

**Evaluation of the Technopolis Final Report
within the framework of the project
„International audit of R&D&I in the Czech Republic”**

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INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Evaluation of the Technopolis Final Report within the framework of the project „International audit of R&D&I in the Czech Republic”

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1. Default documents

This evaluation was made upon request by the “International Audit of Research, Development and Innovation in the Czech Republic” main vocational guarantee, prof. Jitka Moravcova. To write this evaluation I received the following documents.

- 1) International Audit of Research, Development and Innovation in the Czech Republic, Synthesis Report, Version 1, 19 august 2011 (delivered 22. 8. 2011)
- 2) Annex 1 to the Final Report: Assessment of Public R&D Expenditures in the Czech Republic,
- 3) Annex 2 to the Final Report: R&D Governance in the Czech Republic,
- 4) Annex 3 to the Final Report: The Duality of Research, Institutional Funding and Research Evaluation in the Czech Republic and Abroad,
- 5) Annex 4 to the Final Report: Review of the IPR System,
- 6) Annex 5 to the Final Report: Science-Industry Linkages,
- 7) Annex 6a to the Final Report: International Co-operation in R&D,
- 8) Annex 6b to the Final Report: International Co-operation in R&D: Bibliometric Analysis,
- 9) Annex 7 to the Final Report: Human Resources in R&D,
- 10) The part of annex 1 of contract between MEYS and Technopolis, which is about content of interim reports and final report – chapter 2.1.1., bullets a)-i)-ii)-iii), b)-i)-ii)-iii), c), d)-i)-ii)-iii), e), f) i)-ii)-iii)-iv)-v)-vi), g), h), relevant for elaborating.

2. Characteristics of the structure and content of the report

The report is a follow-up to the first and the second interim report and adds/completes analyses and conclusions that were not a part thereof or were only included in their interim versions. It concludes the International Audit of Research, Development and Innovation in the CR. It consists of seven chapters, the first being an introduction and the seventh containing conclusions and recommendations, plus eight annexes (Annex 1 to 5, 6a, 6b, 7). The total extent of the report with its annexes is approximately 920 pages. It is an extraordinary analytical work, impressive not only in its range, but also in its thematic scope (it comprehensively addresses the most important aspects of the organization and management of research and development in the Czech Republic) and the depth of insight into many of its issues (particularly the issue of financing in the international context, problems of the organization and management of research and development at the government level, the issue of evaluation of R&D in the CR, methodology for evaluating the R&D results). Therefore, it represents a study of the current Czech national research and innovation system (including its historical contexts, dating back to 1989 or to the previous period), unique in its comprehensiveness, breadth of the covered issues and integrity. Although some sub-topics relating to the R & D system in the CR, including the analysis of data on research funding and results, cover the matters already published (see, for example, footnote 1), about which the academic and scientific community is regularly informed, the issue has not yet been addressed in such a comprehensive and coherent document as the reviewed report and its annexes.

The aim of the project, however, is to audit the Czech research and innovation system, which is part of the study. In the essential respects, the results of analyses performed by a professional auditor lead to the same conclusions (whether explicitly stated in the report, or contained therein in an implicit form) which result, without being explicitly formulated as such, though, both from the annual

funding and performance analyses of institutions processed by the Research, Development and Innovation Council and published by the Office of the Government¹, and from interdepartmental comment procedures on various strategic and legislative documents, or from materials published by the institutions².

Although the structure of the summary report (the order and content of chapters) has its own internal logic, unfortunately, it does not follow the structure of the audit assignment (see a similar comment in my review of the second interim report). Each specific requirement of the audit assignment is directed to obtain specific answers, conclusions and recommendations on specific issues relating to the organization of research, development and innovation in the country. For the purposes of using the report as a basis for an adjustment or for a new concept of R&D&I organization in the CR, it would be much more instructive to approach it not as a general study, in which answers to the specific question in the specification of the assignment need to be found in various chapters, but as a set of straight sections corresponding to the structure of the specification, despite the fact that the content of some parts of the assignment naturally overlaps.

