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# First Interim Report

**September 14, 2010**



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ



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## 1. Introduction

This is the first Interim report of the international audit of research, development and innovation in the Czech Republic. The overall aim of the audit is to support the further development of R&D&I policies and practices that will support the development, growth and quality of the system.

This study started in May 2010 and will be completed by December 2011. It is divided into two phases, each lasting 9 months. Each phase will finish with a major report that has firm conclusions. This additional document – which we began drafting after only three months of work – offers very preliminary findings about some of the inputs and outputs to the research and innovation system, the way it is governed, managed and evaluated. It is intended to provide initial feedback to Czech stakeholders and create an opportunity for discussion, which will benefit our work. However, the reader should recognise that this is a report on work in progress; it is not a final report of a completed study.

The first steps in our analysis were focused on reaching and documenting an understanding of the historical and systemic background to the current R&D&I system. Much of this history and systemic description is well known to actors in the research and innovation system. While we cannot do without documenting it so that we have a sound starting point for our work, we have tried to put much of the detail in an Annexe, so that the Czech reader may more easily skip well-known information.

The analysis has allowed us to make some first findings and identify topics that in most cases require follow-up analyses before sound conclusions can be drawn. Given the amount of work still to be done, it would be premature to make many recommendations. We do however make two – one on research assessment and the other on evaluation practices more broadly.

The team conducting the audit works within the contemporary ‘innovation systems’ heuristic, which has over the past 20-30 years become the dominant one in analysing research and innovation policies. The innovation systems approach focuses on the complexity of the relationship between innovation and research. Based on empirical evidence that disconfirms the old ‘linear model’ idea that research somehow automatically leads to innovation and wealth, the innovation systems perspective emphasises the role of networking, path dependence, institutions, capacities and co-evolution in determining the successfulness of innovation systems.

This has important implications for policy – and thus indirectly for the set-up and the analyses in this audit, as well as for the interpretation of our current findings

- Interconnection and interdependence are at the heart of the innovation system concept
- Innovative activity encompasses a wide range of phenomena
- Business enterprises are central actors in the system
- Demand, not just supply, drives innovation systems
- Innovation activities are much more than R&D
- Design, engineering and management play key roles in innovation systems
- Innovation functions do not map ‘tidily’ on to organisations
- National systems are internationally open
- In policy, balance – or ‘mix’ – is key

In this First Interim report we consider

- R&D inputs and outputs in the Czech R&D&I system
- Governance and management of the R&D&I system
- Evaluation and resource allocation

Finally, we draw a number of preliminary conclusions and make two recommendations. A separate volume of Annexes, which cover these themes in greater detail, supports this report.

## 2. R&D Inputs and Outputs in the Czech Republic

This Chapter describes Czech investment in R&D at the overall level and discusses outputs of the research system in statistical and bibliometric terms. It is worth recalling that – like all evaluation tools – these approaches have limitations. The descriptive economic statistics on inputs lack a qualitative dimension, often raising as many questions as they answer. This is in fact very useful for our study, raising research questions and suggesting hypotheses. The limitations of bibliometrics are significant and well known, including their in-built focus on one **sub-set** of the outputs of research, their greater ability to deal with the ‘hard sciences’, economics and psychology than with other social sciences and humanities, the focus on English-language journals, the systematic bias against developing countries, and so on. Nonetheless, used properly and with respect for their limitations, bibliometric indicators are extremely valuable diagnostic tools that provide an important part of the picture needed for evaluation. They need to be used in combination with other more qualitative techniques to reach a ‘rounded’ assessment of performance, and they certainly are not a viable basis on their own for mechanistically allocating research **funding**, as we will explain later in this report. Nonetheless, as **evaluative** tools, bibliometric indicators have an important role to play in our diagnosis.

This Chapter summarises the analyses and findings reported more in detail in Annex 1 to this report, and more specifically in Appendix A and B.

### 2.1 R&D Spending in the Czech Republic

In the last fifteen years, the Czech republic considerably narrowed the gap in R&D intensity with the other EU-27 countries, even though R&D investment is still below the OECD average. The funding structure of the Czech Research and Innovation system already resembles to a large extent that of the EU-15 and EU-27; there is an active Business Enterprise sector which performs and funds a significant proportion of the Czech Republic’s Gross Expenditure on R&D.

