This will be monitored for 3 years after the end of the project. Projects themselves last 2-6 years – they hope for most to be 3-4 years. The projects will be evaluated ex post via the same process as the monitoring.

Grant Agency

The institution manages the grant funds according to holder's instructions, in accordance with all the state financial regulations. The director of the institution is responsible for proper use of the finances, together with the grant holder who is also responsible for management of grant funds in cooperating institutions. The Czech Science Foundation checks occasionally on the use of the funds; the grant may be withdrawn if serious discrepancies are detected. The Czech Science Foundation monitors the use of the instrumentation purchased for three years after termination of the project. If it is found that the instruments are not properly used, then The Czech Science Foundation may decide to transfer them to other institutions.

Evaluation of R&D Programmes

In the current evaluation system, programme evaluation is seen as "an evaluation of the effective use of targeted support funds.'

It is stated that the goal of the programme evaluations is:

- To provide the government, public, and eventually other interested parties with a comprehensive set of information on results gained while providing purposeful support on the R&D activities of individual providers;
- To provide the R&D&I Council with information on how individual providers of R&D support fulfil their own defined program goals that are indicated in the government-approved program proposals; these observations will be used by the CRD when judging new program proposals.

Programme evaluations – in the form of a summarised report on the assessment of the programme - are to be drafted by the competent Administration Body at the end of the programme and transmitted to the R&D&I Council for approval.

These reports are to include:

- Basic data on the programme implementation (number of publicized settings of the public commission in the case of program realization in the form of public commissions in R&D, number of proposals submitted as part of the contractual proceedings on the public commission) – data on public tenders and on the number of concluded projects need not be included, this data will be taken from the R&D IS.
- Indication of particularly significant results (do not include a transliteration of results in IIR); the particularly significant result must be specific and precisely identifiable (e.g. do not indicate that the result is a number of valuable studies or analyses, etc.),

- Information on what method will be utilized to achieve the results (specific utilization, not general statements, e.g. that the results will be utilized for conceptual work of the ministry, etc.),
- A comparison of achieved results with the goals of the program, i.e. if and how the results achieved by resolution of the project contributed to fulfilling the goals of the program and the degree to which the goals of the program were fulfilled (expressed in %),
- A comparison of achieved results of the program with the state abroad at the time of the program's completion.

The R&D&I Council will then draft a summarized programme assessment and perform a 'comparative evaluation' of all programmes concluded in that year. The core criterion for the evaluation at R&D&I Council level is the average Index SR value of all programmes. The Index SR stands for the rate of total point evaluation of all R&D outputs reached in a given programme and the total funding provided from the national budget for this programme.

The Summarized Assessment will contain an overview of evaluated programs, information on the timetable and process of evaluation, results of the evaluation (according to the effectiveness of provided support with consideration towards the providers' reports), and a summary and proposal of measures. Seeing that the evaluation of individual research activities resolved as part of the given program is fully and solely in the competence of the respective provider, the Summarized Assessment will not contain evaluations of individual research activities.

For the appraisal of planned and fulfilled goals, data provided by individual providers into the R&D SI will be used (approved program goals, data on public competitions, number of resolved and successfully completed projects, actual total expenses and from the national budget).

5.1.2 Policy & Programme Design in Practice

In most R&D&I systems, there is two-way communication between the implementing, policy and strategic levels, so that strategies are not so much imposed top-down but reflect discussions and emerging consensus within the system. This aids alignment among the different levels and actors involved. Often, however, the research performers end up having a large say in, sometimes even controlling, the way resources are allocated[42] at programme level. It is therefore important to understand not only whether there is consistency between priorities and current R&D&I policy but also how priorities are set.

The Role of the Advisory Bodies

In the Czech Republic, in line with common international practice, stakeholder communities are involved in the development of strategies and programmes as well as in the appraisal of project proposals, project monitoring and evaluation.[43]

Table 18, below, lists the various bodies set up at ministerial and agency level to fulfil these roles as well as their composition. We need to mention that this information is predominantly based on desk research and will be completed with information provided by the funding bodies in the next stage of our analysis.

Current information shows that the Ministries and Agencies involve the stakeholder communities at various levels. The most active ones from this perspective are the two

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[42] See Dietmar Braun, 'Who governs intermediary agencies? Principal-agent relations in research policy making,' *Journal of Public Policy*, 13 (2), 1993, pp135 – 162

[43] In this section, we focus on the involvement of stakeholder communities through the creation of Advisory Bodies. Those cases where there was a broad stakeholder involvement for the design of policies and research strategies are indicated in the next section below.

major ‘sectoral’ ministries – the Ministry of Health and the Ministry of Agriculture – who have a long-term tradition in stakeholder consultation. Both ministries set up two different advisory bodies for their policy-making; the Council of Health Care Providers and the Academy of Agricultural Science are the ones most actively involved. In relation to the advisory bodies in charge of project appraisals, monitoring and evaluation, these two ministries also have a different process for the establishment of the bodies, i.e. the Scientific Board of the Internal Grant Agency is in charge. In the other Ministries, the Councils (or Committees) are set up for each single programme by the Ministry departments.

Information on the typologies of stakeholders involved is still limited, especially in relation to the advisory bodies involved in policy-making. Exceptions are the Ministry of Culture and the Ministry of Agriculture. Users of R&D are strongly involved especially in the Ministry of Health, and – at least formally - also in the Ministry of Agriculture.

Finally, for the moment it is unclear to what extent the stakeholders involved cover the full value chain, i.e. research – intermediary technology supplier – product developer – user. This holds true for the advisory bodies consulted during the strategy development as for those involved in project appraisals, monitoring and evaluation. To the best of our knowledge, in fact, ‘for profit’ private research organisations have the legal entity of business organisations and are therefore considered ‘industry’- in stakeholder statistics and in common practice.

Table 18: Overview of the Advisory Bodies in the Ministries/Agencies and their composition

		Min. of Industry & Trade	Min. of Education	Min of Culture	Min of Interior	Min of Defence	Min of Health	Min of Agriculture	Technology Agency	Grant Agency
Advisory Body for Policy-making	Body			Council for R&D of the Ministry	Programme Committees	Council for R&D of the Ministry	Professional Collegium of the Ministry	Council of Applied Agricultural Research	Scientific Council	Scientific Council
	Members	n.a.	n.a.	Representatives of research institutes and universities; one museum is represented (the National Technical Museum)	Experts from the Ministry, the central government, research and other institutions active in security research	n.a.	Representatives of research institutes, universities, hospitals	Users, people from other ministries, the agrarian and food industry chambers, association of farmers	Experts	Top rank scientists representatives of individual scientific fields, types of institutions and regions
	Body						The Council of Health Care Providers	Academy of Agricultural Science		
	Members						Representatives from all the most significant organisations linking together individual health service providers	Representatives of research institutes and higher education active in agricultural R&D		
Proposal appraisal & project monitoring and evaluation	Body	Programme Council, for each programme	Programme Council, for each programme	Programme Council, for each programme	Programme Committees, for each programme	Programme Council, for each programme	Scientific Board of the Internal Grant Agency (13 Field Committees & Economic Commission)	Evaluation Committee	Discipline Committees & sub-committees	Discipline Committees & sub-committees
	Members	Experts indicated by the key stakeholder groups and partners (industry associations and private research organisations)	The profile of the experts varies from programme to programme	n.a.	Experts from the Ministry, the central government, research and other institutions active in security research	Representatives of the state administration, association of research organisations, association of the defence & security industry	Representatives of the state administration, the Czech Medical Association, Academia, Hospitals & other research institutions Recommended ratio = 8:3:3:3.	n.a.	Experts	Experts representatives of individual scientific fields, types of institutions and regions

Priority-setting processes

The Law requires the developers of draft programmes to perform a SWOT analysis, a context analysis and a comparative analysis of the situation in the Czech Republic and abroad in order to see the draft programme accepted by the R&D&I Council. This ruling indicates the strong importance that policy-makers in the CR attribute to the collection and use of 'strategic intelligence' for the development of policies and R&D&I strategies.

The analysis of what happens in practice for the priority setting at the high policy level (National Policies and Research Priorities) and the second level (the ministerial R&D&I strategies, i.e. the Concepts) is still in its initial stages; information is incomplete especially in relation to the Ministerial Concepts (see Table 19, below). However, current information shows that

- High-level policy documents
  - Are usually based upon (external and/or internal) analyses of the strengths & weaknesses in the national environment and an analysis and/or comparison with situation abroad
  - Rarely refer to the outcomes/outputs of past or running programmes; the only exception is the National Innovation Policy 2005-2010.
  - Never refer to results of programme evaluations
  - Are most often based on a wide consultation of stakeholders. This was especially the case for the latest policy documents (the National Policy for R&D&I, 2009 – 2015) and the Priorities of Applied Research, Development and Innovation for 2009-2011
  - The National R&D Policy 2004-2008 as well as the National R&D programmes (NPV I, II and III) were (also) based upon foresights.
- Strategy documents at the Ministerial level ('Concepts')
  - Are rarely based upon external studies (exception is the 2008 Concept of the Ministry of Culture).
  - All set their objectives in the context through an analysis of the local environment and/or a SWOT – at variegating levels of depth though (detailed or rather basic) - and usually include a comparison with the situation abroad
  - Key tool for the priority setting is consultation with the stakeholders
  - They never refer to outcomes/lessons learnt from impact assessments of previous programmes

As a preliminary conclusion we can state that there seems to be a divergence in the level of strategic intelligence tools used between the administration bodies responsible for high-level policy documents (the R&D&I Council and the Ministry of Education in the past) and those responsible for R&D within their own sector.

What these two categories of administration bodies do have in common is the involvement of the stakeholder communities and the lack of use of evaluations (ex-ante or ex-post) as a tool for their strategy building and decision-making.

Consistency between the Concepts for R&D&I and High-Level Policy Objectives & Priorities

In this phase of the study, we considered the consistency of the currently valid R&D&I Concepts with the policy objectives stated in the National Policy for R&D&I, 2009 – 2015 and with the research priorities defined in the document Priorities of Applied Research, Development and Innovation for 2009 – 2011.

The main objectives of the National Policy were:

1. To simplify the support of R&D, supporting institutions according to the results achieved and teams according to the projects undertaken.
2. To simplify the R&D&I support system and the administrative procedures.

3. To encourage and support *excellence in research* and facilitate the application of R&D results in innovation.
4. To strengthen research-industry cooperation. To condition programme support of R&D upon the cooperation of public research with users of R&D results, based on co-financing from public and private resources.
5. To introduce a more flexible organisational structures of public research organisations
6. To provide qualified human resources for R&D&I,
7. To intensify international collaboration in research, development and innovation

The Priorities of Applied R&D&I for 2009-2011, eight directions for research were identified:

- Biological and ecological aspects of a sustainable development
- Molecular biology and biotechnology
- Sources of energy
- Material research
- Competitive engineering
- Information society
- Security and defence
- Priorities of development of Czech society.

Table 19, below, illustrates how the various administration bodies perceived the alignment of their research strategies (Concepts) with the high-level policy objectives and how they placed their research in line with the research priorities defined by the R&D&I Council.

Table 19: The Concepts of the various administration bodies and their alignment with the higher-level policies

Policy Document	Sources Used for the Development	Main Topics	Alignment with the National Policy	Reflecting the Research Priorities
Interdepartmental concept of support to large R&D infrastructures – Ministry of Education	Based on relevant European documents concerning R&D (Lisbon Strategy, Green Paper of ERA, ESFRI Roadmap and Council Regulation on the Community Legal Framework for European Research Infrastructures etc.)			
Interdepartmental concept of applied research and development of national cultural identity till 2015 – Ministry of Culture	Drafted by the Comenius University Reference to the British programme "Capitalisaton of Cultural property" Input from • The study "Applied social science research" (Technology Centre) • Institutions dealing with social science research proposing thematic areas	• Cultural heritage and national identity; • The history and multicultural society; • Technology, processes and materials; • The environment for arts development and preservation of cultural heritage.	• Support to R&D excellence and the implementation of R&D results in innovation • Enhancing collaboration between researchers and users of the R&D results • Involvement in international collaboration for R&D&I	• Management and Administration • Human resources and its development • Competitiveness of the Czech society • Czech identity and the surrounding world • Technologies and methods
National Strategy of Security Research in the Czech Republic 2010-2015 – Ministry of Interior	Close collaboration with the Ministry of Defence	• Security of Citizens; • Critical Infrastructure Security; • Crisis Management; • Foresight and Scenarios; • Situation Readiness; • Identification of People and Assets; • Innovation; • Coordination of the Security Research Strategy and its Implementation between the EU and the Member States and the Relevant Institutions and Organisations of the EU and NATO	• Support to R&D excellence and the implementation of R&D results in innovation • Enhancing collaboration between researchers and users of the R&D results • Involvement in international collaboration for R&D&I	Not mentioned

Policy Document	Development Modalities	Main Themes for Research	Alignment with the National Policy	Reflecting the Research Priorities
The concept of defence applied research and development till 2015 – Ministry of Defence	Input from the University of Defence, the ministry organisational units dealing with defence R&D, legal and natural persons operating in defence industrial R&D		• Support to R&D excellence and the implementation of R&D results in innovation • Enhancing collaboration between researchers and users of the R&D results • Involvement in international collaboration for R&D&I	Extends the priorities related to Security & defence
The concept of health applied research and development till 2015 – Ministry of Health	Extended literature review and specific reference to the World Health Organisation programme Health 21 Input from the Council to the Ministry, the 13 committees of the Internal Grant Agency, and some external experts	Themes for research defined along 12 fields of research	• Support to R&D excellence and the implementation of R&D results in innovation • Enhancing collaboration between researchers and users of the R&D results • Involvement in international collaboration for R&D&I	• Health • Molecular biology & biotechnology • Information Society • Human Potential of the CR
The concept of agricultural applied research and development till 2015 – Ministry of Agriculture	Input from representatives of the Czech Academy for Agricultural Sciences, sectoral research organisations, universities, and organisations users of R&D results	• Protection and exploitation of natural resources; • Technology development for sustainability of agrarian sector, including technologies for renewable energy; • Availability, quality and safety of food, effects on public health and nutrition; • Sustainable landscape management; • Development of rural areas.	• Support to R&D excellence • Enhancing collaboration between researchers and users of the R&D results • Involvement in international collaboration for R&D&I	• Sustainable Development • Molecular Biology • Energy Resources • Material Research

Even though the information is still incomplete, the following observations can be made:

- In relation to the consistency with the National Policy objectives, all Concept documents referred to the same objectives, i.e. the fostering of R&D excellence and the application of R&D results in innovation; the strengthening of research-industry co-operation, and the intensification of international collaboration in R&D&I. One needs to acknowledge that these were effectively the objectives where R&D programmes could make a difference. All Concepts describe in detail what these policy objectives 'mean' in their fields of research
- In the case of the Concept for Health R&D, when considering the sources used for the development of the Concepts in combination with the main themes for research listed one cannot but notice that the research themes strongly reflect the various stakeholder communities' fields of research.

In relation to the Research Priorities themselves, the impression is that there is some truth in the critics that these priorities were so broad that any field of research could find its place. Literature[44] shows, however, that the definition of research priorities is a dilemma for policy-makers in most countries, each approach taken having advantages and disadvantages. We will address this issue in the further stages of our study.

- A very detailed/narrow definition of the thematic priorities has the advantage of enabling the mobilisation of a specific and clear 'community and allows for the definition of clear targets and goals. Disadvantages are the risk of 'betting on the wrong horse' and of creating a lock-in in certain fields, thus loosing sight of broader developments (in other words, the level of flexibility decreases)
- A very broad definition of the thematic priorities shows the advantage that no possible strengths or opportunities are excluded. There is a broader social base for the research and further specification and selection of specific themes can always happen during implementation. Disadvantages are to be found in the fact that no true choices have been made, showing therefore a limited focus and creating little critical mass; it barely has a mobilising effect and it is more difficult to define clear targets.

5.1.3 Monitoring and Evaluation in Practice

Performance indicators

In this phase of the study, we looked into the performance indicators listed in a limited set of ministerial strategy documents (Concepts) and recently approved programmes.

A first observation is that the Administration Bodies define their performance indicators at highly varying levels. Some limit themselves to very general indications, others go into an extended detail; some focus exclusively on R&D outputs as the ones included in the R&D&I Information System, others consider (also) other objectives.