Unlike the second interim report, the formulation of the audit exercise specification is much better reflected in a very valuable set of highly informative annexes, whose natural feature, however, is their extensiveness. In terms of operational orientation in the evaluations, conclusions and recommendations, therefore, the Annexes cannot completely compensate for the above-described conceptual lack of the main report. Actually, it would be desirable for the main report to be a summary of findings, reasoning, conclusions and recommendations from the Annexes, not another independent study, even less specific than the Annexes. Thus, it should be noted that to obtain relevant information about the conclusions on each section in the assignment specification, the annexes are key in this situation.

In the text following right below, I characterize the distribution of answers to questions in the audit assignment into various chapters of the report and its annexes, while in the subsequent paragraphs I pay systematic attention to the contents of each chapter of the report and the annexes. Each requirement of the audit assignment is more or less successfully addressed in the following chapters or sections and annexes:

- The issues of sections a)-i)-ii)-iii) in the assignment specification are dispersed in Chapters 3 and 4 of the summary report which, on the level of the basic statement of facts, deal with the funding of research and development in the country. The conclusions do not have the character of explicit recommendations; they can be deduced from some parts of the text, in which they are included by default. Sections a)-i)-ii) (except for the issue of financial impact of OP RDI projects, which is not mentioned in the summary report at all - in Annex 1, the OP RDI is mentioned in a different context on page 14, but not in relation to the financial impacts) are

¹ Analysis of the situation in research, development and innovation in the Czech Republic and its comparison with foreign countries.

² For example, the report criticizes the shortcomings of the Methodology of evaluating R&D results, which were in vain pointed out, using almost the same formulations, in interdepartmental comment procedures to the Methodology, in analyses carried out by institutions, whether for the purposes of the comment procedures or publication in the scientific community. (Specific examples and the link http://cms.jcmf.cz/osov/odborne_akce.html were provided in the review of the second monitoring report.)

detailed in the comprehensive analytical Annex 1. Some results from Annex 1 are transferred to Chapter 3. The issue of institutional financing in connection with questions of evaluation, review of the Methodology of evaluating R&D results in the CR and the results of case studies from abroad (Netherlands, Great Britain, Finland, Austria), is also addressed in Annex 3, however, focusing primarily on the Methodology of R&D evaluation in the CR, which is viewed highly critically. Funding is also dealt with in Annex 2 (pages 63 to 69), from which some charts and text passages are reproduced in Chapter 3. Thus, information about the very precisely and consistently formulated subsections a)-i)-ii)-iii) of the assignment specification, must be sought for in the mix of two chapters in the main report and three appendices. This represents considerable discomfort both in the actual reading, and especially in shaping the overall view of the issues of funding and when formulating conclusions. Questions raised in section a)-iii) are answered in part - support diversification in various fields is dealt with in Annex 1, questions relating to critical quantities are not satisfactorily answered, unfortunately, in any part of the report. The last sub-question in section a)-ii) - the financial impact of OP RDI projects – is not answered, either.

- Sections b)-i)-ii)-iii) and c) are discussed in Chapter 6 of the main (summary) report and Annex 2. Compared to the version attached to the second interim report, this annex is almost unchanged. Changes include data updates resulting from the development in the interim between the second and the final report, and a different order or titles of the paragraphs. By estimate, 90% of the text remains unchanged compared to the version of February 2011. I have already evaluated Annex 2 in my review of the second interim report as a high quality analytical paper, so I only briefly recapitulate here: Chapter 6, together with Annex 2, gives a detailed description of the organization of research and development in the CR and a robust analysis of its pros and cons in the light of international experience. In addition, it contains very important conclusions concerning the issues of evaluation, which complements the requirements of section d)-i) of the assignment specification. Compared to the corresponding text in the second report, it also assesses the function of the Technology Agency of the CR (Technology Agency) and the Science Foundation of the CR (Science Foundation) and their position in R&D&I system.
- Sections d)-i)-ii) are mentioned in paragraph 6.2 of the summary report, weaknesses of Methodology of evaluating R&D results, succinctly formulated in the previous reports in the Annex 3 of the final report, are summarized at a general level here, unhighlighted, as part of a continuous text. The methodology of evaluating R&D results, however, is very closely (due to the elaboration of this issue in the first and the second interim report, maybe even too much) addressed in Annex 3. Yet this time the context with the R&D system as a whole, especially with financing, is obvious, as well as comparison with the methods of evaluation in scientifically developed European countries (Netherlands, Great Britain, Finland, Austria). In addition, the annex contains the results of a survey collecting views of the scientific community on the Methodology.
- Protection of intellectual property rights, i.e. section d)-iii), is dealt with in very short paragraph 5.5 (1½ pages), but it is elaborated in detail in Annex 4.
- A similar structure can be observed in section e) (relationship between the research and the application area) – a one-page paragraph 5.4 in the summary report and Annex 5, in section f) (Human Resources) - paragraph 5.6 in the summary report and Annex 7. The issues of international cooperation in R&D, the processing of which is required by section g) of the audit assignment specification, is dealt with in paragraph 5.3 of the summary report and Annex 6a (general), Annex 6b (based on a bibliometric analysis).