Emerging findings that require further investigation point at quite large differences between the sectoral focus of government funding of Business R&D compared to the distribution of the private sector’s own funds; evidence that tends to confirm the view of many in the research system that science-industry linkages in the Czech republic are rather weak - in particular in relation to the Higher Education sector; and a potential structural mismatch in scientific orientation of the Business Enterprise Sector R&D on the one hand and the Higher Education and especially Government Sector R&D on the other.

#### 2.1.1 Trends in R&D Intensity

In the last fifteen years, the Research and Innovation system of the Czech Republic was characterised by a continuous growth of investments in R&D. According to Eurostat, in the Czech Republic, Total R&D Expenditure (R&D intensity) reached 1.54% of GDP in 2007 and 1.47% of GDP in 2008.

The growth in R&D intensity was *among the largest within the EU27 member states* - despite a very high GDP growth. It allowed for a considerable narrowing of the gap in R&D intensity between the Czech Republic and the EU-27. Nevertheless, investment by the Czech Republic in R&D is still some distance below the OECD average.

### *2.1.2 R&D expenditures by sectors of performance and sources of funds*

Whereas overall R&D intensity provides a first indication of the level of research activities in a country, the relative proportions of activity in the business and government sectors provides an indication of the maturity of the system. Typically, in poorer countries the government is responsible for most of R&D, often because it is 'kick-starting' the innovation system through expenditures in the Higher Education sector that will provide qualified R&D manpower to the wider economy. The normal pattern is that business expenditures then increase to become the majority as industry grows and becomes more technology-based and R&D activities in industry therefore increase. Because of its role in generating research manpower and in tackling the (often more fundamental) research that cannot be addressed in the private sector, government needs to continue to spend on R&D. But – as reflected in the EU's 'Barcelona Goal' of spending 3% of GDP on R&D – a reasonable target is generally thought to be that the state should be spending up to about 10% of GDP on R&D and that the private sector should be spending twice as much.

In 2008, the Business Enterprise sector accounted 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. As in all other European countries, the Private Non Profit Sector is negligible in terms of R&D investment and performance levels and is hence not portrayed in particular in the analysis.

When looking at the **trends in the funding structure** over the last decade, we see that all relevant funding sectors have increased their R&D investments almost proportionally. Overall, the Czech Republic exhibits an R&D funding structure in which both the Business Enterprise Sector and the Government Sector contributed equally to a continuous growth in R&D investment.

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 - unlike many new member states, which have significantly lower shares of R&D funding by the business enterprise sector. 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. Today, the only major difference in relation to the overall funding structure of the Czech Republic is in the proportion of funding from abroad.

Regarding the funding structure of **R&D performed by the Business Enterprise Sector**<sup>1</sup>, it is evident that the vast majority of funding stems from own enterprise sources. Funding from abroad amounted to 6% of total funding and funding from the government to 13% in 2008.

As the figures from 1999 show, the share of Business Enterprise R&D funded by the Government has remained relatively constant. Compared internationally, it is rather high: 6% above the EU-27 and EU-15 averages. Our analysis shows that government funding of Business Enterprise R&D is particularly focused on the Services Sector (62.4%), and within that sector, on 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%), but is also marginalised in absolute

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<sup>1</sup> 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

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.

Government was close to being the exclusive funder of **R&D performed by the Higher Education Sector**<sup>2</sup> (91%). Most interestingly, funding flows from the Business Enterprise Sector to the Higher Education Sector are still at very low levels and show little increase since 1999, which seems a confirmation that science-industry linkages are rather weak 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 (1% in 2008 - the EU-27 average was at 6%).

**R&D performed within the Government Sector**<sup>3</sup> was to a large extent funded by government sources (84% in 2008). Unlike the Higher Education Sector, the government sector received a considerable share of R&D funding from the Business Enterprise Sector (11% in 2008). Compared with 1999, the share has increased by 4% by 2008.

### 2.1.3 Type of Research conducted and representation of Scientific Disciplines

There are important differences in the extent to which sectors perform R&D in different disciplines.