In relation to the Concepts, we looked into those developed by the Ministries of Culture, Defence, and Agriculture.

- The Ministry of Culture defined performance indicators to an extended level, i.e. up to the sub-priorities. These indicators were all related to R&D outputs
- The Ministry of Defence merely stated that project proposals needed to indicate at least one expected R&D output in order to be eligible for appraisal

[44] J. Deuten, P. Boekholt, "Prioritering in kennis- and innovatiebeleid – Ervaringen uit Canada, Duitsland, Frankrijk, Finland en Noorwegen", Technopolis Group, 2009

- The Ministry of Agriculture indicated performance indicators related to administration efficiency (number of projects funded with international collaboration or with research-industry co-operation, number of inter-departmental programmes launched, number of teams established for the identification of research themes, number of tenders published, etc.), some more policy-related indicators such as the number of PhD students and researchers in the field, and indicators related to R&D outputs (number of R&D results implemented, number of publications, methodologies, etc.)

In their Programme descriptions, the Ministries indicated the following indicators:

- For the TIP programme (Call 2011), the Ministry of Industry and Trade stated that the projects needed to lead to at least one R&D output (prototypes, patents, software, etc)
- For its Departmental R&D Programme III (2010 – 2015), the Ministry of Health defined performance indicators especially at the Programme level, including both R&D outputs and more policy-related indicators such as the level of involvement of SMEs, of international co-operation, and of support to 'young researchers'. It included also performance indicators related to administration efficiency such as the minimum of supported projects and successfully concluded ones, and some financial indicators. At sub-programme level, the performance indicators were of a very general nature
- In its Programme for applied R&D&I in national and cultural identity, the Ministry of Culture defined performance indicators related to R&D outputs at programme and sub-theme level; at theme level, the indicators were very general

Scope and time frames of the evaluations

Evaluation of Programmes seems to be a pitfall in the programme management processes; most importantly, there were no references to be found in strategic documents to the findings of such evaluations. This regards evaluations at the end of the programme as well as – especially – impact assessments 3 to 4 years later.

This is even more surprising when considering the constant insistence - in all strategic policy documents since 2004 - on the importance of programme evaluations. All concepts/programme documents also duly indicate (generic or concrete) indicators for performance evaluation and participants are obliged to be available for impact assessments until 3 years after project conclusion.

5.2 Administration of the Proposal Appraisals

5.2.1 Processes Governed by Law

The Public Tender

The "grantor" (funding body) publishes the public tenders, their content and terms and conditions in the Commercial Journal and through the R&D&I Information System online. The tender may contemporaneously also be published through other means. The tender must contain:

- Information on the programme
- Terms and conditions, including the latest version of the programme approved by the Government; requirements for proving – and methods for assessing - the applicants' eligibility; the method and criteria for proposal appraisal; the deadline for the tender; the deadline for the proposal appraisals; the place where tender documentation can be collected; where, how, and by when proposals should be submitted; the name of the funding body, head office and telephone number and electronic address of contact persons
- Precise indications on eligible costs
- Eventually other terms and conditions

- The scope of the requested information and instructions for the proposal drafting, indication of eventually mandatory attachments
- A definition of the information that will be published in relation to the proposals, applicants and participants
- In the case of a two-step public tender, requirements for the finalisation of the proposal
- The place, manner and deadline for the announcement of the proposal appraisal results.

The duration of one-step *public tender calls*, or for the first level and the second level of two-step ones shall be at least 36 calendar days. The duration of the *appraisal process* shall be 180 calendar days at most for one-step and 240 calendar days for two-step public tenders.

The “grantor” is responsible for the organisation of the public tender; it may select a legal entity with which it concludes an Agreement on Assistance in Organising a Public Tender in Research, Development and Innovation. This legal entity, shall be excluded from participating in the tender, may not participate in the preparation of any proposal and may not have any demonstrable interest in the result of the evaluation of the proposal.

Appraisal of the proposals

Councils for Appraisal, nominated by the “grantor”, are responsible for the overall management of the appraisal process and

- Evaluate the compliance of the proposal with the terms and conditions of the public tender, and
- Draw up a protocol that contains the list of recommended proposals, information concerning their submission within the tender deadline, the completeness of the proposals and concerning proposals that do not comply with terms and conditions, providing reasons for their exclusion. The protocol shall also contain information on proposals received after the tender deadline, including the date of receipt.

Members of these Committees “may not have any connection to the subject of the public tender in research, development and innovation or any bias towards the applicants and in particular they may not contribute to drawing up the project, may not have any personal interest in the Decision on the Provision of Support for a particular project and may not have any personal, professional or other relationship with the applicants.” It is unclear to what extent members of these Councils are external experts.

The Law assigns the responsibility for the actual proposal appraisals to Advisory Bodies constituted by external experts. These Programme Committees or Expert Advisory Bodies evaluate the eligible proposals.

At the latest during the publication of the public tender, the ‘grantor’ will develop internal regulations and publish the information in relation to the composition of these advisory bodies, the methods for handling the information contained in the proposals, and other rules governing their activities.

In principle, each proposal is evaluated by at least 2 experts. The Programme Committees must guarantee an objective and unbiased appraisal of the proposals in accordance with the rules and criteria announced in the public tender, taking into account the opinions of the experts.

The Programme Committee will draw up a protocol listing the results of the appraisal of each proposal.

Decision-making

Protocols on the evaluation of proposals and a final proposed ranking of all the proposals shall be delivered by the Programme Committee to the grantor, which shall be obliged to make a decision concerning the selection of the proposals and to publish the results of the public tender in research, development and innovation by the scheduled deadline for project evaluation.

The grantor [also the Minister in person] may decide against the recommendations of the Expert Advisory Body, provided that it explains the reasons in writing in the protocol and publishes such decision on the Internet.

The grantor shall enable the applicants to obtain the results of the evaluation of their proposals, including the reasoning and the opinions of the experts without disclosing their personal data.

Time to contract

The deadline for concluding a Contract on the Provision of Support or issuing a Decision on the Provision of Support is set at a maximum of 60 calendar days from the date on which the Act on the State Budget of the Czech Republic enters into force for the specific year during which the project is to commence, or - if the results of the call were announced after that date - from the date on which the results of the public tender were published.

The Contract on the Provision of Support between the grantor and the receiver covers the whole period of the contract and a subsequent period for the evaluation of the project results (maximum of 180 days after the project is completed). There are also other rules on what has to be part of the contract, such as the regulation of the rights of use and ownership of the results, the method of dispute settlement, and the sanctions for contract breach.

Funding

The overall funding agreed for the project is at the beginning of the project subdivided into funding on a yearly basis.

The grantor is obliged to transfer the funding within 60 calendar days from the date on which the Contract on the Provision of Support entered into force, or from the date on which the Decision on the Provision of Support was issued.

In the case of multi-annual projects, in the second and subsequent years of the project, the grantor will transfer the funding within 60 calendar days of the beginning of the calendar year - provided all the receiver's obligations arising from the Contract are met and data was inserted into the R&D&I Information System.

The receiver is obliged to launch the project within the same period of time.

5.2.2 Proposal Appraisals in Practice

The information currently at our disposal confirms that all ministries rigorously applied the appraisal processes described above.

The difficulty to have access to detailed information on the efficiency of the administration bodies in their overall programme management – not on a yearly basis but at overall programme level - slightly delayed our analysis.

However, as a first step we analysed the data related to Public Tenders in the time period 2004 – 2009 (stored in the R&D&I Information System) at both Programme and administration body level.

Table 20, below, illustrates the **success rates of the proposals** in the time period 2004 – 2009, both in terms of eligibility and fund granting. It shows that in 2004-2010, 91% of the proposals were eligible; the overall success rate was 33%.

These data varied strongly among the various ministries:

- Levels of eligibility were below the overall average of 91% in the ministries of Defence (33%), Culture (65%), Interior (65%), and Health (77%).

- Levels of success rates in terms of funding granted were below the overall average of 33% in the Ministries of Agriculture and Defence and above-average in the Ministries of Education, Industry & Trade, and Health.

Table 20: Success rates of proposals at Administration Body level, 2004 – 2009

Administration body	Total proposals	Total eligible proposals	% eligible proposals	Total granted	Success rate proposals - versus total	Success rate proposals - versus eligible
Min. of Industry and Trade	3061	2757	90%	1417	46%	51%
Min. of Education	2658	2394	90%	1517	57%	63%
Min. of Culture	219	143	65%	77	35%	54%
Min. of Interior	17	11	65%	5	29%	45%
Min. of Defence	937	309	33%	130	14%	42%
Ministry of Health	2265	1744	77%	919	41%	53%
Min. of Agriculture	2135	1872	88%	363	17%	19%
Grant Agency CR	15251	14661	96%	4387	29%	30%
Academy of Sciences	4337	4249	98%	1156	27%	27%
Min. of Environment	737	693	94%	182	25%	26%
Min. of Transport	474	460	97%	175	37%	38%
Min. for Regional Development	221	217	98%	64	29%	29%
Min. of Labour & Social Affairs	50	40	80%	15	30%	38%
State Office for Nuclear Safety	5	5	100%	4	80%	80%
Research Council	9	1	11%	1	11%	100%
Grand Total	32376	29556	91%	10412	33%	35%

Source: elaboration of data in the R&D&I Information System

Internationally, it is unusual to see rates of eligibility as low as those highlighted in red, suggesting that administrative requirements are overly bureaucratic, applicants are under-informed, or both. Overall success rates, however, are high in some cases. The FP6 proposal success rate was 18%, and while the scientific community tends to regard a success rate of 33% as a guarantee of competition, many research councils operate with lower rates.

Another finding of our analysis regarded the **use of the budget planned** for the calls: overall, only 74% of the planned budget was allocated (see Table 21, below).

Particularly strong under-use of the available budgets for the public tenders (i.e. funding granted versus originally planned budget) can be noticed in the Ministries of Regional development, Defence, and Culture, as well as in the Science Foundation and the Academy.

Failure to use allocated budgets is a problem in any state administration. It raises questions about both administrative effectiveness and demand, which we need to explore further in the next stage of our work.

Table 21: Funding granted versus budgets planned for the public tenders in 2004 - 2009

Administration Body	Budget planned for calls (in CzK)	Funding granted in calls (in CzK)	Granted funding % of planned	Granted funding % of total budgets
Min. of Industry & Trade	26,773,692	22,726,719	85%	40.6%
Min. of Education	13,443,254	10,992,200	82%	19.7%
Min. of Culture	218,265	101,267	46%	0.2%
Min. of Interior	3,570	3,570	100%	0.0%
Min. of Defence	1,316,914	527,886	40%	0.9%
Min. of Health	4,893,039	3,508,864	72%	6.3%
Min. of Agriculture	2,444,093	2,010,490	82%	3.6%
Grant Agency CR	16,783,030	9,882,585	59%	18%
Academy of Sciences	6,825,454	4,145,540	61%	7%
Min. of Environment	1,249,739	1,272,933	102%	2.3%
Min. of Transport	413,036	441,599	107%	1%
Min. for Regional Development	819,649	213,425	26%	0.4%
Min. of Labour & Social Affairs	39,000	67,960	174%	0.1%
State Office for Nuclear Safety	16,700	16,500	99%	0.0%
Research Council	14,900	14,900	100%	0.0%
Grand Total	75,254,335	55,926,438	74%	100.0%

Source: elaboration of data in the R&D&I Information System

Finally, we looked into the **number of calls** published per programme. In the time period 2004 – 2009,

- Among the 15 sub-programmes of the *First National Research Programme* (NVP I), planned to run from 2004 to 2009, only 1 sub-programme (the highly appreciated Research Centres, competence of the Ministry of Education) issued calls for more than 2 years. The other 14 sub-programmes were 'active' only in 2004 and 2005
- The *Second National Research Programme* (2006- 2011) included 7 sub-programmes. Only 1 of them (the International Co-operations, competence of the MEYS) ran for more than 3 years, i.e. from 2006 till 2010. The others concluded their activities in 2008.
- The situation is slightly better for the *Departmental Programmes*. In the time period 2004 – 2009, 22 Departmental Programmes were funded. Two of them (both competence of the Ministry of Industry) launched calls for 4 years, and 7 of them lasted 3 years. The remaining 13 programmes issued calls for 2 years or less.

Also in this case, further analysis is required before conclusions can be drawn.

6. Preliminary Conclusions

Over the past two decades – and especially after 2000 – Czech Republic has seen a very significant reform effort, in order to tackle the problems of transition, modernisation and accession to the EU.

In the beginning of the 1990s, transition from the Communist regime left Czech policymakers with a strong distrust of government planning and quantitative goal setting, ironically enough at a time when W European governments were turning toward management by objectives within the state sector via the New Public Management movement.

Major transition problems in the R&D&I system included

- An unhealthy separation of higher education from research, through the separation of the Academy from the Universities
- Separation of industrially-orientated R&D from industry, in the form of 250 or so research institutes that performed R&D **outside** companies, leaving many firms with low levels of absorptive capacity and therefore a limited propensity to innovate
- A lack of sufficiently effective mechanisms to encourage relevance, performance and to ensure quality within the research-performing system. In particular, the vertically integrated role of the Academy as policymaker, funder and performer of research shielded it from competition and left it with limited means to react to changing societal needs. Similarly, the universities lacked external incentives to focus their efforts and ensure quality

Over the past two decades, the broad lines of the response to the transition and modernisation challenges have been pursued by moving in the direction of a W European model (a model that itself has been something of a 'moving target' during the period).

A key intervention has been to create a 'binary' research funding system, distinguishing between **institutional** funding intended to sustain the research activities of the universities and institutes and what in the Czech Republic is referred to as **targeted** funding. This is competitive funding, provided through external agencies. In most systems, these competitive funds provide high leverage over the wider research activities of research performers because they cover the marginal costs of research, ie those additional funds that allow researchers to do particular things. They are subject to quality control during the proposal assessment process, by implication influencing the quality of the whole research effort. They can be programmed towards particular societal objectives (eg particular themes such as climate change, objectives such as industrial innovation or configurations, such as collaborative work with industry) and most systems use a mix of societally related and bottom-up programming. Typically, this is done respectively via an innovation agency and ministry-driven finding on the one hand and research councils on the other.

The wish to have an improved steering and quality control of the research activities led to a shift in funding focus, from a preference for institutional funding in the 1990s and beginning of the 200s to a budget allocation in the favour of targeted funding in 2012.

Another major change in the R&D&I policy has been to use targeted funding to create incentives for better research-industry links and to foster innovation. The continuing prevalence of a 'linear' understanding of the relationship between research and innovation means that such measures are often understood simply as ways to valorise whatever research the university and institute systems happen to do. In practice, such targeted funding acts as (a) a 'focusing device' that draws the research system's attention to societally/industrially relevant problems and (b) a mechanism for co-development and knowledge transfer between industry and external research performers.

A key conceptual change during this period has been the growing recognition of the need for coordination (as opposed to central planning) across the research and innovation system in order to ensure some degree of coherence among the parts of the system. This has led the R&D Council's role to evolve from one of providing scientific advice to playing a leading role in the governance of the system and in setting overall priorities.

In principle, the Republic has therefore made significant progress in governance through establishing the Council, which provides an **arena** in which research and innovation policy can be discussed – and an opportunity to develop the holistic research and innovation policy currently envisaged by policymakers. However, there are important limits to how much time and analytic effort such a Council can devote to its work and it of course lacks the extensive contacts with various sectors of society and the R&D&I system that should be maintained by the ministries and agencies. Finding a sustainable and effective division of labour between the Council and the other actors may require some experimentation.

Inevitably in a system in rapid transition, there are gaps between intention and execution. The current allocation of responsibilities for developing and implementing research and innovation policies among ministries and agencies is itself a transitional one, with more budget chapters remaining than was intended by the reformers. Over time it will be necessary to establish clearer principal-agent relations between the ministries and the Agencies.

Influencing and implementing a national R&D&I strategy needs distributed strategic intelligence, analytic and design capacities across the organisations involved in policy design and implementation. Czech R&D&I Policymakers have significant amounts of strategic intelligence available to them through the national research results database, the work of the Czech Statistical Office and the Technology Centre, and a range of other international and national studies.