- The issues (in my opinion, absolutely crucial) from section h) of the audit assignment specification are addressed in Chapter 3 and section 4.3 of the summary report. Some relevant information can be found in Annex.

More detailed comments on some partial aspects of the report are presented in the following paragraphs. Like in the previous opinions, I have to point out that, given the scope of the report (approx. 920 pages including the annexes), the period of two weeks (from 22 August to 6 September 2011, when all parts of the report were finally available) is clearly insufficient for processing a qualified opinion, I would consider six weeks as a standard term. Therefore, I commented in a greater detail, in particular, those parts of the report that are directly related to the explicitly specification of the audit assignment and which I consider to be crucial for the audit. These include Chapters 3 and 6 of the summary report and Annex 1, Annex 2, Annex 3, Annex 6a Annex 6b; please note that I commented the almost unchanged Annex 2 in my review of the second interim report - that's why I comment only its summary here (Executive Summary). I have not reviewed the issues of intellectual property rights protection (Intellectual Property Rights System) in Annex 4, which is not my expertise, I have not commented on Annex 5 and Annex 7 due to time constraints, to which I have essentially no comments.

3. Evaluation of the thematic areas (chapters) of the report

3.1. Chapter 1 - Introduction

With reference to the specification of the audit assignment, this chapter lists the topics contained therein. These topics, unfortunately, do not correspond either to the structure of chapters, or to the sections of assignment specification (in some themes, several sections of the assignment specification overlap - see above). A somewhat unnecessarily cautious impression is caused by the opening sentences on page 1³, which indicate the report's conclusions may not be quite specific at times. Further, the chapter mentions the position of the CR among 139 countries evaluated in the paper The World Economic Forum's Global Competitiveness Report (2010-2011) using various aspects of research, development and innovation, including the educational component. It points out (predictably) the fact that the CR is well positioned in this list with regard to the area of research and education, and (also predictably) the wrong position of the CR in terms of aspect evaluation at the institutional (government) level.

3.2. Chapter 2 - Perspectives on Innovation Systems

The chapter is undoubtedly well-founded in terms of expertise, but from the perspective of audit assignment requirements, it is a quite general and rather "extra added" (and from this viewpoint also too extensive - 20 of the total 70 pages of the report) review of issues related to innovation and the innovation system as such. Its inclusion in the report is indeed justified in the text by the fact that the

³ „There are large differences between different national contexts, so it would be foolish to offer a unique example as ‘best practice’. What works in one place may not work in another.“ ... (p. 1)

basic concepts formulated in the chapter are used for audit purposes⁴; however, it relates only to innovation to a significant extent, and is not directly applied in a major part of the report and the annexes. It describes the evolution of the concept of innovation in its historical context; general schemes that are available in the literature, such as the organizational structure model for the policy of research, development and innovation, etc. It does not fit into the logical structure of the report on the specifically assigned and implemented audit and, essentially, even should not be a part of it, although it results in a list of general criteria on which the audit should be (and apparently was) based. These criteria are so universal and generally acceptable that it was enough just to list them. The previous "criticism" somewhat does not apply to section 2.7 Functions of R&D Councils, based on the authors' own study⁵ and dealing with the issue of panels which play the role of policy-making, coordination, or advisory bodies for research and development – an analogy in the CR is the Research, Development and Innovation Council).

Examples of minor errors and ambiguities:

- On page 5, missing footnote references.
- The formulation of the page 6 concerning the definition of NRIS: "As a result, we developed the very wide definition employed in this Audit as a system of interconnected organisations or core actors and wider framework conditions within which societies create, store and transfer the knowledge, skills and artefacts that contribute to innovations (Figure 1)." The importance of such a general and broad definition for the audit itself, i.e. for answers to the questions raised in the assignment specification, is not justified.