- The Business Enterprise Sector shows a strong specialisation in Engineering, which has traditionally been the backbone of the Czech Economy and continues to perform rather well, contributing to about a third of total GDP (see Rammer et al. 2007)
- The Government Sector is strongly specialised in Natural Sciences (62%)
- 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 and the Higher Education sectors

Table 1: 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)

<sup>2</sup> 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

<sup>3</sup> 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 institution. It also contains public libraries, archives, museums and other cultural establishments conducting R&D as their secondary activity

The figures regarding the representation of the different scientific disciplines point, on the one hand, to a potential structural mismatch in scientific orientation of the Business Enterprise Sector R&D and the Government and Higher Education Sector R&D, which might prevent close collaboration between the different performance sectors and explain the low level of funding of HERD via Business Enterprises.

In fact, the Business Enterprise Sector concentrated about 76% of its research in the field of Engineering whereas the Government Sector and the Higher Education account for much lower shares in this field (respectively 11% and 37%).

On the other hand, further qualitative analyses need to be performed in order to improve our understanding on the reasons why the Higher Education Sector that has by far higher shares in Engineering than the Government sector, has failed so far to attract considerable amounts of R&D funding from the Business Sector.

## 2.2 Bibliometric Analysis of the CR Research Output in an International Context

In this section we offer a first impression of the current outputs 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 now as a member of the EU. <sup>4</sup>

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. These indicators can be subdivided into two classes: publication output indicators and citation impact indicators.

It is important to note that publication output numbers are not clear-cut synonym for productivity, and citation impact measures are by no means to be directly interpreted as synonym for 'scientific quality'. 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.).

Furthermore, the objective of this analysis was to perform a top-down country-level bibliometric analysis in order to identify the position of research in the Czech republic in the international context.

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 at research group level, and even more and more at individual researcher level. The two approaches have different objectives and require different 'rules of the game'.

Top-down 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 organisations. As the

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<sup>4</sup> The detailed report on this analysis is included as Annex 1, Appendix B to this report; it includes important clarifications in terms of instruments and methodologies used for this analysis as well as an illustration of the key data. Annex 2 to this report reproduces the full data tables.

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 up to the work floor level, to construct valid sets of publications, directly forthcoming from the units under study. In a proper evaluation of the research on work floor level, bibliometric data are only one of the pillars of the whole process. 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 than one could ever draw based on a top down, descriptive, macro level analysis such as the one performed in this study.

From this, we state that this is not an evaluation of the Czech science system the way it is commonly understood.

The study so far clearly shows that the Czech Republic's science system has gone through drastic changes. Accession to the European Union has created large opportunities for the Czech Republic.

Important findings of the analysis include

- The increasing international visibility of the output of researchers from the Czech Republic and a remarkable improvement in the quality of the scientific publication output of the Czech Republic over time –especially in the last decade.
- The increasing trend in international and especially national cooperation – the latter indicating an improvement of the internal cohesion in the Czech science system.

The comparison with a number of benchmark countries made clear that the Czech Republic still has a long way to. However, it is bridging the gap, especially in terms of output development.

### *2.2.1 The research output and impacts*

During the time period 1993-2009, the output of the Czech Republic in the journals processed for the Web of Science<sup>5</sup> has nearly tripled. When comparing data on citations received by researchers from the Czech Republic in 2005-2009 with those received in 1993-1997, one sees that in the most recent time period, the number of citations received (which are indicators of impacts) is more than six times higher.<sup>6</sup>

The impact of the publications from the Czech Republic has increased strongly, and although still somewhat below worldwide average impact level, the impact

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<sup>5</sup> 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 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

<sup>6</sup> 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 (older publications have had more time to collect citation impact).

was at such an initially low level that an improvement to a worldwide average level was not to be expected in such a short period.

In general we therefore observe an increasing international visibility of the output of researchers from the Czech Republic. The sustained increase in the impact, developing at a much faster pace than the number of publications, indicates a remarkable improvement in the quality of the scientific publication output of the Czech Republic over time –especially in the last decade.

### *2.2.2 Research Profile of the Czech Republic*

The composition of the research conducted in the Czech Republic shows a **slow change in scope**. As a country with a traditionally 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.

In the period 1993-2009, the largest field is Physics & materials science, covering over 18% of the total Czech output, 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 gives the Czech Republic a very traditional European continental research profile, similar to the profiles of particularly Germany, France and Italy (contrary to a more Anglo-Saxon profile, where the life and medical sciences play a more dominant role).