At this stage it is clear that the evaluation component of these capacities is insufficient. A crucial missing ingredient is ex-post evaluation of policies, programmes and institutions that explore the connection between activities and not only immediate outputs but outcomes and impacts. Ultimately, R&D&I funding is not provided in order only to create outputs but to effect changes in society. Feedback is urgently needed about the connection between funding and the achievement of these wider societal objectives. Without this component of strategic intelligence, policymakers simply do not know what the results of their interventions are and - most importantly - which factors enabled or hindered the success of their policy interventions and programmes, to be taken into account in future actions.

In the next stage of our work we will explore other capacities more deeply, but it seems likely that there is a need also to strengthen programme design and management capacities.

Research funding administration has been given a strong boost by recent legislative changes that, for example, impose limits of the amount of time funders may take to reach funding decisions. This is an unusual but creative way to tackle efficiency. The inability in the past of several of the funders to spend their budgets, however, suggests that there are issues of administrative complexity, efficiency and possibly also demand that need to be resolved. Again, we aim to explore these questions more deeply in the coming months.

Appendix D Assessing the Guidelines for Evaluating R&D Results (WP d,i)

Author: Technopolis Group, Vienna

1. Introduction

In line with the Terms of Reference for the Audit and our study proposal, the objective of this workpackage is to assess the 2004 Guidelines for Evaluating R&D results. Four methodological approaches were foreseen:

- 'Analytical reasoning', mainly based on the experience of the involved experts
- Comparison with evaluation systems and practices in other countries / institutions. Candidates mentioned in the proposal were the UK (Research Assessment Exercise), Norway, France, Austria (for the university system), Switzerland (for the research institutes – particularly in the field of agriculture, which is dominant both in CH as well as in CZ)
- Comparison with the evaluation guidelines developed and employed in the allocation of funds within priority axes 1 and 2 of the Operational Programme Research and Development for Innovation (OP RDfI)-II, which will employed during the next 1,5 years
- Empirical testing of the use and usefulness of the Guidelines through questionnaires, interviews, and focus groups

Based on all three inputs we will do a SWOT analysis of the Guidelines and make recommendations for improvement. The deliverable will be a revised version of the Guidelines.

In these first three months of the study, we focused on the analysis of the Methodology Guidelines, expanding the scope of the study to including the 2009 Methodology. In the last days before this report was due, we also briefly analysed the 2010 Methodology.[45]

We also started the comparison with evaluation systems and practices in other countries, covering in this first phase the UK, France and the Netherlands.[46]

An important evolution of the Methodology for the Evaluation of R&D results is its use – announced in the 2008 Reform Plan and implemented in the National R&D&I Policy 2009

[45] The approval date of the final version - i.e. 10 days before the delivery deadline of the First Interim Report - implied that for this report only a preliminary analysis could be performed; a closer analysis of the actually approved version will follow in the next report.

[46] The Netherlands developed the Standaard Evaluation Protocal (SEP), which has also been used by the Academy of Sciences of the Czech Republic as inspiration for the development of their internal evaluation system.

– 2015 – as a tool for decision-making on the allocation of institutional funding (at the funding providers' level).

In other words, the evaluation methodology was given the additional role of guiding a Performance-based Research Funding System (PRFS).

Quite obviously, there is a close link between these two roles. However, inevitably our assessment needs to take into account the diverse effects of the application of the methodology in the two systems, i.e. the evaluation system and the PRFS. As a consequence, in this section we first outline the findings of our analysis of the Evaluation Methodology – including the comparison with international practice.

In a second section, we relate on our preliminary analysis of the currently envisaged Performance-based Research Funding System.

2. The Evaluation Methodology

2.1 The 2004 Evaluation Methodology

The methodology to be applied for the evaluation of R&D is outlined in the `Resolution of the Government of the Czech Republic' of 23 June 2004, no. 644 on the evaluation of research and development and its results.[47]

The objective of this Evaluation Methodology document was to tackle the perceived failure in evaluation quality in the R&D system. The document states, "The current R&D support system does not allow one to distinguish between the quality of attained results, professional standards and performance of individual organizations, departments and individuals and to take advantage of these distinctions to facilitate changing the system (the amount of the provided support, organisational changes, personnel classification, salary and promotion orders, etc.)." The alarming decline in R&D performance at international level and the persistence of failures in the R&D&I system at national level – despite the overall highly positive evaluation of the R&D activities – convinced policy-makers that instead changes to the system were highly needed.

Problems that were identified in the way evaluation was practised in that time period included

- The complexity of evaluation
- Extensive administration
- The request of unnecessary data that often was not used for evaluation
- Most importantly, the fragmentation of the evaluation system and lack of standardisation

The 2004 Evaluation Methodology document first reproduces the evaluation guidelines that were included in the National R&D Policy for the years 2004-2008 (section III.1) and subsequently complements these guidelines with more detailed information (section III.2).

The 2004 document is very ambitious in aiming to improve evaluation on all the levels of the research system at the same time. It diagnoses a strong bias towards ex ante evaluation and tries to balance ex ante and ex post evaluation in response. Similarly, it stresses that the development of the Czech Evaluation system should be based on international experience with research evaluation and foreign experts included.

[47] For the Czech version of this document see http://www.vyzkum.cz/storage/att/4095103B3DF675FBB4E74B73874615F5/Metodika%20hodnoceni%20vav.pdf. Our analysis is based on an English translation of this document.

The 2004 Evaluation Methodology introduced to the Czech Republic the concept of quantitative results evaluation, stressing the importance of respecting the differences between disciplines when evaluating research results. However, it is not entirely clear what the balance should be between quantitative and qualitative evaluation. Sometimes 'mechanical' evaluation based on the counting of and point attribution to R&D outputs is indicated as only part of a broader evaluation system; sometimes it stresses that research results need to be quantified. Nevertheless, quantification concerns numbers on both input (funding) and output (R&D results).

And although it is said that the evaluation of results should be taken into account when distributing state budget for R&D it is certainly not clearly stated that it should be the only basis for institutional funding.

In the sub-sections below we describe the key characteristics of the methodology proposed, first listing the established key principles for evaluation in the Czech Republic and subsequently listing the evaluation best practise it recommends to be implemented at the various levels (state, policy, programme, project, etc.)

2.1.1 Key principles for evaluation

The resolution stated that evaluation at all levels needs to reflect the following base lines, specifying that "Without these basic principles being observed, it is not possible to carry out evaluation of R&D and its results."

- Evaluation is to be regular and repeated after some time (i.e. not just the entry proposal appraisals but also continuous assessment and final assessment, including ex-post analyses).
- Specific objectives – and measurable goals - need to be set out at all levels (programme, project, research plan, institution, policy, etc) that can then guide the evaluation.
- Evaluation criteria should be:
  - Known and binding,
  - Clear-cut (not contradicting)
  - Quantifiable, measurable, evaluable,
  - Related to a given objective

2.1.2 The use of the R&D Information System

In line with the 2002 R&D Support Act, the R&D Information System is indicated as the basic tool for the collection of information for evaluation. Information in the register is considered to be of key importance:

- For the overall evaluation of R&D in the Czech Republic (or EU)
- As a source of information on the efficiency of R&D, research activity, institutions and departments
- As information for the evaluation committees

It was envisaged that based on the results of the evaluations, changes in the state budget on R&D could occur, in particular in the medium term. The results in the data register were also to be used for the analysis of the R&D situation in the Czech Republic and for the preparation of National R&D policies.

The 2004 Guideline suggested including in the R&D Information System only the highest quality results into the R&D information system, thus reducing the burden of input of information that was not usable for evaluation purposes. Depending on the nature of the evaluated research, the **high quality results** were defined as follows:

- Articles in impact and selected peer-reviewed scientific journals; scientific books and articles in professional books and peer-reviewed collections in foreign languages (and in social sciences and in the Czech language),
- Results protected by industrial legal protection and other similarly protected results (patent applications, granted patents, industrial samples, recognised varieties of agricultural crops, recognised breeds of livestock, etc.), licenses.
- Applied outputs
- Other outputs provided that they are predetermined in the draft programme sanctioned by the Government (allowing one to report the results in specific R&D activities – e.g. a research report such as the results of procurement of research for the needs of state administration).

Based on the comments of the Academy of Sciences and the Grant Agency of the Czech Republic the outputs in the field of social sciences were expanded by professional books and peer-reviewed collections published in the Czech language. An option to use other specific outputs was included, on condition that these outputs would be clearly defined beforehand in the programme proposal approved by the Government.

In addition, it was felt that the evaluation scale should be standardised in order to be able to compare evaluation results. **Evaluation criteria** were specified per area:

- Technology and engineering (inanimate nature): applied results, patents, licenses, new technological products and technologies, articles in impacted and selected peer-reviewed scientific journals, scientific books and article collections and books in foreign languages.
- Living nature (biology, medicine, agriculture, environment, etc.): new treatments, recognized breeds of livestock, recognized plant types, etc., articles in impacted and selected peer-reviewed scientific journals; professional books or articles in scientific books or peer-reviewed collections in foreign language, applied results, patents, licences and new technological products and technologies
- Social sciences (humanities, social, economic, legal and historical): articles in impacted and selected peer-reviewed scientific journals; professional books or articles in scientific books or peer-reviewed collections in Czech language, applied results
- Mathematical sciences (mathematics, cybernetics, information technologies, physics and its applications, chemistry): articles in impacted and selected peer-reviewed scientific journals; professional books or articles in scientific books or peer-reviewed collections in a foreign language, applied results, patents, licences and new technological products and technologies.

Finally, the policy document states, "Quantified results of R&D activity must be given weight in the allocation of funds for R&D in the next solution period and used as one of the main criteria for proving the quality of the workplace during the evaluation of project proposals, research plans and other activities and in announcing programmes for providers."

In 2004 all types of results were weighted by factor 1, meaning that there was no differentiation between results. This was improved in 2005 when the results were weighted according to quality. Articles in the highly cited journals (with a high impact factor), patents and selected applied results received a weight of 2. Articles in journals with an average impact factor, books or chapters and other applied results still received 1 point. Articles in journals with low impact factor and in journals not included in Web of Science received 0.5 points.

2.1.3 Guidelines for evaluation at the different levels

Evaluation of R&D programmes

While the rights and obligations in the evaluation of the programme proposals were covered in detail in the 2002 R&D Support Act[48], the evaluation of programme results was only very generally regulated. The 2004 Evaluation Methodology acts upon this gap and proposes to use for programme evaluations similar procedures as are used for the approval of programme proposals. Programmes should be assessed after their completion, in order to evaluate the extent of achievement of their objectives, results and cost-effectiveness. As the Government approves programme proposals, the evaluation results should be submitted to the Government for feedback or approval, especially if a similar programme is to follow the evaluated one.

In this context, the National R&D Policy 2004-2008 stressed the evaluation of results and effects of the programmes, including the whole range of social functions and effects of research on the economy, society, education and knowledge. It considered that programme evaluations (National Research Programme, departmental programmes) should summarise the expected, ongoing and attained results - economic, social and other - of individual projects.

The National R&D Policy also hints at the influence of the evaluation results on future funding. It states, "The results and findings of ex post evaluations will serve as feedback for future decision making on the selection of projects and their solvers. [...] The evaluation results (with an emphasis on the results of long term re-evaluations) will be a crucial criterion for the allocation of available funds. Those who achieve better results long term will be preferred."

Final evaluation of projects, research intentions, and other R&D activities

The 2004 Evaluation Guidelines also proposed that in the case of projects, research intentions, and other R&D activities, the principles and mechanisms valid for the proposal appraisals would also apply to the evaluation of the results. It stipulated that the character of the research activity performed would be taken into account during the final assessment. In the case of basic research, publications in renowned journals were required, while in the case of applied research, patents, licenses, technological processes, medical treatments, etc. would be counted as outputs.

The 2004 guidelines stressed the importance of assessing the R&D results by referring back to the explicit goals of the research and to focus the final evaluation of the results on quality assessment and the applicability of the R&D results (usefulness).

In 1998, the 'Research Intentions' system had been introduced in order to connect institutional support for research to specific objectives. Subsequently, the Ministry of Education, Youth and Sport started funding the Research Intentions of the institutions in 2001. They funded a little less than 60 Research Intentions. In 2004 a new set of Research Intentions was funded across all ministries and the Academy of Sciences. These new intentions were implemented in 2005. New legal arrangements allowed funding not only of the traditional research performers (universities and institutes of the Academy of Sciences) but also the funding of non-profit private research institutes and companies. It is estimated that about 18 research intentions from private companies were funded. Since 2005, a further tranche of research intentions was funded (98% at the universities), and in 2007 a further 30.

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[48] In the section "Public tender in research and development" of Act no. 130/2002 on the Funding of Research and Development

Evaluating the effectiveness of institutions in research and development

The lack of a standardised evaluation methodology across the various funding institutions was considered to be a major barrier to the assessment of the actual quality of the R&D results and therefore for an evaluation of the effectiveness of R&D funding as a whole.

In order to overcome this, the 2004 Evaluation Methodology proposed the evaluation of the aggregated inputs (specified as public funding for R&D regardless of whether they were supplied by the project, the research plan, procurement, etc.) and outputs (specified as all quality results in the database, also irrespective of whether they were reported as a result of the project, the research plan, procurement, etc.).

It was suggested that the result of this evaluation would gradually translate into proposals for the allocation of expenditure on R&D.

The National R&D Policy 2004 – 2008, however, took a broader stand and stated that in the evaluation of research institutions, "appropriate attention is to be paid not only to the efficient use of received public funds, but also to the ability of those institutions - on the basis of their results – to obtain and valorise funds from the private sector."

Evaluation of National Policy in R&D

In the field of national policy on R&D, the Evaluation Methodology document stipulates paying more attention to the responsibility for implementing policy (also paying attention to reasons for non-compliance and countermeasures taken), the analysis of outstanding issues, and the efficiency assessment of individual policy instruments and their implementation. Independent experts are expected to be more involved and most importantly, the importance of the evaluation as a 'learning tool' is stressed, i.e. the results of the evaluation of the National R&D Policy will be taken into account during the preparation of other national policies.

2.2 The Evaluation Methodology in 2009 & 2010

Since the 2004 version of the Evaluation Guidelines a new version has appeared every year containing fresh amendments.[49].

Although some continuity can be observed over the years, the following transformations in the evaluation system are particularly noteworthy:

- In the 2009 version of the Methodology for Evaluation, the broad outline of a comprehensive Evaluation Guideline covering all the different layers of the research system in 2004 is replaced by a very specific evaluation methodology that focuses almost **solely on the quantification of research outputs** for the evaluation of research organisations and research programmes.
- The 2009 version marks the introduction of the adoption of the metrics-based evaluation of R&D results as a **Performance-Based Research Funding System**, albeit only at the level of funding bodies
- The 2010 Methodology enforces and expands the use of the metrics-based evaluation of R&D results as a funding system at the level of research institutions

49 An overview of the Evaluation Methodologies from 2004-2010 can be found at: http://www.vyzkum.cz/FrontClanek.aspx?idsekce=18748

2.2.1 The 2009 Evaluation Methodology

The 2009 version of the Evaluation Methodology was developed by the Commission for the Evaluation of R&D Results, which is an advisory body of the Research and Development Council. The evaluation of R&D is based on the Government resolution No. 287, also known as the 2008 R&D reform.[50]

The document outlines changes and commonalities compared to earlier versions; describes the various steps in the process of results evaluation; and details the modalities for the evaluation of the results of research organisations and the evaluation of R&D programmes.

It describes in detail the procedure for the transformation of research results into points and the discussion concentrates on the weighing of the different research results and attempts to unify the evaluation. Accounting for disciplinary differences has become a major point of discussion, as this is not easily reconciled with quantitative evaluation.

The document furthermore states, "The chief purpose of the evaluation of results of research organisations is to propose a division of funds for the institutional support of R&D in accordance with the R&D Reform."

Changes and commonalities compared to earlier versions

The introduction of the document outlines the changes and commonalities between the 2009 version and earlier versions:

- A fundamental change in the 2009 version is that the point evaluation of individual results will now be done for the year that the result has been realised, whereas it used to take into account the year in which it was put into the R&D Information System.
- The 2009 version also entails for the first time *differentiation according to disciplines*. For results of specializations registered into the National Excellence Reference Framework (including Philosophy and Religion, History, Archeology, Anthropology,Ethnology, Political Science, Administration, Legal Science, Linguistics, Literature, Mass media, and Audiovisuals, Art, Architecture, Cultural Heritage, Educational science), evaluation is carried out on the national level in particular. In this area, articles published in peer-reviewed Czech scientific periodicals (Jneimp) will have a higher point evaluation than in other specializations. The same approach will be applied to results of scholarly books (category B).
- However, the point system has remained essentially the same as it was in 2008 (see Table 22, below), as have the following general principles:
  - The efficiency of the recipient and provider has not been evaluated
  - Only research organisations that can be recipients of institutional support of R&D and the results are included in the evaluation of results of research organisations
  - The evaluation of results of research organisations according to this Methodology is one of the criteria for the allocation of institutional support
  - All results of research organisations claimed within the past five years will be included in the evaluation regardless of the source of support.