3.3. Chapter 3 – Reforms in Czech R&D&I Funding and Governance

The aim of Chapter 3 should probably be answering the key questions raised in section h) of the audit assignment specification in:

h) Compare the current management and governance system in the R&D&I area in the CR with the principles of the *Reform of the R&D&I system in the CR, the Methodology for evaluation of R&D results and the National R&D Policy in the CR for the years 2009-2015*. The result should be the finding of whether these strategic documents define the changes that will work in the desired direction.

⁴ „The purpose of his Chapter is to set out the main concepts we use in the report ...” (p. 3).

⁵ E. Arnold, G. Hutschenreiter, Chile's National Innovation Council for Competitiveness: Interim Assessment and Outlook, Paris. OECD, 2009.

This chapter briefly comments on the history of the R&D governance system in the CR since 1990. It summarizes the principles of the Reform, however, it does not evaluate them in terms of their importance and relevance to the real reform of research, development and innovation in the CR which would bring the CR closer to the European or global standard. At this point, it does not comment on the Methodology of evaluating R&D results and the National R&D&I Policy in the CR for the years 2009-2015, either. Comparing the planned steps of the Reform with the real conditions of the R&D&I governance system in the CR and "the finding of whether these strategic documents define changes that will work in the desired direction" remains overall at a general level. Detailed reading of the text and especially the annexes can still "reveal" some conclusions contained in the report in an implicit form (see also below).

More specifically, and giving some figures, the report focuses on the situation in R&D funding from the state budget. It is based on extensive and – except for certain inconsistency in terminology, data, and the legend of the charts - expertly prepared Annex 1:

- In terms of an institutional funding perspective, a key (although inaccurate) statement is that the ratio of 60%: 40% between project and institutional R&D funding from the state budget planned by the Reform has been achieved and it is not appropriate to further increase this ratio in favour of project funding - see Annex 1, p. 8⁶, as well as Annex 2 on page 7 (why so many times in different places?). The ratio of project and institutional funding from the state budget, according to charts in Figure 9 and Figure 10 on page 30, has developed as follows: 46% : 54% (2004), 43% : 57% (2008), 54% : 46% (2012 estimate)^{7, 8}. Comparing with the situation in "benchmark" European countries (targeted support from government budgets (GBAORD) is 31% in Austria, 31% in France incl. CNRS, 24% in Italy, 33% in the Netherlands, 42% in Norway, 28% in Switzerland - see Annex 1, Table 4 on page 34), along with the recommendation not to increase the ratio in favour of targeted funding, can be considered as the evaluation of the requirement in the Reform (60%: 40%) as strategically wrong.
- As a serious fact indicative of the improper setup of the R&D&I organization governance system in the Republic (albeit in the very carefully worded report, again, this inaccuracy is not mentioned explicitly⁹) can be considered the direct warning of the auditors concerning the ratio of institutional and targeted funding of research and development in tertiary education institutions (HERD) from the state budget in comparison to international standards (institutional HERD support in the CR is 60%, about 95% in Germany, 90% in Austria, 80% in the Netherlands, 75% in Switzerland - see Figure 13 on page 33 of the Report, and Figure 18 on page 40 of Annex 1).

⁶ „...the ratio of project funding versus institutional funding is already high in international comparison. ... we see no need to further expand its share on cost of institutional funding.“ ... (Annex 1, p. 8)

⁷ On p. 32 under the table Figure 11, the text mistakenly reads „Czech government research funding involves a comparatively high proportion of project based funding – 46% state spending on research (GBAORD) is allocated in this way...“. This has been probably adopted from Annex 1 (p. 33) where, however, it relates to 2008.

⁸ It should be added that "optically" this ratio (46% IS : 54% TS) seems more favourable for institutional funding than the actual ratio of direct institutional and targeted support to research organizations, because the 46 percent of total institutional R&D support from the state budget include approximately 10% of the funds for international cooperation).

⁹ „The portion of institutional funding to Czech universities is towards the lower end of the range, internationally.“ ... (p. 32).