Clinical medicine provides only 10% of the national publications output, underlining the observed preference for the natural sciences. Other disciplines covering more than 5% of the national output are Basic life sciences, Biomedical sciences, and Biological sciences. In all of these disciplines, however, we observe low impact scores.

We observe only a few disciplines with average impact levels, namely mathematics & statistical sciences, Environmental sciences and technology, and a few with a much smaller output, i.e. Literature, Management and planning.

Looking into the research profile of only the most recent time period (2005-2009), we see a few remarkable differences

- 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.
- An improvement of the impact in the most important fields in the national research profile. This was most marked for two of the six largest disciplines in which Czech scientists are active, i.e. Physics and materials science and Clinical medicine, but the other top ranking disciplines in the profile also show an increasing impact for Czech science. Other fields in which the impact increased were Mathematics & statistical sciences, Environmental sciences and technology, Instruments and instrumentation, and notably, Social and behavioural sciences, - all of which have reached internationally average impact levels. 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 a high impact score for Czech publications

### *2.2.3 Scientific Collaboration*

Czech publications show an increasing trend in scientific collaboration. 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 in the last decade, while elsewhere it has tended to grow.

The largest change in the Czech science system was the huge shift from publications with no collaboration at all, towards 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 types of scientific activity also show increased impacts. This is an important observation, as in other countries increased impact is normally generated by international cooperation. Of course - and this is partially the case for the Czech Republic - the publications resulting from national cooperation follow a similar pattern, thereby contributing to the strength of the system.

#### *2.2.4 Benchmarking analysis of the Czech output in an international context*

We compared the research performance of the Czech Republic with a number of benchmark countries including neighbouring countries (Austria, Germany, Hungary) and 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 analysed the research performance of this set of countries over a longer period to be able to identify significant trends in the development of the Czech Republic in this international context.

#### **Overall benchmarking**

The comparison with the benchmarking countries makes it clear that the Czech Republic still has a long way to go. In the period 1993-2009, the Czech Republic's output was among the smallest and of a similar volume to those in Hungary and Slovenia. The number of citations received was small. Only Slovenia received fewer citations than the Czech Republic.

With respect to normalised 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 tended to publish in journals with somewhat higher impact factors in the field to which the journals belong. Countries with high impact scores were Finland, Sweden, Denmark, and the Netherlands (with impact levels of 19%, 20%, 27%, and 30% above worldwide average field impact level, respectively).

#### **Trends in outputs & impacts**

The development of the Czech Republic is comparable to that of Hungary and Slovenia. However, 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.

It is important to stress that the growth in *output development* was more marked for the Czech Republic than for the other benchmark countries, thereby bridging the gap. Also in terms of impact we observe an upwards trend for the Czech Republic, albeit not as pronounced as for the volume of production.

- When we look at the *productivity of researchers* in the Czech Republic, we clearly observe a positive trend. When we compare the full period 1993-2009 with the most recent period 2005 - 2009, the researchers in the Czech Republic are now catching up strongly, together with their colleagues in Hungary and Slovenia. The improvement in output per inhabitant increased by roughly 50% for the researchers in these three countries.
- When we compare the impact development over the two periods, we find an even more important development, namely an increase of the Czech impact of nearly 25%, making this the strongest increase observed among all benchmarking countries

### **Research fields**

The analysis of the research fields across the set of benchmark countries clearly shows the growing strength of the Czech Republic. The country is more active in number of fields traditionally belonging to its 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. This is partially due to the fact that the Scandinavian countries and the Netherlands have been moving towards an Anglo-Saxon research profile for a longer period of time, i.e. a profile in which biomedicine takes a more prominent position compared to more classical European continental research profile.

There have been improvements in impacts in many fields. The most striking is the strong increase in the impact of social scientists from the Czech republic, a clear sign that these researchers are catching up with international performance levels. This also indicates that the positive changes in research performance of the Czech Republic's science system are not limited to the natural, life and medical sciences, but are occurring across the whole system.

### 3. Governance and Management of the Research System

This Chapter discusses the history of the R&D&I system in the Czech republic since about 1990 and describes the pattern of reform and policy interventions since then as well as the current R&D&I governance structure and administration.

The full analysis is reported in Annex 1, Appendix C to this report.