[50] For the Czech version of the 2009 document see: http://www.vyzkum.cz/storage/att/CDDC542199F1640B59A7D1E841B7151C/Metodika%202009_schv%C3%A1leno.pdf. Our analysis is based on an English translation of this document.

Table 22 The 2009 point table

Result types			I – NERR specializations 0)	II – other specializations
J_{imp}	article in impacted magazine 1)		**10 to 305** 2)	
	article in prestigious impacted magazine (*Nature*, *Science*, *Proc. Natl. Acad. Sci. USA*) 3)		**500**	
J_{neimp}	article in non-impacted magazine	world-renowned database 4)	**12**	**8**
		list of critiqued periodicals 4)	**10**	**4**
B	scholarly book	world language 5)	**40**	**40**
		other languages		**20**
D	article in proceedings 6)		**8**	
P	patent	European or international patent (EPO, WIPO), patent of USA and Japan	**500**	
		Czech or national patent excepting patent of USA and Japan, used on the basis of a valid license contract	**200**	
		other patents 7)	**40**	
Z	pilot plant, confirmed technology, species, breed		**100**	
F	usable sample		**40**	
	industrial sample		**40**	
G	prototype, functional sample		**40**	
H	Applied results		**40**	
N, L	certified methodologies and procedures, specialized maps with scholarly content		**40**	
R	software		**40**	
V	research report containing classified information		**50**	

0) NERR includes specializations (according to R&D IS codebook: AA – Philosophy and Religion, AB – History, AC – Archaeology, Anthropology, and Ethnology, AD – Politology and Political Science, AE – Administration – AG, Legal Science, AI – Linguistic Science, AJ – Literature, Mass media, and Audiovisuals, AL – Art, Architecture, and Cultural Heritage, AM – Education and Schools.)
1) publications indicated in the following database Web of Science of the company Thomson Reuters: Science Citation Index Expanded (SCI-EXPANDED) – 1945 – present; Social Science Citation Index (SSCI) – 1980 – present; Arts & Humanities Citation Index (A&HCI) – 1980 – present; Index Chemicus (IC) – 1993 – present; Current Chemical Reactions (CCR-EXPANDED) – 1986 – present
2) evaluation J_{imp} = 10 + 295 × Factor, where:
Factor = (1 - N) / (1 + (N / 0,057)), where N is the normalized order of magazine, N = (P - 1) / (Pmax - 1)
P = order of magazine in the given specialization according to Journal Citation Report in succession ordered descending according to IF
Pmax = order of magazine in the given specialization according to Journal Citation Report
In the case that the magazine will be registered to more specializations, the normalized order of magazine N will be calculated as an arithmetic average of normalized orders of the magazine in all specializations where it appears

3)	this means multidisciplinary (i.e. open specialization) magazines Nature (ISSN 0028-0836), Science (ISSN 0036-8075) and Proceedings of the National Academy of Science of the USA (ISSN 0027-8424)
4)	the distinction between "world renowned database" and "list of critiqued periodicals" is indicated in part B.3.1.2. of the Methodology
5)	world language means English, Chinese, French, German, Russian, and Spanish
6)	the proceedings must be registered in the database Conference Proceedings Citation Index – Science or Social Science & Humanities (previously ISI Proceedings) of the company Thomson Reuters.
7)	Czech or other national patent awarded (hitherto unused) or used by the patent owner.

Evaluation at different levels

The 2009 Evaluation Methodology covered both the evaluation of the results of research organisations and the evaluation of R&D programmes.

In relation to the evaluation of the results of research organisations, the following points should be mentioned:

- The evaluation of the results of research organisations is understood as the translation of the results of all research organisations to a common numerical scale (i.e. quantification of results).
- The evaluation of results is carried out exclusively on the basis of valid data provided to the R&D Information System.
- In the case of universities, the evaluation of results is first done at the level of the institution. It can then be extended to the second level of the university units (departments, faculties, etc). In the case of governmental bodies, the organisational units are evaluated individually.

In the introduction of the document it is first stated that the evaluation of the results of research organisations is merely a way of sorting according to a unified criteria and does not contain any recommendations. According to its goals the evaluation of results constructs a comprehensive set of basic data to inform on the results of research organisations. However, a few lines lower, the document says that the chief purpose of the evaluation of results of research organisations is to propose a division of institutional support of R&D, in accordance with the 2008 R&D reform.

The second part of the 2009 Evaluation Methodology is devoted to the evaluation of completed research programmes.

The programme funding body should include in its evaluation basic data on the programme, basic data on the realisation of the programme, indication of results, information on the used methods to obtain the results, a comparison of results with the aim of the programme, and a comparison of the results of the programme with the state abroad. The results of all projects funded by the given programme and archived in the central Information System are assigned to the programme. Furthermore, evaluation should be performed based upon the objectives/aims of the programme.

For each completed programme, the funding authority should develop a summary report on the evaluation and submit it to the R&D&I Council. For this evaluation, the Index SR indicator is used as a characterisation of the effectiveness of the utilisation of public support. This indicator is based on the total score (sum of points) of achieved results per 1 mil. CzK funding.

Each year, the R&D&I Council publishes a Summarised Assessment of all completed programmes. This report contains an overview of the evaluated programmes, information on the timetable and progress of the evaluation, the results of the evaluation, a comparison among the completed programmes based upon the Index SR, and a summary and proposal of measures.

2.2.2 The 2010 Evaluation Methodology

After some iterations of the draft version, the Government approved the 2010 Evaluation Methodology on August 4, 2010.[51]

Our preliminary analysis indicates that it is *similar to the recent versions* of the Evaluation Methodology; the 2010 Methodology remains rather mechanistic and based on counting the various types of results according to the point system.

In the new methodology, the rating of various types of results ranges from 4 to 500 points and the results are sorted into two large groups according to the research fields of their origin. Philosophy and Religion, History, Archaeology, Anthropology and Ethnology, Political Science, Management and Administration, Legal Sciences, Languages, Pedagogy and Arts are included in the National Reference Framework of Excellence (NRRE). The results of these fields are evaluated according to the preferential rules. Results of all other research fields are evaluated according to the same procedure as previous years (see Table 23, below).

The *main difference* between the Evaluation Methodology 2010 and previous methodologies is a change in categories of results: a new type of journal article has been introduced named Jrec. As a result there are now 4 recognized types of journals:

- Journals monitored (included) in the database WOS Thomson Reuters (Jimp)
- Journals included in other recognized databases as Scopus or ERIH (Jneimp)
- Journals in other peer review journals (Jrec).
- A fourth class are super journals - Nature and Science.

[51] The approval date of the final version - i.e. 10 days before the delivery deadline of the First Interim Report - implied that for this report only a preliminary analysis could be performed; a closer analysis of the actually approved version will follow in the next report.

Table 23 The 2010 point table

Label of the Result	Type of Result	Points (NRRE - Social Sciences & Humanities)	Points (Other Fields)
Jimp	Article in journals covered by WoS	10-305 (see the formula)	10-305 (see the formula)
Jimp	Article in Nature, Science, PNAS	500	500
Jneimp	Article in journals covered by SCOPUSs or ERIH (nonWoS)	12	8
Jneimp	Article in (Czech) reviewed journals listed in the "List of Periodicals" (nonWoS)	10	4
B	Book in English, French, German, Russian, Spanish or Chinese	40	40
B	Book in other languages including Czech	40	20
D	Article in Proceedings (included in the ISI Proceedings)	8	8
P	Patents EPO, WIPO, USPTO, JPO	500	500
P	Patents utilized according to the valid license (Czech or other national)	200	200
P	Patents - other	40	40
Z	Trial Operation, Verified Technology, Variety, Breed	100	100
F	Utility Model	40	40
F	Industrial Design	40	40
G	Prototype, Functioning Model	40	40
H	Applied Resuls (reflected in legislation or standards)	40	40
N, L (S)	Certified Methodology, Specialized Maps	40	40
R	Authorized Software	40	40
V	Research Report including secret information	50	50

Most importantly, the 2010 Evaluation Methodology is the first to set out the application of the results evaluation as a Performance-based Research Funding System (further: PRSF) at the level of research organisations.

It introduces a 'damping factor' for groups of disciplines in order to limit large shifts in funding among fields and results categories:

- Between basic and applied research (limit 1.5% change)
- Among 10 large research fields (limit 15%)
- Among various categories of results, with exception of Jimp and Jneimp (the limit is a 1.5% change)

This 'damping factor', however, can only slightly mitigate the potential negative effects of adopting the results evaluation as a performance-based research funding system at the level of single organisations. In fact,

- There are still considerable inter-field differences. These differences relate to different publishing patterns among disciplines (example economics and history) and different relevance of outputs as listed in the Evaluation Methodology 2010.
- Jimp journals are excluded from the dampening factor. Not only are these the outputs that can least easily be manipulated, they are also the research results that weigh most for the achievement of points in the system. Table 24, below, illustrates that in 2009, articles published in journals covered by WoS accounted overall for 65% of the points achieved.

Table 24 Weight of the R&D results for the achievement of points – results of 2009

		Percent of total in 2009
Jimp	Article in journals covered by WoS	65.1%
Jneimp	Article in journals covered by SCOPUS or ERIH (non WoS)	5.0%
	Article in (Czech) peer-reviewed journals listed in the List of Periodicals (nonWoS)	3.5%
B (+C)	Book or Chapter in Book	8.1%
D	Article in Proceedings (included in the ISI Proceedings)	1.6%
P	Patents	1.9%
V	Research report containing secret information	0.02%
T*	Trials, Verified technologies, prototypes etc.	2.5%
Z	Trial operation, Verified technology, Variety, Breed	2.7%
S**	Prototype, certified (applied) method, functional sample, authorized software, utility model, industrial design	5.9%
G	Prototype, Functional Model	1.6%
N	Certified Methodology	0.5%
F	Utility Model	0.3%
L	Specialised Maps	0.2%
R	Authorised Software	1.0%
	Total	**100.0%**

* Category valid until 2006; substituted by categories S and Z

** Category valid in 2007 and 2008; substituted by new categories in 2009

Source: Technology Centre

2.3 International Comparison

2.3.1 The Netherlands: Standaard Evaluation Protocol

Background

The steering philosophy of the Dutch Quality Assurance for public research organisations is founded in the Higher Education and Research Act (Dutch abbreviation WHW). This 1993 Act codified the enhanced institutional autonomy and introduced the principle of self regulation. Since then, the policy framework for the Dutch universities and research organisations revolves mostly around funding and quality assurance. The act introduced quality assurance as a policy instrument in the steering philosophy. In exchange for more autonomy, the public research organisations were expected to play an active role in the establishment of a new quality assurance system for research (and teaching).

In order to establish a new quality assurance system for publicly funded research in 1994 the Standard Evaluation Protocol (SEP) was introduced. The Standard Evaluation Protocol has been formulated by the three main Dutch organisations responsible for publicly funded research in the Netherlands: the Royal Netherlands Academy of Arts and Sciences (KNAW), the Netherlands Organisation for Scientific Research (NWO) and the Association of Dutch Universities (VSNU). Over time, some changes were made in SEP. In 2009 the fourth SEP was accepted, following the protocols of 1994, 1998 and 2003.

The SEP aims to assess the quality of research in universities, to facilitate both (public) accountability and improvement of research and research management. The SEP provides common guidelines for the evaluation and improvement of research and research policy, based on expert assessments. Quality assurance was based on self-evaluation reports prepared by the institutions and site visits were carried out by experts (peers) for each disciplinary area in a six year cycle. More than the previous systems, the SEP and the self-assessment focus on bringing about a dialogue involving the assessor and the institution – as opposed to a detached assessment – and at improving the quality of the research concerned. The relevant literature distinguishes between a 'jury' model of assessment and a 'coach' model.

Up until 2003, the VSNU had been responsible for organising nation-wide evaluations on discipline level. Since 2003 the universities themselves have organised the research assessments. During its six-year cycle, an independent expert committee (the Meta Evaluation Committee) evaluates the Standard Evaluation Protocol and the research assessment processes based on the protocol. KNAW, NWO and VSNU organise this review. The last one was in 2008, the next one will be organised in 2013. The results of the review are made public.

The Standard Evaluation Protocol for Public Research Organisations

The SEP 2009-2015 aims at two objectives with regard to the evaluation of research and research management:

- Improvement of research quality based on an external peer review, including scientific and societal relevance of research, research policy and research management
- Accountability to the board of the research organisation, and towards funding agencies, government and society at large

The objective of improvement is aimed at both the research and its management. External evaluations could be of great value to the institute and its researchers, since international experts in the field formulate recommendations regarding the research, including the strategy and policies which direct and provide the conditions for the conduct of research.

With the external evaluation, the institute and its research groups account for their research activities to the board of the university, KNAW or NWO. In a broader sense, the external evaluations inform funding agencies, government and society at large of the quality and relevance of research activities, thus accounting for the public investments made in scientific research.

This protocol is primarily directed toward the evaluation of scientific research. Traditionally, such evaluation focuses on the quality of work according to the standards of scientific disciplines and the ways in which results are communicated to a scientific audience. However, the scope of the term 'research' is not limited to the research results. Research management, re- search policy, research facilities, PhD-training and the societal relevance of research are considered integral parts of the quality of work in an institute and its programmes. With these elements, the evaluation of research has a broad scope.

The evaluation process

Assessment following the SEP means that every six year research activities will be assessed through an external evaluation, based on a self-evaluation and a site review. In addition, universities must carry out an internal midterm review: a self-evaluation of their research activities. This means that self-evaluation takes place every three years. In the SEP, guidelines regarding assessment criteria, minimum information requirements and the procedure of the external review are formulated. It is important to note that the assessment is both retrospective and prospective, attending to past performance as well as future plans.

The Standard Evaluation Protocol entails three main characteristics:

- Two levels of assessment: The assessment takes place at two levels of research organisation, i.e. the level of the institute (or faculty or research school) and the level of research groups or programmes.
- Three vital tasks: The assessment regards the three vital tasks of research organisations, i.e. producing results for the academic community, producing results that are relevant for society, and educating and training the next generation of researchers.
- The assessment is based on four criteria:

1. Quality (including international academic reputation and PhD training)
2. Productivity (the relationship between input and output)
3. Societal relevance (including valorisation)
4. Vitality and feasibility (the ability to react adequately to important changes in the environment).

The external assessment covers not only the content of the research programme but also the management, strategy and mission of the research centre where it is carried out. The evaluation protocol leaves scope for assessment of one or more research centres (Institutes) within the same university or for comparison with similar centres at home or abroad.

The conclusion of the assessment should be summarized in a single term according to a five-point scale, 'excellent' meaning world class research, and 'un-satisfactory' meaning below acceptable standards. In reality there is a tendency to only give a 4 or 5, with a 3 as the minimum.

After the site visit, the evaluation committee will report its findings to the board of the research organisation. The board will publish the report after internal discussion with the assessed research unit and will make its position regarding the evaluation outcomes public. The evaluation report and the position of the board together constitute the results of the evaluation.

The management of the evaluation

The governing boards of KNAW, NWO and the universities will determine the units that will be evaluated and provide an overall schedule for all evaluations. The executive board of the university is further responsible for the planning of each individual evaluation and its follow-up.

At the start of any external evaluation process, the board will provide a planning document. This includes all major steps to be taken from the start of the self-evaluation to the eventual mid-term review. It consists of:

- Arrangements for the self-evaluation report and other documentation, such as the outcome of the previous mid-term review and other relevant evaluation results
- Selection and configuration of the external evaluation committee
- Planning of the site visit
- Publication of the evaluation results
- Arrangements for the follow-up of the evaluation

The unit to be evaluated provides a self-evaluation document, including a SWOT analyses, which is to be endorsed by the board. After approval by the board, the self-evaluation is sent to the external evaluation committee.