- To a certain extent in contradiction with the above statements (see the figures and footnote 9) is the somewhat ambiguous and unspecific text on page 29, concerning the allocation of institutional R & D funds from the state budget between the universities and the Academy of Sciences, referring to future discussions on the roles of the Academy and the universities¹⁰. The ASCR has a materially clearly defined and strong position in the R&D&I system alongside universities and the report should express a clear opinion on this as well as on the issue of funding.
- An important conclusion can be made based on the note on page 33 concerning the inappropriateness of the proposed 100% allocation of institutional funds based on the PBRF (Performance-Based Research Funding System), i.e. based on the quantitative evaluation of outcomes (Methodology for evaluating R&D results)¹¹
- The report also rightly points to the extremely low share of the industrial sector in R&D funding at universities (0.7% of the total R&D support at universities come from industry, i.e. ten times less than in the EU-27 – see page 33 of the report, Figure 16 on page 37 in Annex 1). With the finding of a growing share of the Ministry of Industry and Trade in the targeted R&D support from the state budget (CZK 4.28 billion estimated for 2012, i.e. 32% of all targeted R&D support from the state budget) and the strong criticism of the MIT's TIP programme in the annex (Annex 1, p. 13 and 14¹²), a conclusion (again, implicit) is thus made that the desired cooperation between research institutions and the industrial sector, proposed in the Reform (section 4 on page 26 reports), does not work. Although on page 29, the report notes that the science-industry relationship has its limitations, it attributes that, in my opinion, not entirely correctly, to the inaccurate definition of applied research, slightly different from the definition in the Frascati manual¹³. The causes are undoubtedly deeper (let me re-emphasize the references to "overfinancing" of the MIT as a provider of targeted support and criticism of the TIP programme).

The text of the chapter contains inconsistencies and ambiguities, of which I will mention, for example, the following:

- The charts in Figure 7 and Figure 8 represent a time series of two different breakdowns of the same – the total R&D expenditure from the state budget of the CR: Chart 7 presents the breakdown by providers, while Chart 8 the structure the type of support. The time course of total funds must be the same in the period common to both the charts. In Chart 7, however, the total amount of the grants exceeds the amount of CZK 25 billion in 2011, while in Chart 8 it falls short of this amount. A similar discrepancy can be observed for 2009. The charts were apparently adopted from various sources without checking.

¹⁰ „...a situation in 2012, where the institutes of Academy will get – at best – half as much budget as the Higher Education Institutions. In the light of the need to strengthen the university sector, this is probably a sensible outcome – but it is one that does not seem to be part of official policy. Over the longer term, this needs to become an explicit discussion, as part of a wider debate about the respective roles of the Academy and the universities.“ ... (p. 29)

¹¹ „When we take into account the intention to make the Czech PBRF allocate 100% of institutional funding, we can see that the balance among forces promoting quality, stability and restructuring has been lost, in turn undermining the ability of the system to respond to industrial and other societal signals.“ ... (p. 33)

¹² „The TIP programme of the Ministry of Industry and Trade does not provide sufficient incentives for science-industry collaborations...“, „...the programme portfolio of the Czech Science Foundation and TIP, which should be substituted by a more advanced programme...“ ... (Annex 1, pp.13, 14)

¹³ „Applied research is defined more narrowly than in the Frascati manual. ... Arguably, this is an important barrier to improved science-industry links.“ ... (p. 29)

- I miss factual substantiation for claims on page 26: "Apparent failure of policy measures: neither the research planning process for institutional funding ('research intentions') nor the evaluation process for 'targeted' (competitive, project-based) funding was seen as successful." A critical attitude to research projects appears in other parts of the report (Annex 1), but I found no factual justification for such criticism.

3.4. Chapter 4 – Structure of the Czech NRIS

A very brief chapter (6 pages) is a description of the National Research and Innovation System in the CR (National Research and Innovation System - NRIS). It has an informative but not evaluating nature; in essence, it does not address any specific point in the audit assignment (with the exception of section 4.3 - see below). As to the brief description of the system's historical development, one cannot agree with the assessment of the role of universities and the Academy of Sciences as almost disjoint¹⁴ in the period before 1989. This trivial classification, appearing in the Annexes to the report as well, is a highly misleading simplification. The role of teachers at universities was twofold in the communist period, too - to teach and work scientifically. This can be demonstrated by many examples showing that very solid science was carried out in many areas at universities in Czechoslovakia, whose results were published in international journals and at international conferences and are registered in the WoS, although the structure of the publishing media used was somewhat different (but the same was true for the Academy). In addition, applied research was conducted, collaboration between universities and the Academy had already existed, often in an intensive form: the Masaryk University (then University J. E. Purkyne) and the AS Institute of the Properties of Metals, the AS Institute of Scientific Instruments.