#### 3.1 Historical background

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.

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.

In the beginning of the 1990s, major transition problems in the R&D&I system, which were results of the Communist period, 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

The broad lines of the response to the transition and modernisation challenges over the past two decades 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 (and it includes not only money targeted at individual priorities but also the kind of ‘response mode’ or ‘bottom up’ funding typically provided by research councils in W Europe). In most systems throughout the world, 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 funding on the one hand and research councils on the other.

Another major change in the R&D&I policy was the increasing focus towards **innovation and applied research**, stressing the importance of research for economic development. Targeted funding has been increasingly used 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.

The wish to have an improved steering and quality control of the research activities led therefore to a **shift in funding focus**, from a preference for institutional funding in the 1990s and beginning of the 2000s to a budget allocation in the favour of targeted funding in 2012. The 2012 budget also foresees a considerable change in the distribution of institutional funding, continuing the evolution over the last decade that saw the overall institutional funding of Academy institutes decrease and the one for Higher Education increase. Finally, a constant increase in the share of targeted funding allocated to the Ministry of Industry and Trade can be noted.

Despite the various policy efforts, some key systemic failures identified in the beginning of the 2000s were perceived as persistent

- *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),
- Shortcomings in *R&D&I support management*, at all levels

The 2008 Reform Plan, partially implemented through the National Policy of R&D&I in the Czech Republic for 2009–2015, tackled these failures through a mix of systemic and programmatic interventions:

1. Systemic interventions, aiming at an improved co-ordination and integration of the research and innovation system. These included a profound structural coordination of the R&D&I governance system; measures aiming at a structural integration of research and innovation; an improved co-ordination of the R&D&I policies and their linkages with other policies; and the coordination of R&D&I support planning and management. 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
2. Programmatic interventions, foreseeing the creation of a policy-mix supporting the stimulation of collaboration in R&D&I; a policy-mix specifically focused on support to innovation; support to international collaboration in R&D&I; support for capacity building; and the creation of an environment stimulating innovation in the Czech Republic

### 3.2 The R&D&I Governance Structure in 2012

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. It is envisaged that it will operate as a virtual science ministry, coordinating R&D&I Policies top-down and having a strong say in budgeting.

In principle, the Republic has therefore made significant progress in governance through establishing the Council as 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.

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.

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

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 currently more budget chapters remaining than was intended by the reformers.

Over time it will also be necessary to establish clearer principal-agent relations between the ministries and the Technology Agency.

Currently, the Technology Agency fulfils a double role: on the one hand, it acts as a *multi-principal* intermediate research funder (similar to the Research Council of Norway), acting as an intermediary for the seven ministries with competence for R&D&I. It takes 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” – a concept that is rather vague. 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 acts as a *mono-principal intermediary*, working for a single policy-making organisation, i.e. the R&D&I Council, without the benefit of the type of connection to societal needs or strategic intelligence that is normally found in ministries.

### 3.3 The Administration of R&D&I Targeted Support

Literature tells us that there is a need for logical consistency across the programme cycle, to maximise the chances that interventions reach their objectives. Programme design should incorporate explicit links to higher-level policy. Assessment criteria to be used in project selection should be firmly and explicitly anchored in the programme logic; and performance indicators need to be quality assured and to derive from the programme logic. 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.

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 also 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.

## 4. Research Evaluation and Resource Allocation

In line with the Terms of Reference for the Audit and our study proposal, the objective of this work package is to assess the 2004 Guidelines for Evaluating R&D results. 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, the 2010 Methodology was approved and we were able briefly, but not fully, to analyse it.<sup>7</sup> Our current analysis is therefore based on an in-depth analysis of the Evaluation Methodologies 2004 and 2009 and a preliminary analysis of the 2010 Methodology. We also started the comparison with evaluation systems and practices in other countries, covering in this first phase the UK, France and the Netherlands.<sup>8</sup> In the next report, we will focus on collecting more empirical evidence to underpin our observations.

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.

The full analysis is reproduced in Annex 1, Appendix D to this report.

### 4.1 The Evaluation Methodology

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

- **The double role of the evaluation methodology.**

The 2004 Methodology introduced the concept of a metrics-based quantitative results evaluation. This was seen as a tool – and only **one** of the main criteria – for improving 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 changing scope of the evaluation guidelines.**

The 2004 Methodology broadly outlined 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.