The board is responsible for the selection of the chair and further configuration of the external evaluation committee. The unit to be evaluated is invited to suggest committee members. The board may also consult third parties to reflect on the impartiality and independence of the committee chair and members.

Accounting for different disciplines and interdisciplinarity

- Taking different disciplines into account:

"The SEP is the basis for research evaluation in all research areas, fields or disciplines. It is of great importance that research activities are assessed according to the standards of the specific discipline. The specific character of each field may require emphasis on some elements of the SEP, while other elements may be less relevant to a certain discipline. The fields of languages & culture, humanities & social sciences, natural & life sciences, medicine & health sciences, design & engineering and agriculture & food sciences may each require different approaches to the evaluation. Within these fields, approaches may also vary among sub-disciplines. While the description of the evaluation criteria and information requirements in the SEP are based on the common ground of these disciplines, the institute is invited to present the specific characteristics of the discipline that inform its research and identity in its self-evaluation and facts & figures" (SEP 2009-2013, p. 6).

- Taking interdisciplinarity into account:

"Research in the Netherlands and abroad is of an increasingly multi-, inter-, or trans-disciplinary nature. Institutes and research programmes with multi-, inter-, or transdisciplinary research require special attention in the evaluation. It is, for instance, often more difficult for these groups to show their results through traditional indicators based on publications in high impact journals, and therefore review committees should include evaluators who have a solid experience in assessing such research. The board responsible for evaluating multi-, inter- or transdisciplinary research should therefore see to adaptations in the standard procedures necessary to assess these particular aspects of an institute's mission, for example with regard to the composition of the evaluation committee or to specific, more qualitative, criteria and indicators" (SEP 2009-2013, p. 6).

Evaluating Research in Context

For years, politicians and those involved in scientific policy have been interested in the societal impact of scientific research. In recent years however, concern for this topic has grown. The Lisbon Agenda (the Knowledge Economy) and the growing attention for the valorisation of scientific research (the third mission of universities and public research institutes) are the driving force behind this. Within the framework of Quality Assurance in important question is: how exactly can this societal impact be measured? And how can it play a role in research and science policy? Assessing the social impact of research is a relatively new phenomenon and covers a broader description than is currently requested. In order to promote the measurement of societal impact in 2006 a new platform, Evaluating Research in Context (ERiC), was set up.

ERiC emerged out of a project from the Consultative Committee of Sector Councils for Research and Development (COS) concerning how to measure the social impact of research. This project yielded the successful measuring method sci_Quest method. Following on from this a broader platform representing the full spectrum of higher education was set up, the EriC platform. Since then the Royal Netherlands Academy of Arts and Sciences (KNAW), Netherlands Organisation for Scientific Research (NWO), Netherlands Association of Universities of Applied Sciences (HBO-Raad), and Quality Assurance Netherlands Universities (QANU) have participated in the project, and Hogeschool Utrecht, the Ministry of Education, Culture and Science (OCW) and Rathenau Institute have been involved as observers.

ERiC's main objectives are stimulating the exchange of knowledge and developing methodology at both a national and international level. In order to do so, ERiC undertakes various activities:

- ERiC develops and disseminates information about how to measure the social impact of research.
- ERiC raises awareness of the possibilities for assessing the social impact of research through workshops, seminars and the website.
- ERiC develops methods for measuring the social impact of research, by carrying out projects with universities and universities for applied sciences.
- ERiC carry out several pilots at various universities in order to 'test' the methods which are developed.
- ERiC responds to issues faced by the research community.

One of the successes of ERiC is that in the latest SEP (used from 2009 onwards) there is a stronger emphasis on measuring the societal impact of research. In brief, the SEP no longer just assesses the scientific quality of research but also uses indicators to measure its societal impact. Examples are cooperation with the private sector and memberships of social organisations and policy bodies.

Review of SEP

Research assessment and quality assurance are generally well developed in the Netherlands and this country is often looked to as a positive example. SEP is broadly accepted and utilised by the publicly funded research organisations. The new quality assurance system has been also effective. The quality of research has improved in three respects: in general, the Netherlands scores well internationally, low-quality research has been weeded out, and the assessment system has become more transparent.

Although the system is believed to function well, it recently has become the object of criticism (after a critical report of the Meta Evaluation Committee in 2008 about the evaluation of SEP over the years 2003-2009). One of the reasons for this criticism is the fact that it is hard to unveil what institutions actually do with the results of assessments. University administrators would seem to consider it inexpedient for various reasons to be transparent about this matter. When questioned, little was in fact done with the results of assessment in the current context, either because financial or employment law offered no scope for this, or because of a lack of decisiveness. Also the government does not translate the outcomes of the quality assessments into its budget allocations. In essence, the higher education institutions themselves and their professionals are playing the leading role in quality assurance and the government has no means to interfere. It made the acceptance of the system easy, but the counter side is that it’s not a steering instrument for the government.

A second reason for concern is that subsidising bodies regularly circumvent the SEP and make use of protocols of their own that differ from those of the SEP. Over time new arrangements arise, such as national research schools or (public-private) innovation programmes both with their own evaluation system. Overall there is an accumulation of procedures that differ somewhat from one another and thus to additional heavy pressure on researchers, who can consequently devote less time to the primary process of research. The criticasters underline that the administrative burden for researchers should be diminished.

A third critical remark is that institutions are free to choose the units that are to be subject to assessment and they are also free to include societal relevance and specific management aspects. This has led to a whole range of units open to assessment, varying from whole disciplines to faculties (and parts of faculties), research institutes, and research schools. With the multiplicity of evaluation research units it is almost impossible to benchmark them.

The fourth point is that external evaluation shows that in the definition of “Relevance” is not clear. SEP does require attention to social and economic relevance, but the criterion “Relevance” stands for both scientific and societal relevance. The Meta Evaluation Committee points out that more emphasis should be placed on societal relevance.

Last but not least an erosion of scores (by the external committee) is recognized. Both the overall scores and the scores at the programme level are often very high (four or five). This could be the indication of the good quality of the Dutch research groups, but also the erosion of scores. A low score is indicating that a group is underperforming rather than that a high score stands for an excellent research group (from an international perspective).

2.3.2 The United Kingdom: the Research Assessment Exercise

In the UK research quality is evaluated in the Research Assessment Exercise. The system was introduced in 1986; subsequent research assessments took place in 1992, 1996, 2001, and 2008.

The Research Assessment Exercise is a peer review process which produces ‘quality profiles’ for each submission of research activity made by HEIs. For each submission, HEIs provide data about research activity, including about research active staff and their published research outputs, the research environment in which they operate and indicators of esteem conferred on those staff as individuals or groups.[52] However, no bibliometric data are included in the submissions[53]. A panel of subject experts subsequently assesses submissions and awards a quality profile to each: this profiles the proportions of research activity in the submission that is judged by the panel to meet each of five quality levels from unclassified, through to world-leading.

The Research Assessment Exercise informs the distribution of funds by the UK higher education funding bodies[54]. Results are used for calculating quality related (QR) funding, the largest of several types of institutional funding. Any UK HEI that is eligible to receive research funding from one of these bodies can participate in the exercise. Once funding levels for institutions (which are actually made on a subject oriented 'cost-centre' basis and which may apply at a sub-departmental level) have been set, these are used for the annual allocation of funding until the next round of RAE.

The mechanism by which the assessment is made has changed over time and has been the subject of protracted debate and a number of extensive reviews (for example the review led by Sir Gareth Roberts following the 2001 RAE). One of the major criticisms of the process is the enormous amount of staff time and resources that HEIs have to devote to the process of preparing RAE submissions.

Hence, in the 2006 pre-Budget Report the Government, "in recognition of the burden imposed on universities be the Research Assessment Exercise"[55], announced the development of a revised scheme for assessment of quality and allocation of funding: the **Research Excellence Framework (REF)[56]**, which will replace the Research Assessment Exercise after 2008. The first proposal put forward by HEFCE suggested a largely metrics-based system – utilising bibliometric approaches and indicators of external research income generated and number of research students for the sciences, engineering, technology and medicine, and light touch peer review informed by metrics for the arts, humanities, social sciences, mathematics and statistics. After extensive consultation57, taking into account the scientific community's reservations about a purely metrics-based approach, the proposal for the REF was modified to focus on the three elements 'outputs', 'impact', 'environment', which together are considered to reflect the key characteristics of research excellence[58].

- Outputs (weight 60%): The primary focus of the REF will be to identify excellent research of all kinds. The quality of research outputs will be assessed against international standards of excellence. All types of high-quality research outputs will be encouraged, and assessed on an equal basis. Outputs will be assessed through a process of expert review, informed by citation information in subjects where robust data are available (for example in medicine and science).
- Impact (weight 25%): Significant additional recognition will be given where researchers build on excellent research to deliver demonstrable benefits to the economy, society,

[52] RAE 2008

[53] In fact, no bibliometric data is used in the Research Assessment Exercise at all

[54] The Higher Education Funding Council for England (HEFCE), the Scottish Funding Council (SFC) for Scotland, the Higher Education Funding Council for Wales (HEFCW) in Wales and the Department of Education and Learning Northern Ireland (DELNI) for Northern Ireland. Total allocated funding for the four UK HEFCs in 2007/08 was £2,170 million

[55] http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/pre_budget_report/prebud_pbr06/report/prebud_pbr06_repindex.cfm (Chapter 3: Meeting the productivity challenge, p. 57)

[56] The Research Excellence Framework is work in progress. This desciption is based on the system as it was planned in April 2010

[57] http://www.hefce.ac.uk/pubs/consult/outcomes/ref.asp

[58] http://www.hefce.ac.uk/research/ref/

public policy, culture and quality of life. Impacts will be assessed through a case-study approach that will be tested in a pilot exercise.

- Environment (weight 15%): The REF will take account of the quality of the research environment in supporting a continuing flow of excellent research and its effective dissemination and application. This will include, for example, the research strategy, staff development and training of postgraduate researchers, and engagement with research users and the public.

The REF will be based on HEI submitting evidence of their research activity and outcomes, which will be assessed by expert panels against these elements. The assessment will be undertaken by an expert panel for each subject Unit of Assessment (UOA). The first assessment is planned to run in 2013.

Compared to the RAE, the new REF appears to be much broader, taking into account a number of aspects unacknowledged in the RAE. Apart from trying to reduce the burden on HEI, the REF incorporate criticisms about the need to fully recognise all aspects of excellence in research as well as enterprise activities and the need for separate assessment of competences such as research strategy; development of researchers, including postgraduate research students, postdoctoral researchers and junior lecturers; equal opportunities policies and success in putting them into practice; and dissemination of research beyond the academic peer group.

Summary of issues

Based on several evaluations of the RAE a summary of main issues concerning the RAE can be made.[59]

Figure 23 Issues related to the UK RAE

Issues related to the UK RAE
Resource cost • Administrative burden on HEI • Need for a properly resourced administration • Frequency of assessment • Any system capable of providing the necessary fairness will be relatively time and labour intensive
Effect of the RAE upon the financial sustainability of research
Perverse effects ('games-playing')
Importance of expert peer review
Focus of RAE • RAE too narrowly academic • Need to fully recognise all aspects of excellence in research (such as pure intellectual quality, value added to professional practice, applicability, and impact within and beyond the research community) • Ability to recognise enterprise activities
Separate institution-level assessment of competences such as • Institutional research strategy; • Development of researchers, including postgraduate research students, postdoctoral researchers and

59 These evaluations include Review of research assessment, Report by Sir Gareth Roberts to the UK funding bodies, May 2003 (see: http://www.rareview.ac.uk/reports/roberts.asp) and N. von Tunzelmann and E. Kraemer Mbula, Changes in research assessment practices in other countries, SPRU (Science and Technology Policy Research), University of Sussex, 2003.

Issues related to the UK RAE
junior lecturers; • Equal opportunities policies and success in putting them into practice; • Dissemination of research beyond the academic peer group.
'Disciplinary' issues • Effect of RAE on interdisciplinarity and multidisciplinarity • Respecting disciplinary differences • Special treatment of the social sciences and humanities vs. natural sciences
Importance of clear rules and transparent procedures, in particular with regard to panels • Need for greater transparency in panel selection • Consistence of practice across panels vs. flexibility for assessors to develop methods appropriate to their subject • Ensure that panels adhere to their own criteria • Professional chairperson from outside subject area with experience in facilitation
Submission rules • It is important to define what is assessable as well as how it is assessed • Lack of clarity over which staff should be submitted in the assessment system
Rating system • Lack of discrimination at the top end • Grade inflation • Comparability of grades between subject areas
Equal opportunities • For non-research staff • For women
Summative vs. formative • Trend from summative to formative evaluations • Evaluation system should provide more useful feedback to participants to help them improve and develop their research
Involvement of academics in assessment system's development and explanation of its final structure and processes
Clear link between assessment outcomes and funding

The researchers view

Interestingly one of the evaluations of the RAE depicts the researchers view on the evaluation system.[60] The research report commissioned for the RAE Review presents key findings from nine workshops that show how researchers experience the evaluation system in the UK, focussing on issues as peer review, transparency, clarity, frequency, communication and interdisciplinary research.

- Peer Review: The overwhelming majority of the academics and research managers who took part in this study felt that research should be assessed using a system based on peer review by subject-based panels – of the twenty nine systems designed, twenty five were based on Expert Review. The participants also indicated that these panels should

[60] Steven Wooding and Jonathan Grant, Assessing Research: The Researchers' View, RMR-1698-HEFCE, May 2003

be informed by metrics and self-assessment, with some input from the users of research.

- Transparency, Stability and Professionalism: There was a very strong desire for a system with clear rules, and transparent procedures, that were established at the outset and not modified during the assessment process. The appointment of panels and the selection of their criteria they used were thought to be critical areas for transparency. Participants in the study considered that the panels themselves should be professionalized and that there should be increased and earlier involvement of international members. They suggested that chair people from outside the subject area with more experience of facilitation should be used, and that these chair people might be paid.
- Clarity of Submission: Almost half the groups were unhappy with the flexibility and lack of clarity over which staff should be submitted in the current assessment system, and one third of the groups felt that more staff should be submitted in future. In addition to reducing the scope for 'playing the system' it was felt that submission of more staff would improve the inclusiveness of the process. A few groups included other steps to make the process more inclusive and sensitive, both to researchers and to a lesser extent institutions.
- Unit Breadth and Interdisciplinary Research: Almost half of the groups suggested that Units of Assessment should be broadened and reduced in number, with many hoping that this would help the assessment of inter-, multi- and trans-disciplinary research. Other mechanisms for improving assessment of interdisciplinary research were suggested including allowing panels to call on - or second - external expertise.
- Frequency: Around half of the groups who addressed the issue of frequency recommended that the research assessment cycle should be extended, but in order to retain dynamism some suggested a light touch 'interim' assessment should be added at the halfway time point.
- Agreement between Disciplines: The most important characteristics of high quality research were seen as rigour; international recognition; originality; and the idea that the best research sets the agenda for new fields of investigation. There was general agreement on the importance of these characteristics by participants from different disciplines and academic roles – although absolute ranking varied. There was also broad agreement across disciplines about the most important characteristics for a research assessment system; however, researchers from Medicine, Science and Engineering placed a greater importance on peer review, while their colleagues in the Arts, Humanities and Social Sciences felt subject related flexibility in the assessment system was more important.
- Comparability and Flexibility: Participants ranked both comparability of assessments between subjects and methodological sensitivity to the subject being assessed very highly when considering characteristics of research assessment systems. Despite this, when designing research assessment systems almost half the groups suggested that panels should be given more autonomy in developing their criteria and assessment methods.
- Acceptance of Burden: Although most participants were keen to avoid a system that was onerous, they appreciated that any system capable of providing the necessary fairness would be relatively time and labour intensive. Given this realisation, it was felt that the system should provide more useful feedback to the participants to help them improve and develop their research.
- Communication. Listening to participant discussions about the current research assessment system, it became clear that whatever new system is adopted, the funding councils will need to put in place programmes to engage the academics in the system's development and explain its final structure and processes.

Public Sector Research

It is also important to note that so-called 'ressortforschungsinstitute' are not subject to the RAE. This major performer of research comprises the **Public Sector Research Establishments** i.e. government laboratories that have not been privatised and the institutes of some of the Research Councils (notably the Natural Environment Research Council, Biotechnology and Biological Sciences Research Council and Medical Research Council). These receive funding from the Government in order to undertake research relevant to the respective policy needs of their sponsoring department.