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<sup>7</sup> 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.

<sup>8</sup> The Netherlands developed the Standaard Evaluation Protocol (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.

- **A substantial restriction in the scope of the envisaged evaluations.**

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 almost unique. While the UK RAE relies on a number of qualitative and 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 directly formative in style but UK researchers 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 assessments 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 outputs. 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 system. 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 with the Evaluation Methodology, which are valid across both its roles (evaluation and funding) 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 sufficiently taken into account
  - Different types of results are not equally important for different disciplines and for different modes of performing research
  - The probability of them 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 in the Czech republic 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.

#### 4.2 Performance-based Research Funding Systems (PRFS)

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<sup>9</sup>.

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

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<sup>9</sup> 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

- 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 abandoning the concept of 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. However, 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 provoke a reduction of institutional funding of scientific fields such as *Bioscience*, *Agricultural Sciences* and *Informatics & Computer Science*. Most importantly, negative impacts can be envisaged on the funding of research areas 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. These include *Computer Applications and Robotics*, *Informatics and Computer Science*, several fields in the *Agricultural Sciences*, and *Genetics and Molecular Biology*.

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. The significant impact of the Norwegian system on researcher behaviour – despite the fact that it can at the limit reallocate no more than 2% of university income – shows the importance of signalling effects and the power of these types of system to cause changed behaviour without structural upheaval.

Based on international experience of **indicator**-based funding systems, it is easy to agree with van Raan’s observation<sup>10</sup> 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.

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<sup>10</sup> Anthony FJ van Raan, “Fatal attraction: Conceptual and methodological problems in the ranking of universities by bibliometric methods,” *Scientometrics*, 62 (1), 2005, 133-143

There is a clear need for indicator-based allocation systems to be ‘damped’ *through the use of indicators other than research output.*

An EU expert group recently reviewed practices for assessing university-based research across thirteen different countries, mostly in Europe<sup>11</sup>. 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

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

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<sup>11</sup> Expert Group on Assessment of University-Based Research, *Assessing Europe’s University-Based Research*, DTD.C4, EUR 24187 EN, Brussels: European Commission, 2008

- Do not use solely indicator-based approaches but combine these with other allocation principles

## 5. Preliminary Conclusions and Recommendations

This report is the first interim output of a very substantial audit of the Czech research system. Its purpose is to give an initial indication of our findings, conclusions and recommendations so that Czech policymakers and researchers are aware of the direction in which we are working and in order to enable discussion and feedback. This should be valuable both for the research policy debate in the Czech Republic and in order to help fine-tune our work going forward. With the bulk of our work still ahead of us, it is important to emphasise that the conclusions and recommendations presented here are at least subject to refinement and may in some cases be significantly altered in the light of future work.

One point, however, is already rather clear and needs urgently to be tackled: namely, that while the research assessment exercise for 2010 (which is intended to affect the allocation of up to two thirds of the institutional funding of research performers from 2011) has the valid intention of reallocating resources towards those who perform the best, its implementation in the present form involves major risks to the research system. Both the scope and the method need significantly to be refined if the Republic is not to take the chance of unintentionally damaging significant and high-quality research resources.

A second, slightly less urgent but nonetheless important issue is the need to establish ex post evaluation processes at least at the level of programmes (and preferably also at the level of policies and institutions) that enable policymakers to make judgements about the efficiency of their interventions. The present practice of counting outputs does not address this question.

### 5.1 Overview of the Key Findings

#### 5.1.1 R&D inputs and outputs

On the input side, despite the difficulties of transition, the Czech research and innovation system has produced significant achievements in the past decade. Key among these is a tripling of absolute expenditures on R&D at the national level – an especially significant achievement in a period of low inflation. The Czech Republic has thereby attained one of the highest rates of increase in R&D intensity in Europe against a background of considerable growth in the economy.

Despite the good level of business R&D, there are also statistical signals to support qualitative indications that science-industry links may be weaker than is desirable. For example, industry funds a comparatively small share of university research. The proportion of the national effort devoted to basic research has apparently been rising and that to applied research has been falling. Classifying research in this way is notoriously difficult and it is often possible to relabel research. But if the statistical observation is valid, it does not bode well for such links. And there is a gap between the engineering focus of business R&D and the natural sciences focus of research in the government sector, even if the universities are to some extent expanding to fill this. Here we need to understand whether this is a useful complementarity or whether it causes bottlenecks, such as skill shortages in the areas of importance to industry.

As regards the outputs of R&D our work so far focuses on academic results in the form of publications, so our picture is incomplete. Nonetheless, the bibliometric evidence shows that there has been a dramatic recovery in scientific productivity since the transition and that the quality of the output has risen – especially over the last decade – towards the worldwide average level. While it is clearly

desirable to raise output and quality further, these achievements are themselves remarkable. As in other countries, Czech researchers are increasingly co-publishing with international partners, indicating their growing integration into the world research communities, but they are also co-publishing more with people from other national institutions, suggesting greater cohesion of the national research effort. The focus of the effort is shifting with medicine and the life sciences playing a greater part. (This may be a further indicator of the misalignment between state and industrial fields of research.)

Comparing Czech research output and quality with that of other small economies, its performance remains largely similar to that of countries like Hungary and Slovenia, although it is improving more rapidly. There remains considerable distance to go before Czech Republic could contemplate approaching the levels of the leading small countries such as Finland, Sweden or the Netherlands.

Both the input and the output pictures therefore show significant improvements since the transition, but neither offers grounds for complacency if the national objective is to establish the kind of research and innovation system that would be needed for the Czech Republic today to rank as one of the leading small countries in industry, technology and science. Continued efforts to increase the amount and quality of both R&D inputs and outputs are therefore fully justified.

#### *5.1.2 Governance and management of the research system*

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

Another major change in the R&D&I policy was the increasing focus towards innovation and applied research, stressing the importance of research for economic development. Targeted funding has been increasingly used to create incentives for better research-industry links and to foster innovation. This implied a shift in funding focus in the last decades in the favour of targeted funding, a constant increase in the share of targeted funding allocated to the Ministry of Industry and Trade, and over the last decade an ongoing trend to decrease the overall institutional funding of Academy institutes and increase the one for Higher Education institutions. Despite these various policy efforts, some key systemic failures identified in the beginning of the 2000s were perceived as persistent (R&D capacity building, the unsatisfactory science-industry and intra-research collaboration, and shortcomings in R&D&I support management).

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. The Republic has made significant progress in governance through an improved coordination and integration, even though there are still some issues to be settled and specific roles to be clarified. Inevitably in a system in rapid transition, there are gaps between intention and execution.

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. That is, those concerned need the analytic skills and resources to develop the basis of well-panned, evidence-based

policies and programmes. At this stage of our analysis, it is clear that the evaluation component of these capacities is largely 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. Without this component of strategic intelligence, there is no feedback loop: policymakers simply do not know what the results of their interventions have been and - most importantly - which factors enabled or hindered the success of their policy interventions and programmes, to be taken into account in future actions.

### *5.1.3 Research evaluation and resource allocation*

Evaluation Guidelines for research assessment were issued in 2004, which identified that the research funding system over-focused on ex ante evaluation and failed to make sufficient use of ex post evaluation to provide a feedback loop that would enable learning and performance improvement by researchers and policymakers alike. The document stressed the need for qualitative as well as quantitative evaluation and to involve the international community. In many respects, it amounted to a statement of international good practice.

However, across successive versions up to 2009, the Guidelines have become focused on using ex-post quantitative indicators to (re)allocate institutional funding among research performers. In principle this allocation of resources takes place at the level of the budgets of ministries and the Academy, leaving these organisations free to use other evaluation systems to allocate the budgets obtained. While the Academy has chosen to do so, others have not – presumably because the use of any other evaluation system to allocate resources would risk favouring entities deemed under the current Evaluation Guidelines to be poor performers, leading to a vicious circle of declining scores and reducing resources.

Interview evidence suggests that while the research community strongly appreciates the need for indicators and incentives that favour the generation of high-quality outputs, it objects strongly and with good reasons to the current Guidelines, which it broadly regards not only as unfair but as failing to take account of differences in modes of research production and as promoting perverse behaviours and as likely to lead to unintended consequences in the form of interrupted funding to good as well as poor performers.