The size of this sector has been considerably reduced in recent years through the privatisation or semi-privatisation of government laboratories. In addition, and partially as a consequence of this reduction, civil spending on R&D by Government departments has declined over recent years but remains substantial although it is now disbursed primarily on a competitive basis. Nonetheless, the former government laboratories remain the major performers of this research.

2.3.3 France: Agence d'évaluation de la recherche et de l'enseignement supérieur

The French research and innovation system lends itself to a comparison with the Czech one, insofar as with the CNRS (Conseil National de Recherche Scientifique) France maintains a large public research organisation comparable to the Czech Academy of Science. Also, the French research and innovation system is in transition from an 'old-school' system[61], where research is typically performed in public research organisations, funding comes as block grants and universities focus on teaching, to a more 'modern' research and innovation system, where a research council awards funding for which universities and research organisations apply in a competitive process.

Apart from the CNRS, there are numerous other public research organisations. They are divided into two categories: public institutes for science and technology[62] *(Etablissements publics à caractère scientifique et technologique - EPST*), and public institutes with a more industrial and commercial character (*Etablissements publics à caractère industriel et commercial - EPIC*). However, more and more research is performed at universities, often in so-called mixed research units shared with public research organisations. There are more than 3000 research units in universities, of which roughly 1300 are mixed units financed by the university and by the public research organisation. Currently, 80% of CNRS staff is located within universities.

In March 2007, the Agency for the Evaluation of Research and Higher Education *(Agence d'évaluation de la recherche et de l'enseignement supérieur - AERES)* was established. Formerly, research evaluation was assigned to different organisations, some dedicated to a single research organisation, other to one discipline or technological area, leading to a fragmented evaluation system. Thus, the creation of AERES responds to the need for a clearer and more effective system.[63]

AERES's task consists of evaluating public research organisations, higher education institutions as well as HEI study programmes and courses. In particular, AERES evaluates

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[61] Sometimes also called pre-Humboldtian, see Use Schimank and Markus Winnes, Beyond Humboldt? The relationship between teaching and research in European university systems, Science and Public Policy, Vol. 27, No. 6, 2000, 397-408

[62] The Centre for Scientific Research (Centre national de recherche scientifique – CNRS) is the main EPST. With around 25,000 employees (around 11,000 of whom are researchers), CNRS is currently France's (and Europe's) biggest public research institute and represents nearly a quarter of the total civil R&D budget in France

[63] In general, French evaluation culture has changed considerably since the mid-1990s: formerly more or less reserved to the Court of Auditors (Cour des Comptes) and mainly concerned with the control of financial flows, the focus of evaluations has shifted, as a series of more strategic policy evaluations have been undertaken more recently

institutions (research organisations and HEI) that have performance contracts with the Ministry of Higher Education and Research. These evaluations take place every four years.

Contrary to the situation in the Czech Republic and the UK, there is no direct link between research assessment outcomes and funding. Rather, evaluations are seen as 'objective negotiation tools' (outils de négociation objectifs) around which the negotiation of the performance contract concluded by the institution and the Ministry is centred.

AERES conducts evaluations both at the level of the whole research institution (i.e. public research organisation or HEI) and at the level of the individual research unit. For a global perspective, evaluations at institutional level take into account the results from the evaluations of individual research units and of the study courses. They also examine the institution's research strategy and governance.

The criteria and procedures established by AERES for all research assessments take into account the diversity of research units/institutions in terms of their nature and mission and the disciplines they are active in. For example, CEMAGREF (Centre National du Machinisme Agricole, du Génie Rural, des Eaux et des Forêts) mostly works for ministries and regional authorities, thus acting as a sectoral research institute or government lab. This specific mission is taken into account in the evaluation.

AERES's approach typically consists of a self-evaluation and external peer review with site visit. The self-evaluation conducted by the research unit or research institution to be evaluated is a core element of each evaluation. It is given to external peers for preparation of their site visit. It also helps to make sure that recommendations take into account the institution's specificity.

Peers are selected from a pool of experts established by HEI, research organisations, and AERES. Peers come from academia or from the socio-economic sphere. Research units are graded in four areas: productivity, attractiveness, strategy and project. The unit also receives a global grade.

Evaluation reports are submitted to research institutions/units for comment. Each evaluation report is published together with the comment written by the research institution/unit.

Because the research assessment is based on a self-evaluation, it is said to encourage self-reflection. Thus, the research assessment has a formative approach, leading to improvements in governance, research, productivity, and the study courses HEI offer. At the same time, they serve as strategic intelligence for ministries.

Issues

Important issues that emerge from the French experience:

- There is no direct link between assessment outcomes and research funding. Evaluations are used as strategic intelligence for negotiating performance contracts.
- The evaluation system has a formative approach and stimulates self-evaluation
- The evaluation system takes diversity into account. The mission of a research unit/institution and the specificity of disciplines are integrated in the evaluation.

2.4 Observations and Preliminary Conclusions

Our observations and preliminary conclusions are based on an in-depth analysis of the Evaluation Methodologies 2004 and 2009 and a preliminary analysis of the 2010 Methodology, and a comparison with international practice. In the next report, we will focus on collecting more empirical evidence to underpin our observations.

In the last 5 years, the policy approach to the evaluation of R&D saw the following fundamental changes:

- The 2004 Methodology introduced the concept of a **metrics-based quantitative results evaluation**, seen as a tool – and only one of the main criteria – to prove the quality of research performance. The 2009 version marks the adoption of the metrics-based evaluation of R&D results as a **Performance-Based Research Funding System -** albeit only at the level of funding bodies. The 2010 Methodology explicitly recognizes the use of the metrics-based evaluation of R&D results as a funding system also at the level of research institutions. Currently, the Evaluation Methodology has therefore a two-fold role. Of course, there is a close link between these two roles: at its "practical level", the Evaluation Methodology defines what results are eligible, how the data are collected and how they are converted into point values, which then form the basis to allocate institutional funding.
- A progressive restriction of the **scope of the evaluation guidelines** can be noted: while the 2004 Methodology was characterised by a broad outlining of a comprehensive Evaluation Guideline covering all the different layers of the research system, the 2009 Methodology focuses almost exclusively on the quantification of research outputs for the evaluation of research organisations and research programmes
- There is a substantial restriction also in the **scope of the envisaged evaluations** themselves: the 2004 Methodology stresses the importance of evaluating research programmes in terms of their results and effects in the socio-economic spheres (and taking into account their specific socio-economic objectives); the 2009 Methodology focuses *exclusively* on the measurement of R&D outputs. The implementation of ex-post impact analyses is never mentioned - neither in the Methodology nor in other policy documents

Important differences can be noted between the current Evaluation Methodology in the Czech republic and international practice.

The Czech system is **purely metrics-based** and as such fairly unique. While the UK RAE relies on a number of quantitative indicators, there are other systems that rely considerably more on quantitative (and bibliometric) indicators, such as the Australian and the Norwegian. Still, they are not quite as radical as the Czech one. We will describe and analyse them in a next step.

The overview of evaluation practices in the UK, France and the Netherlands showed also other considerable differences:

- Both the Dutch and French research assessment exercises adopt a **formative approach**. The idea is that research assessment should improve quality of research. The UK RAE is not formative in approach but UK researchers would consider feedback on how to improve quality as a kind of compensation for the burden the RAE places on them. The Dutch and the French system also allow research units evaluated to comment on the assessment they receive.
- All research assessments we have looked at have a **larger scope** than the Czech one, taking into account dimensions that go beyond pure research quality. While the Dutch system also takes into account research management, research policy, research facilities, PhD training, and societal relevance of research (NL), the UK RAE looks at research strategy, staff development, training of postgraduate researchers, and engagement with research users and the public. The French system looks at research strategy and governance.
- Since 2009, the Dutch Standard Evaluation protocol has taken into account **societal impact**, using the ERiC systems. An increased focus on societal impact is also planned in the UK Research Evaluation Framework. Indicators of societal impact used are cooperation with private sector and memberships of social organisations and policy bodies. In contrast, the Czech system only takes into account applications (mainly patents).

- While the Czech evaluation methodology is purely retrospective, the Dutch system is **both retrospective and prospective**, taking into account past performance as well as future plans.
- The Dutch Standard Evaluation Protocol has to be seen in a context of autonomy. In exchange for autonomy, universities are subject to **quality assurance**. Quality assurance is also seen as an instrument for steering universities.
- Last but not least, the examples show us that there does not necessarily need to be a (direct) link between the assessment of research and the allocation of funding. In the Dutch system there is no link with funding at all while in the French system there is an indirect link with funding. In the latter case the research assessment is used for negotiating performance contracts between the university and the ministry. The French system has the advantage of allowing capacity building.

At this practical level we have identified a number of critical issues which are valid for both roles of the Evaluation Methodology and remain stable despite the efforts made to differentiate and detail the system from 2004 to present:

- Different types of institutions, their different missions, tasks, activities, and funding situations are assessed according to identical criteria despite institutions being very heterogeneous.
- Differences between disciplines are not taken into account accordingly:
  - Different types of results are not equally important for different disciplines and for different modes of performing research
  - Chances of actually succeeding in the scheme differ, as not all types of results are equally achievable for all scientific disciplines, especially the highly rated patents
  - Scientific disciplines differ in their publication cultures and patterns both in terms of publication type and frequency
- The exclusive focus on countable research results on an annual basis might encourage perverse effects, such as the notorious "salami tactics" in publishing ever smaller pieces of research findings, which puts those disciplines at a disadvantage where these "least publishable units" are larger than in others
- The Evaluation Methodology does not consider input factors, i.e. the different starting positions of the institutions are not taken into account.
- The Evaluation Methodology is based purely on research results to the exclusion of anything that goes beyond: research quality, research management, post-graduate training etc.
- The Evaluation Methodology is set at too high a level of aggregation compared to the level at which level research is taking place. As a consequence, good researchers may go unnoticed, not getting rewarded for the quality of their work.
- Unlike the Dutch, UK and French systems, the Evaluation Methodology has no formative element, being retrospective and purely metrics-based. Thus, it does not create any opportunities for researchers, research managers and research institutions to improve quality.

No other system of performance based research funding allocation known to us and still in use is equally radical in its exclusive focus on the past and in its level of standardisation across different types of institutions and disciplines.

3. Performance-based Research Funding Systems (PRFS)

In this section we focus on the use of the metrics-based results evaluation system as a Performance-based Research Funding System.

In a first stage we sketch the policy background to this additional role of the evaluation methodology. Secondly, we set the PRFS in the Czech republic in the international context, describing key characteristics of PRFSs and their typical effects. We then report on our preliminary analysis of the effects on fields of research in the Czech republic and relate on the outcomes of an expert panel study on practices for assessing university-based research, commissioned by the European Commission. Finally, we draw some conclusions.

3.1 Policy Background to the PRFS in the Czech Republic

3.1.1 The Policy Context

As mentioned in the preceding chapter 2.1, the concept that funding allocation should be guided by performance and results achieved had already been voiced in the 2004 Evaluation Methodology and the National R&D Policy 2004 -2008. In these policy documents, however, the R&D results were considered to be only one of the relevant factors – albeit at times a critical one.

The shift occurred in the 2008 Reform of the R&D&I System where it was stated, "**t**he institutional support to departments will be allocated at the level of budgetary chapters according to the results of research organisations within their competence achieved over the past five years." In other words, the budgets made available to the institutions responsible for institutional funding (the Ministries and the Academy of Sciences) would be determined by the aggregated R&D results of the research organisations in their field of competence.

As a rationale for this change in the budget allocation, the 2008 Reform stated, "The allocation of institutional funds among the budgetary chapters cannot stem from only the amount of funds that were allocated in the previous year, but must be based on **more objective criteria**, which are the results that have been achieved in the past five years. Unlike the targeted (project) support directed at the attainment of set targets, which is therefore directed at the future, the institutional support is intended to produce a long-term conceptual development of research organisations and must bring along corresponding results, too (regardless of the source, from which they were financed)."

Apparently, the intention of the 2008 Reform was not that the metrics-based results evaluation would determine institutional funding at the level of the individual institutions. In fact, the policy document stated, "Within the respective budgetary chapters, it will be possible to modify the allocation of funds on the basis of a more detailed evaluation of research organisations using internationally recognised methodologies, the results of which will be published."

However, all Ministries declined this offer and opted for the application of the metrics-based results evaluation to also be used for the distribution of institutional funding at the level of individual institutions. Only the Academy of Sciences is currently organising an alternative internal evaluation.

It can be envisaged – and interviewees have confirmed – that the results evaluation will also be applied at lower levels within the institutions concerned, e.g. within universities at the level of faculties and departments, and even down to the individual researcher. In this context it is telling that the Charles University felt the need to mitigate the effects and foresees – internally to the university - the attribution of extra points and additional funds to books as a research result.

One should therefore note that when indicating the modalities for the allocation of institutional funding at institutional level, the 2010 Methodology actually reacts upon an accomplished fact.

3.1.2 From "Research Intentions" to "Long-term Conceptual Development"

The change in policy-making in relation to institutional funding did not only regard the more pronounced focus on the achievement of results as objective criteria for funding allocation; policy-makers also stepped away from the concept of "Research Intentions".

Essentially, policy-makers in 2008 substituted a radically prospective funding system (the Research Intentions) with a radically retrospective funding system (the achievement of results in the past).

The Research Intentions scheme, launched in 1998, is generally perceived to have had some very positive attributes. Most important, it provided a measure of stability and security for research organisations. In addition, organisations had considerable freedom to design the Research Intentions according to their needs and wishes. In other words, institutes with good plans could do a lot. However, the Research Intention scheme also gave rise to criticism. As Research Intentions cover long periods (5-7 years), this can restrict progress or development within institutions because they are locked into the programmes that are defined in the intentions. In addition, criticism concentrates on the evaluation of the Research Intentions, which was perceived as not very objective: almost all Research Intentions were evaluated as 'excellent' or 'above average'.

The evaluation of the Research Intentions scheme voiced in the 2008 Reform document was that "The introduction of a research plan-based institutional financing did not bring the necessary dynamics into the organisational structure of public research. While institutes abroad in this area are born and die, their focus (research programmes or plans) considerably changes, their management radically changes, etc., the changes in the Czech Republic are basically negligible."

The 2008 Reform document considered that the decision no longer to tie institutional funding to research intentions would result especially in "the transfer of decision-making in funds for long-term development of organisations from the level of ministries (where decisions were taken in funds and often in the research plans orientation) to the organisations themselves." In essence – or at least in theory - the research organisations are given full autonomous decision power. The 2008 Reform states: "Whether the organisation uses these funds to attract (or retain) skilled workers, investments into new apparatuses and equipment, cooperation with other organisations, etc. will depend on the organisation itself with only one single condition – money must be used on research and development and bring results."

3.2 Performance-Based Research Funding Systems in the International Context

3.2.1 Key characteristics of PRSFs

There is growing international interest in performance-based research funding systems. Performance-based models have been implemented in the UK, Spain, Slovak Republic, Hong Kong, Australia, Poland, Italy, New Zealand, Flanders, Norway, Denmark and Finland. They operate at different levels, for example, the Spanish system measures and rewards individual performance. The UK and Hong Kong RAEs have 'units of assessment' that correspond more or less to departments or research groups. Most operate at the level of institutions.

Research evaluation processes tend to focus on four output measures: volume; quality; impact; and utility[64]. The earlier systems tend to be heavily based upon peer review but – as in the Czech Republic – there is growing interest in indicator-based systems. However, while the use of indicators in the Czech Republic appears to be driven by a desire to de-politicise and de-personalise the evaluation and funding process, elsewhere the interest in

[64] Aldo Geuna and Ben Martin, "University research evaluation and funding: An international comparison," *Minerva*, 41, 2003, pp27-304

indicators reflects a desire to simplify and reduce the cost of assessment. Even among indicators-based systems, **cost** is a major consideration. While Norway chose to establish a national system of grading journals and to require researchers to input their publications into a central database, Sweden has opted to focus on ISI journals and ISI-derived indicators in order to put a system in place more quickly and economically than was the case in Norway[65].

Intervals between successive allocation exercises vary among countries. In the Czech system, the decision about budget allocation is updated annually, taking into account the past five years of research results. This means that funding in 2011 will be based on the evaluation of results in 2009 covering results published or produced from 2004 to 2008; funding in 2012 will be determined by the evaluation of results in 2010, covering results of the time period 2005-09.

Finally, the **percentage of funding** that depends on the research evaluation is a key feature of performance-based research funding systems.

In the Czech Republic, the introduction of the metrics-based results evaluation as a Performance-based Research Funding System (in principle at 'budget chapter' level) will occur in various phases, predominantly depending on the conclusion of the Research Intentions. As is illustrated in the table below, in 2010 the results evaluation ("RVO-Hodnocení") will determine the full institutional funding for those research organisations that concluded their Research Intentions in 2009 ("Ukončení VZ"), 1/3 of the institutional funding for those who concluded their Research Intentions in 2010 or will conclude them in 2011 provided they were launched in 2005 or 2006 ("Zahájení VZ").

Without going into further detail, the table below illustrates that in 2011, for the majority of the research organisations the institutional funding will be determined by the performance-based funding system – if not entirely at least for 2/3.

Table 25 Introduction of the Performance-based Funding System, 2010 - 2012

Zahájení VZ	Ukončení VZ	2010		2011		2012	
		RVO (Hodnocení)	VZ („CEZ")	RVO (Hodnocení)	VZ („CEZ")	RVO (Hodnocení)	VZ („CEZ")
2005	2009	1	0	1	0	1	0
2006	2009	1	0	1	0	1	0
2004	2010	1/3	2/3	1	0	1	0
2005	2010	1/3	2/3	1	0	1	0
2005	2011	1/3	2/3	2/3	1/3	1	0
2006	2011	1/3	2/3	2/3	1/3	1	0
2007	2011	0	1	0	1	1	0
2007	2012	0	1	0	1	1/3	2/3
2007	2013	0	1	0	1	1/3	2/3
2009	2013	0	1	0	1	1/3	2/3
2009	2013	0	1	0	1	1/3	2/3

Source: Approval of the proposal for state budget expenditure on R&D for the year 2010 with view on the years 2011 and 2012

At this stage, a precise calculation of the amount of overall funding that will be influenced by the PRFS in 2010, 2011 and even 2012 looks like a titanic exercise. In the same year, a

65 Håkan Carlsson, "Allocation of research funds using bibliometric indicators `- asset and challenge to Swedish Higher Education Sector," *InfoTrend*, 64 (4), 2009, 82-88

rough calculation of the total 'basic' national public funding for universities (teaching funding + institutional funding) and for the Academy of Sciences (investment funds and institutional funds) leads to the result that overall, institutional funding accounts for approximately 30% of the total 'basic' national public funding (including approximately 80% of the public funding of the Academy).

A consistent finding by analysts is that PRFS typically move **small** amounts of money around each time they are performed[66] - in strong contrast to the situation in the Czech republic. In terms of shares of the total 'basic' national public funding, for example, in 2008 the PRFS in Australia and New Zealand governed 10% of university funding, in Italy and Norway 2%, and in Sweden 12.5 %.

3.2.2 Effects of Performance-Based Systems

In principle, performance-based research funding systems have important benefits

- The institutions have stronger incentives to facilitate research for their researchers
- Research is now perceived as a common and institutional responsibility not only as an individual task
- New publications receive attention not only from external peers but also internally from the institution
- Research management improves with the aid of bibliometric information about the research activities[67]

Performance-based research funding systems tend to attract academic opposition. No one likes to be measured, especially if the measurement has consequences. There are nonetheless a number of serious objections to the type of systems that have been put in place in recent years. Figure 24 lists the main advantages and drawbacks of such systems.

[66] Gunnar Sivertsen, "A performance indicator based on complete data for the scientific output at research institutions," *ISSI Newsletter*, 6 (1), March 2010; A Rodrigues-Navarro, "Sound research, unimportant discoveries: Research, universities and formal evaluation of research in Spain," *Journal of the American Society for Information Science and Technology*, 60 (9), 1845-858

[67] Sivertsen, *Op Cit*

Figure 24 Advantages and drawbacks of performance-based university research funding

Advantages	Drawbacks
Performance-based – 'meritocratic' in that it links resources to performance, rewarding good research Strong incentive to improve individual as well as institutional performance Competition may lead to increased efficiency – ineffective research identified and cut Encourages research to be properly completed and written up for wider dissemination Provides public accountability for government funds invested in research Encourages more explicit/coherent research strategy on part of department or institution Provides mechanism for linking university research to government policy (e.g., to shift priorities) Concentration of resources may enable best departments to compete with world leaders (e.g., in US)	High cost and labour intensity (whether peer review or indicator-based) for universities and evaluating agencies May cause 'homogenization' of research and universities – i.e., decrease in diversity and experimentation May discourage more innovative and risky research Encourages 'publication inflation' (e.g., 'salami publishing') and other 'game playing' (e.g., with indicators) – i.e., 'looking good' rather than necessarily doing better May encourage traditional 'academic' research at expense of research linked to society's needs Tends to separate research from teaching, implying lower priority for teaching Rewards past performance not current or future potential Reinforces research elite/status quo – may cause overconcentration May lead to excessive government influence/'interference' in university

Source: Aldo Geuna and Ben Martin, "University research evaluation and funding: An international comparison," *Minerva*, 41, 2003, pp27-304

The novelty of such systems, however, means that there is so far a limited amount of **evidence** about their effects. The UK RAE has clearly increased the quality of UK university research. It has also encouraged the UK universities to take a rigorous approach to developing and implementing their own research strategies. It has also enabled the government to maximise the research return for limited funding[68]. The reason for the RAE's success in these respects is that there was a gap of several years between successive exercises, allowing time for the system to adjust to the expectations of the RAE and for individual researchers to change their behaviour[69].

Performance-based funding can have surprisingly **large effects on collective behaviour**. This is not only a response to potential funding changes but also reflects the role of rankings and grades from performance systems as indicators of esteem. Australia introduced a simple and mechanical system based on publication numbers in 1995. Study of aggregate publication data, complemented by case studies at two universities, indicates that this resulted in an increased number of publications – indeed, Australia's contribution to the Science Citation Index increase by 25% through the 1990s. However, researchers systematically shifted their output towards lower impact factor journals, in order to achieve greater publication numbers, leading to a decline in Australia's relative citation impact in the same period[70].

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[68] T Clark, *OECD Thematic Review of Tertiary Education, Country Report United Kingdom*, Paris: OECD, 2006

[69] J Taylor and R Taylor, "Performance indicators in academia: An X-efficiency approach," Australian Journal of Public Administration, 62(2), 71-82; cited from Nicoline Frølich, *The Politics of Steering by Numbers: Debating Performance-Based Funding in Europe*, Report 3/2008, Oslo: NIFUSTEP: 2008

[70] Linda Butler, "Explaining Australia's increased share of ISI publications – the effects of a funding formula based on publication counts," *Research Policy*, 32 (2003), 143-155

Norwegian university researchers have significantly increased the volume and quality of their output since an indicator-based system was introduced, despite the fact that it only affects 2% of total university funding[71]. (Note, also, that publication is only one of four indicators that drive institutional research funding, the others being: PhD production; EU research funding; research funding from the Research Council of Norway.) The Norwegian experience is also that self-reporting can lead to significant error: in a spot check of the 2006 submissions, it was found that **half** the publication points credited to one university were wrong, mainly due to false reporting of textbooks as books but also to other inaccuracies[72].

Field-specific factors

The design of performance-based funding systems is sensitive and contentious. Geuna and Martin note that the process of consultation on the UK RAE led to successive refinements – to a point where the resulting complexity led to pressure to move to an indicators-based approach[73]. Such an approach has now been piloted and subsequently rejected, as a result of which the latest RAE has been postponed by a year in order to allow time for better methods to be developed.

Systems that rely solely or heavily on output indicators are especially vulnerable to inducing perverse effects. Some fields (especially in the humanities) emphasise publish in monographs or books; others (notably the basic 'hard' sciences) in journals. Applied scientists and engineers often communicate more via conference proceedings than through learned journals. Mathematicians write few but extensive articles; chemists produce many, short articles; and so on. Performance-based research funding systems, which use publication as an indicator, need to take account of the **major differences in 'propensity to publish' among fields.**

The UK RAE and a number of others achieve this by not putting different fields in competition with each other. Instead, similar departments compete within about 60 (the number varies from RAE to RAE) 'units of assessment' so that the RAE rewards quality **within** disciplines but do not cause competition **among** disciplines. The Swedish system uses 34 different disciplinary categories.

Like the Czech one, the Norwegian system sets the disciplines against each other and tries to compensate for differences in publication behaviour by providing different weights for difference performances. There are nationally defined lists of 'Level 1' and 'Level 2' (higher) publications, with books and monographs being weighted at several ties the value of an article in each case. The committee that designed the funding system argued that it was not possible to take better account of differences in publication behaviour, even using bibliometric methods[74].

While the bibliometrics profession tends to be fastidious about making comparisons **within** fields, precisely because of inter-field differences in publication behaviour, propensity to publish is rarely quantified. One reason for this is that a proper comparison would need to take account of the numbers of researchers who do not publish at all – and they, of course, are not visible in the bibliometric databases. Sandström and Sandström[75] have developed a method for estimating the size of the non-publishing population and used this as a basis for the field-normalisation technique used in the new Swedish system. They

[71] Sivertsen, *Op Cit*

[72] S Hernes, "Publiseringspoeng og referensekvalitet", *Forskerforum*, 6/2007

[73] Geuna and Martin, *Op Cit*

[74] Kirsti Koch Christensen (chair), *Vekt på forskning: Nytt system for dokumentasjon av vitenskapelig publisering*, Committee report to the Norwegian Association of Higher Education Institutions, 2003

[75] Ulf Sandström and Erik Sandström, "The field factor: towards a metric for academic institutions," *Research Evaluation*, 18 (3), 2009

do not publish the field factors, but it appears that the differences among them are very large: a publication in the humanities and social sciences can be weighted up to 15 times as much as one in chemistry[76]. Figure 25 shows the effects of the field adjustment at the university level. The effects of the adjustment are especially large for Karolinsaka, the medical university, and the two leading technical universities: KTH and Chalmers. The other big universities have a wider range of disciplines so field adjustments tend to cancel out to a greater degree. The small universities tend to be more orientated towards social sciences, humanities and professions than the large ones. The Swedish system is based on ISI papers (equivalent to the Jimp papers in the Czech system, which in recent exercises drove 65% of the funding allocation). Clearly, variability in publication behaviour is a major influence on the number of journal publications produced, which therefore needs to be handled in a performance-based research funding system.

Figure 25 Effects of field adjustment on Swedish university production, 2005-7

University	Papers published (A)	Field-adjusted papers published (B)	Ratio (A)/(B)
Lund	4,193.5	3,571.9	1.17
Uppsala	3,743.0	3,193.2	1.17
Gothenburg	2,485.5	2,291.2	1.08
Karolinska	4,153.5	3,164.3	1.31
Stockholm	2,091.0	1,934.7	1.08
Umeå	1,622.0	1,411.3	1.15
SLU	1,571.0	1,316.9	1.19
KTH	2,482.5	1,990.0	1.25
Linköping	1,588.5	1,423.0	1.12
Chalmers	1,767.5	1,388.5	1.27
Luleå	416.5	370.0	1.13
Mid Sweden	218.0	214.5	1.02
Örebro	213.0	220.2	0.97
Karlstad	199.5	188.3	1.06
Växjö	135.5	140.7	0.96

Source: Sandström and Sandström, *Op Cit*; own calculations

Analysis of changes in Flanders also underscores the importance of field effects. The formula used to allocate the Flemish BOF institutional funding for universities was changed in 2003. Previously, this was allocated using a formula based on PhD production (50%), other graduate production (35%) and the volume of public research funds attracted (15%). The old formula was retained for 70% of the funding. The rest was allocated based on a combination of SCI publication and citation indicators, with the new formula being phased in over three years. A notable result was a significant increase in funding to a university specialised in biomedical sciences[77].

[76] Carlsson, *Op Cit*

[77] Koenraad Debackere and Wolfgang Glänzel, 'Using a bibliometric approach to support research policymaking," *Scientometrics*, 59 (2), 2004, 253-276

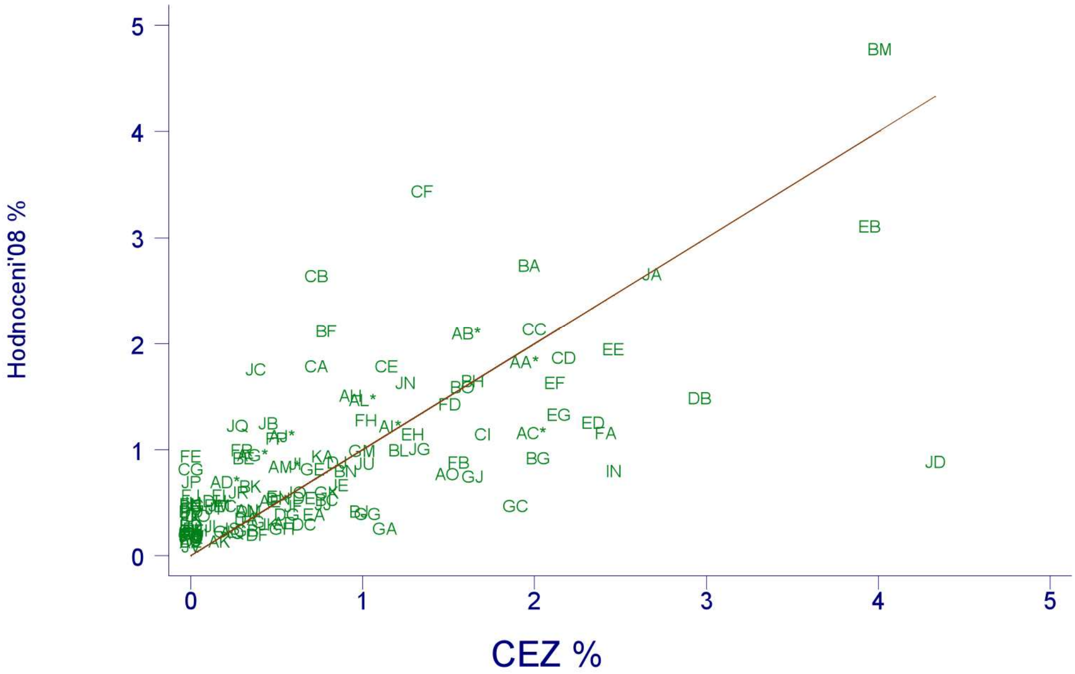
3.2.3 Effects of the PRFS on fields of research in the Czech republic

Figure 26, below, illustrates a simulation of the effect that the use of the metrics-based research results evaluation as a funding system for the distribution of institutional funding. The simulation compares percentage allocations between several tens of scientific fields by the Research Intentions system ("CEZ") and by the Performance-based Research Funding System (PRFS – "Hodnocení"), based on calculations referring to 2008.

The data used for this simulation were listed in the report of the "Project for the preparation of the Methodology to evaluate the results of research institutions and of programmes finished in 2010", a report published by the Secretariat of the Board of the R&D&I Council. As such, the simulation below does not take into account the changes introduced in the Methodology 2010. However, the effects of the 'dampening factors' introduced in the Methodology 2010 are bound to be limited – especially due to the exclusion of the Jimp factor (see the preceding Section 2.2.2).

The graph below shows that while for many fields the difference between the two funding systems is only a few percentage points, several scientific fields will experience considerable changes – in the positive or negative sense. One can notice, for example, that the share of field "DB" (Geology & Mineralogy) on funding based on the Research Intentions obtains 3% of total funding under the old system and drops to 1.4% if funded applying the PRFS.