Comparison with other research assessment systems internationally shows that these are more broadly based, contain formative as well as summative elements, consider prospective as well as retrospective aspects of performance, deal with longer time periods (the Czech system operates at intervals of one year) and rely on a mix of qualitative and quantitative indicators with an element of peer or expert judgement. Attempts to move towards a more strongly indicators-based approach in the UK have been piloted and rejected in the UK on the grounds that they produce inadequate descriptions of performance.

It is intended that the Evaluation Guidelines for 2010 shall be used to allocate up to two thirds of institutional funding in 2011. Our conclusion is that this would be premature and risky, because these guidelines provide an account of performance that is inadequate while failing to take on board key parameters needed to make funding allocation decisions. Major objections to the method as currently proposed include

- It is inconsistent with the time constants involved in R&D, which are multi-annual not annual
- Because it considers a rolling five-year period in the past, the cut-over to the new funding system in three years means there is no time for the system to react and improve performance – the outcome of the change of system is already predetermined to a large extent, so it rewards and punishes researchers but does not help them improve

- While it takes account of journal rankings within different fields, in relation to impact-factor journals (where outputs dominate the allocation of resources) it is not field-specific in the sense of taking account of crucial differences among fields, such as the propensity to publish (the best scientists in some fields publish many times as many articles as the best scientists in other disciplines)
- It encourages 'gaming' the system – creating behaviour aimed at maximising the value of the indicators rather than the value of the performance
- It takes no account of outcomes or impacts, focusing solely on outputs
- It lacks 'esteem' indicators (eg memberships of key panels or journal editorial committees) that provide feedback about how researchers are perceived by their scientific communities
- It employs innovation output indicators whose relationship to the innovation process is unsystematic, are easily manipulated and whose importance varies among fields
- It systematically discriminates against non-ISI indexed fields, primarily in the arts, humanities and parts of the social sciences
- It lacks information about inputs and therefore cannot discriminate on the basis of efficiency

## 5.2 Recommendations

It would be premature at this preliminary stage to make many definite recommendations. We confine ourselves to two: the first because it involves a clear and present danger to the health of the R&D&I system in the Czech Republic; the second because it addresses a clear deficit that impedes good policymaking.

It is a cliché, but it is nonetheless true, that research capacity takes many years to establish but can be destroyed overnight. Large changes in research funding priorities can therefore lead to disproportionately large and disruptive changes (losses) in research capacity. Our analysis clearly identifies that the radical change in the funding system intended can have such effects. The simulation so far done suggests that some of the fields most disadvantaged by the change in system are those that have high priority in national policy. The relationship between the results of the Evaluation Methodology and the results of other, more conventional methods of evaluation is as yet unknown.

Here, as is often done elsewhere in tackling changes whose effects are uncertain, we think it is wise to adopt the **precautionary principle**. Thus, while the current allocation of resources is no doubt flawed, it is an accomplished fact with which the research performing institutions have been able to live. Moving from this via the Evaluation Methodology to what would almost certainly be another sub-optimum is likely to do damage. The right thing to do is to stop and think before making another leap. The UK system has recently done precisely that, delaying the Research Assessment Exercise by a year in order to learn the lessons of the failed pilot of a more indicators-based approach.

**Recommendation 1. The implementation of the Research Evaluation Guidelines linked to reallocation of up to two thirds of institutional funding appears to represent a significant risk to the health of the R&D&I system. It should not be used in its present form. It is better to do nothing at this point than to use a tool that seems likely to do damage. It should be replaced by a more nuanced and robust system, whose likely effects are better understood. The existing division of institutional resources should therefore continue to apply for an**

**additional year, until such time as a more robust system can be implemented.**

Our second recommendation is simpler. The corollary of the shift in evaluation emphasis towards counting outputs is that the opportunity provided by evaluation to understand the relationship between the diagnosis of problems and the goals implicit in a state programme on the one hand and the achievement of the goals and the solution of the problem on the other has been missed. In most cases relevant to research and innovation, producing outputs is only the first (and often the least important) part of the journey towards reaching policy goals. It is that overall journey that needs to be evaluated.

**Recommendation 2. Ex-post evaluation capacities and practices should be introduced in connection with the funding of R&D&I policies, institutions and programmes. These should depend upon evaluation conducted by people external to the funding bodies involved and should in many cases include an international dimension.**

In Brighton, 14/09/2010



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