Figure 26 Field specific shares (in %) of institutional funds allocation by Research Intentions and by the Performance-based Research Funding System



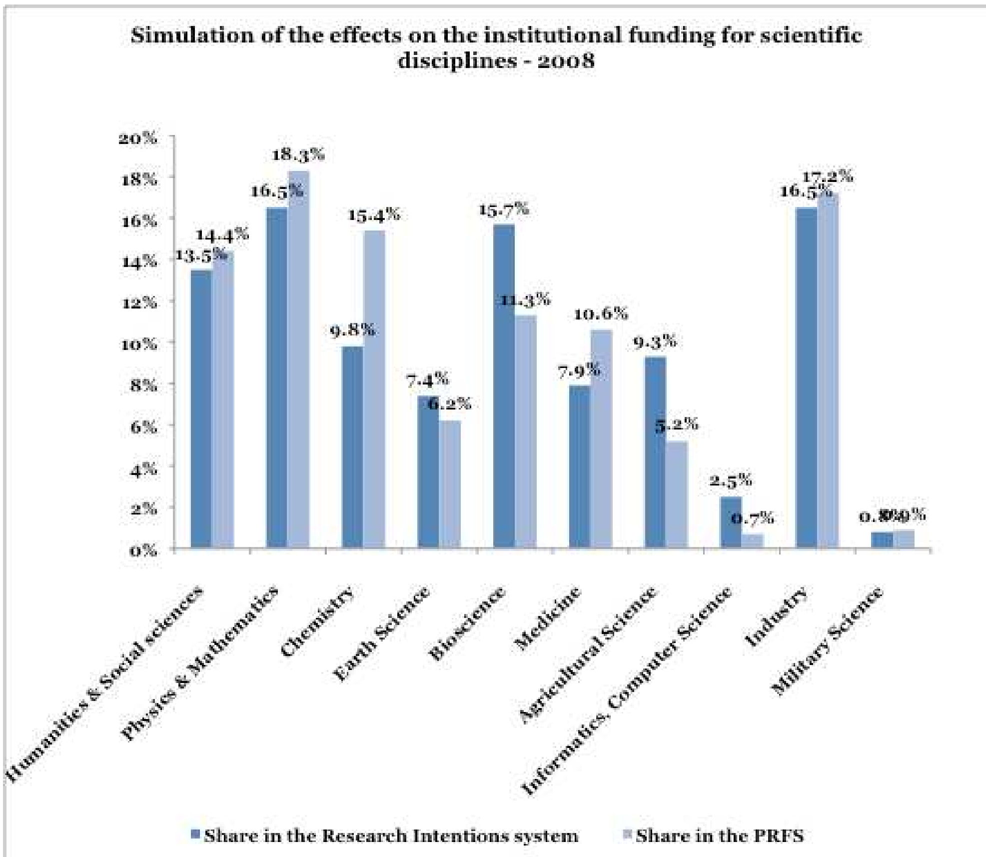
Source: Elaboration of data listed in the report of the "Project for the preparation of the Methodology to evaluate the results of research institutions and of programmes finished in 2010", Secretariat of the Board of the R&D&I Council, 2010

These envisaged changes in funding allocations between the scientific fields imply a **shift in focus** for the institutional funding of research, illustrated in Figure 27, below.

Many of these changes are influenced (also) by differences in propensity to publish among fields, described in the preceding section:

- The application of the PRFS is expected to be to the advantage of especially the scientific disciplines grouped under *Chemistry* and *Medicines*, followed by *Physics & Mathematics*.
- It is expected to be to the disadvantage of research in *Bioscience, Agricultural Sciences* and *Informatics & Computer Science*.

Figure 27 Simulation of the effects on the institutional funding for scientific disciplines



Source: Elaboration of data in the report of the "Project for the preparation of the Methodology to evaluate the results of research institutions and of programmes finished in 2010", Secretariat of the Board of the R&D&I Council, 2010

Table 26, below, illustrates the expected change in institutional funding in terms of its distribution over the various Scientific and Technological fields.

- Under the Research Intentions system, the most financed scientific fields were *Solid Matter Physics & Magnetism, Genetics & Molecular Biology, and Computer Applications & Robotics* (highlighted in dark orange), followed by Geology & Mineralogy, Physiology, Microbiology & Virology, Cardiovascular diseases, and Informatics & Computer Science
- When applying the PRFS, *Solid Matter Physics & Magnetism* and *Physical & Theoretical Chemistry* become the most financed research areas, followed by Genetics & Molecular Biology, General Mathematics, Analytical Chemistry, and Electronics & Optoelectronics, Electrical Engineering

Table 26 Effect of the PRFS on the funding distribution over the specific scientific and technological fields

Code	Science field ("branch")	SHARE RESEARCH INTENTIONS 2008	SHARE PRFS 2008	CHANGE
A	**Humanities & Social sciences**	13.5%	14.4%	7%
AC	Archeology, Anthropology, Ethnology	2.0%	1.1%	-45%
AD	Politology & Political Sciences	0.2%	0.6%	200%
AG	Legal Sciences	0.4%	0.9%	125%
AJ	Letters, Mass-media, Audiovision	0.5%	1.1%	120%
AK	Sport & Free-time Activities	0.2%	0.1%	-50%
AO	Sociology, Demography	1.5%	0.7%	-53%
B	**Physics & Mathematics**	16.5%	18.3%	11%
BA	General Mathematics	2.0%	2.7%	35%
BE	Theoretical Physics	0.3%	0.9%	200%
BF	Elementary Particles and High Energy Physics	0.8%	2.1%	163%
BG	Nuclear, Atomic and Molecular Physics, Colliders	2.0%	0.9%	-55%
BJ	Thermodynamics	1.0%	0.4%	-60%
BM	Solid Matter Physics & Magnetism	4.0%	4.7%	18%
C	**Chemistry**	9.8%	15.4%	57%
CA	Inorganic Chemistry	0.7%	1.7%	143%
CB	Analytical Chemistry, Separation	0.7%	2.6%	271%
CC	Organic Chemistry	2.0%	2.1%	5%
CD	Macromolecular Chemistry	2.2%	1.8%	-18%
CE	Biochemistry	1.1%	1.7%	55%
CF	Physical & Theoretical Chemistry	1.4%	3.4%	143%
D	**Earth Science**	7.4%	6.2%	-16%
DB	Geology & Mineralogy	3.0%	1.4%	-53%
DC	Siesmology, Volcanology, Earth Structure	0.7%	0.2%	-71%
DF	Soil Science	0.4%	0.1%	-75%
DG	Athmosphere Sciences, Meteorology	0.6%	0.3%	-50%
DH	Mining, incl. Coal Mining	0.1%	0.5%	400%
E	**Bioscience**	15.7%	11.3%	-28%
EA	Cell Biology	0.7%	0.3%	-57%
EB	Genetics & Molecular Biology	4.0%	3.1%	-23%
EC	Immunology	0.2%	0.4%	100%
ED	Physiology	2.3%	1.2%	-48%
EE	Microbiology, Virology	2.5%	1.9%	-24%
EF	Botanics	2.1%	1.6%	-24%
EG	Zoology	2.1%	1.3%	-38%
F	**Medicine**	7.9%	10.6%	34%
FA	Cardiovascular Diseases incl. Cardiotharic Surgery	2.4%	1.1%	-54%
FB	Endocrinology, Diabetology, Metabolism, Nutrition	1.6%	0.8%	-50%
FI	Traumatology, Orthopedics	0.1%	0.2%	100%
FL	Psychiatry, Sexuology	0.2%	0.5%	150%
FP	Other Medical Disciplines	0.5%	1.1%	120%
FR	Pharmacology & Medidal Chemistry	0.3%	0.9%	200%
G	**Agricultural Science**	9.3%	5.2%	-44%
GA	Agricultural Economics	1.1%	0.2%	-82%
GC	Agronomy	1.9%	0.4%	-79%
GF	Plant Pathology, Vermin, Weed, Plant Protection	0.1%	0.4%	300%
GG	Livestock Rearing	1.0%	0.3%	-70%
GH	Livestock Nutrition	0.5%	0.2%	-60%
GJ	Animal Vermins & Diseases, Veterinary Medicine	1.6%	0.7%	-56%
I	**Informatics, Computer Science**	2.5%	0.7%	-72%
IN	Informatics, Computer Science	2.5%	0.7%	-72%
J	**Industry**	16.5%	17.2%	4%
JB	Sensors, Measurment, Regulation	0.5%	1.2%	140%
JC	Computer Hardware & Software	0.4%	1.7%	325%
JD	Computer Applications, Robotics	4.3%	0.8%	-81%
JJ	Other Materials	0.8%	0.4%	-50%
JK	Corrosion & Surface Treatment of Materials	0.5%	0.2%	-60%
JL	Materials Fatigue, Friction Mechanics	0.1%	0.2%	100%
JM	Building Engineering	0.2%	0.4%	100%
JQ	Machines & Tools	0.3%	1.2%	300%
JT	Propulsion, Motors & Fuels	0.1%	0.4%	300%

Source: Elaboration of data in the report of the "Project for the preparation of the Methodology to evaluate the results of research institutions and of programmes finished in 2010", Secretariat of the Board of the R&D&I Council, 2010

The table above also lists those scientific fields that, according to the simulation, will experience major shifts in their institutional funding.

- Scientific fields with percentages highlighted in red are those that are expected to see major drops in their institutional funding (- 50% or more). They are spread over all scientific disciplines – with the exception of Chemistry, but show a significant effect especially for the research areas in Earth Science and Agricultural Science. Areas included are Sociology, Demography; Nuclear, Atomic & Molecular Physics; Geology & Mineralogy; Cell Biology; Cardiovascular diseases; Agricultural Economics; Agronomy; Informatics & Computer Science; and last but not least, Computer Applications & Robotics.

- Scientific fields with percentages highlighted in green are those that are expected to experience a significant increase in their institutional funding (double or more). We see that these research areas are concentrated especially in the field of Medicine, Industry, and Chemistry; interestingly, it includes also some research areas in Humanities & Social Sciences.

R&D&I policy in the Czech republic is strongly influenced by its strategic objectives – a sign of good practice in R&D governance.

The next step in our analysis was therefore to consider to what extent these changes in funding distribution over the S&T fields, provoked by the adoption of the PRFS, are in line with the strategic objectives for research set out in the *National Priorities for Applied R&D&I* for the years 2009 – 2011.

For the time period 2009-2011, 8 national research priorities were defined:

- Biological and ecological aspects of a sustainable development
- Molecular biology and biotechnology
- Sources of energy
- Material research
- Competitive engineering
- Information society
- Security and defence
- Priorities for the development of the Czech society.

We have only started this analysis; however, our preliminary findings show that the PRFS can be expected to have significant negative impacts on the funding of research in Scientific and Technological fields that were explicitly indicated in the policy documents as key technologies for the achievement of the National Priorities for Applied R&D&I 2009 -2011:

- The drastic drop in institutional funding for research in the field of Computer Applications & Robotics (one fifth of the funding allocated through the Research Intentions) is in strident contrast with the importance attributed to developments in this research area – and especially robotics – in the description of the R&D objectives for the research priorities Competitive Engineering and Information Society
- The same consideration is valid for the reduction of institutional funding in the field of Informatics & Computer Science (half of the funding), a key technological field for the R&D objectives in the Information Society research priority
- We notice the considerable drop in funding for several of the research fields in the field of agricultural science, which seems in contrast with the importance attributed to these specific fields of research in the research priority Biological and ecological aspects of a sustainable development
- The reduction in funding for Genetics & Molecular Biology (from 4% to 3%) is certainly not in line with the high importance attributed to the research in this field in the context of the research priorities Biological and ecological aspects of a sustainable development and Molecular biology and biotechnology

3.3 International view of good practice

An EU expert group recently reviewed practices for assessing university-based research across thirteen different countries, mostly in Europe[78]. Among its more striking conclusions is that "There is no single set of indicators capable of capturing the complexity of research and research assessment." It stresses a number of aspects of assessment systems, notably

- Consultation of HE researchers in the development of assessment systems to ensure procedural fairness, transparency, and a high level of acceptance
- The use of peer review panels, to ensure a broader understanding of the research being assessed, as well as of its contribution to knowledge, and to facilitate the assessment of research in emerging new disciplines and of interdisciplinary research
- The combination of peer assessment and bibliometric indicators
- The use of information about process and impact, including impact on teaching, to balance the focus on research output
- Self-evaluation as a key component in the assessment process
- Experiments designed to facilitate the measuring of societal impact
- Focus on units of assessment positioned somewhere between the individual researcher and the entire institution
- Unintended consequences of assessment exercises, be it that stakeholders make decisions contrary to the original objective(s) pursued, or be it that research quality is made the focus of attention to the detriment of other university functions

It proposed the following 'good practices'

1. Combine indicator-based quantitative data with qualitative information, for example information based on expert peer assessment. This enables the quantitative information to be tested and validated within the context and purpose of the assessment, with appropriate reference to the discipline and disciplinary practice
2. Recognise important differences across research disciplines. Peer-reviewed journal articles are the primary publication channel for practically all disciplines, but the complexity of knowledge has led to a diverse range of output formats and outlets
3. Include assessment of impact and benefits. Because research does not exist in isolation, assessment should include indicators, which are capable of capturing and recognising this. This differs for different disciplines. Stakeholder esteem indicators can show how research is viewed by the wider community
4. Integrate self-evaluation as a useful way to include the research community pro-actively in assessing their own contribution, but also as a means of placing the research process – which includes the organization, management, and developments over time – into context and related to institutional mission

[78] Expert Group on Assessment of University-Based Research, Assessing Europe's University-Based Research, DTD.C4, EUR 24187 EN, Brussels: European Commission, 2008

3.4 Observations and preliminary conclusions

Different governments use performance-based research funding in different ways, depending upon the needs and the national context. Depending on their design, performance-based research funding systems can act as a competitive source of discretionary income, as a reward for quality and/or volume of output, as an instrument of policy or – as in the case of the UK RAE – all three[79].

In the Czech republic, the adoption of the Performance-based Research Funding System needs to be set against the context of a search for objective criteria to guide the allocation of institutional funding and an increasing – close to exclusive - focus among policy-makers on concrete R&D results. We can notice a move towards granting research institutions 'autonomy' on how to manage their funding, thereby stepping a top-down strategic steering of research financed through institutional funding.

Internationally, the use of performance-based research funding systems has mixed consequences but does certainly bring benefits in terms of apparent increases in quality and incentives to improve research strategy and management. A great deal of care has to go into the design of the system in order to avoid unintended – and sometimes perverse – consequences.

Because these exercises are intended to **affect** and not just reward or punish performance, there needs to be a sufficient time between them to allow the research community to adapt its behaviour.

Inter-field differences in publication behaviour are large and need explicitly to be tackled in any system. One approach is to avoid putting fields in competition with each other – but this of course requires a separate decision about whether to (re)allocate money among fields. The alternative is to perform some tie of field normalisation in the process of calculating the indicators or in making the transition from performance indicators to money allocation. Our simulation of the effects of the PRFS on the funding of research in S&T fields in the Czech republic clearly points to changes in funding influenced by the differences in propensity to publish among fields, leading to a significant increase in funding for scientific disciplines grouped under *Chemistry* and *Medicines*, followed by *Physics & Mathematics*, and a decrease in funding for research in *Bioscience, Agricultural Sciences* and *Informatics & Computer Science.*

Our analysis furthermore shows that the PRFS can be expected to have significant negative impacts on the funding of research in Scientific and Technological fields that were explicitly indicated in the policy documents as key technologies for the achievement of the National Priorities for Applied R&D&I 2009 -2011.

In contrast to the current intentions in the Czech Republic where by 2012 the PRFS will govern approximately 30% of the total 'basic' national public funding (including approximately 80% of the public funding of the Academy), international practice indicates that **modest amounts** of money need to be moved in any one exercise, precisely in order to minimise the damage that such consequences can do to the research system.

[79] P. Bourke, Evaluating University Research: *The British Research Assessment Exercise and Australian Practice*, Commissioned Report No. 56, Canberra: National Board of Employment, Education and Training, 1997

Based on international experience of **indicator**-based funding systems, it is easy to agree with van Raan's observation[80] that "Ranking of research institutions by bibliometric methods is an improper tool for research performance evaluation, even at the level of large institutions." He explains that the methods are not good enough and laments policymakers' tendency to try to buy 'cheap and dirty' solutions that are way behind the state of the art and produce misleading results. There is a clear need for indicator-based allocation systems to be 'damped' *through the use of indicators other than research output*.

Key lessons from international experience therefore include

- Move slowly enough to let the system respond to the changed incentives
- Take small steps – moving small amounts of money has big effects on behaviour
- Explicitly tackle field differences
- Do not use solely indicator-based approaches but combine these with other allocation principles

[80] Anthony FJ van Raan, "Fatal attraction: Conceptual and methodological problems in the ranking of universities by bibliometric methods," *Scientometrics*, 62 (1), 2005, 133-143

In Brighton, 14/09/2010

Erik Arnold

Technopolis Limited

Managing Director