A short paragraph at the end of this chapter covers public and private funding again, and basically recaps some data in Annex 1 (for example, the chart in Figure 16 on page 40 is identical to that in Figure 1 of Annex 1), without a clear selection system for the data to be recapped.

3.5. Chapter 5 - Performance

The title of this chapter promises information about the performance or, more precisely, the performance of research and development in the country. In very short paragraphs, it deals with general aspects with an impact on system performance as a whole (at the same time, it thus touches sections d)-iii) - paragraph 5.5, e) - paragraph 5.4, g) - paragraph 5.1 and 5.3); however, the system performance as such is not assessed. In publishing performance assessment, it is based only unilaterally on periodical publications apparently registered in the WoS for the years 1993-2009 and uses a single parameter, the field-normalized impact of Czech publications CPP / FCSm (ratio of the average number of citations per Czech publication and the corresponding average number of

¹⁴ „...Before the transition, the universities focused on education but during the last two decades they have rapidly built research activities...“, „...The other large organisation is the ASCR related to the government sector, which was more or less the sole producer of basic research in communist times.“ ... (p. 35)

citations per publication in all fields in which the CR is active). Its time course is processed in terms of international and national cooperation (Figure 17) and the types of research institutions (Figure 18).

A natural factor influencing the performance of the R&D system is research management. It is evaluated by the report in its section 5.2, based only on the peer review results of specially selected research groups¹⁵, to the choice of which I formulated my reservations in my review of the second interim report¹⁶.

Chapter 5 also contains inconsistencies and ambiguities, some examples are given below:

- The CPP / FCSm parameter is not explicitly defined in the text of the main report or Annex 6a dealing with bibliometrics (the parameter was used and defined in Annex 8 to the second interim report).
- Why this special CPP / FCSm parameter, mapping only the evolution of citations of one type of publications, was chosen to evaluate the performance of R&D in terms of outputs is not justified.
- The report lists 15 research groups evaluated by expert panels. In Annex 3, on page 1, 17 evaluated research groups are mentioned, while on page 8, 18 groups. I suppose these were the same groups which were dealt with in the reports of expert panels (Panel Reports) that were available to the external examiners for the evaluation of the second interim report (there were 16 groups listed in the panel reports).
- On page 44, the report classifies the evaluated research group as good to excellent, groups that are not yet at the international level, and finally the groups that are oriented "nationally" and must significantly improve their performance to reach the international level. In Annex 3, page 7, however, it is noted that groups of high quality have been selected.
- The chart in Figure 18 contains terminological tension. The common name Research Organisations, which should be used for research organizations as such, according to the description of the chart on page 43, includes mainly ASCR institutes, the term "Government" obviously covers other research organizations in the state sector. The correct classification could be Universities, ASCR, Hospitals, Companies, Other GOV.
- The statement on page 51 concerning career growth and human resource management in research¹⁷ should be briefly reasoned in this general summary as well, even when a more detailed analysis of the situation is included in Annex 7. Operational programmes necessitated the introduction of career systems, which many universities begin to work with as an internal

¹⁵ „... 15 high-performing research groups across the ASCR and the university system plus three RTOs...“

¹⁶ One-sided or unbalanced selection of reviewed scientific groups: With the exception of the University of Ostrava, the Institute of Biophysics of the Academy of Sciences in Brno, and both groups of applied research (Liberec, Brno), all the other groups are from Prague, of the 26 public universities, only one is represented in the selection that is not based in Prague – the University of Ostrava; otherwise, only Charles University and the Czech technical University in Prague have been contacted, in the six groups of medical and natural sciences, there were 4 institutes of the Academy of Sciences and 2 mixed groups (universities and the Academy of Sciences).

¹⁷ „Research career structures in the CR suffer a number of weaknesses.“ ... „Career progression is cumbersome rigid“ ... „Human resource management in the research system is primitive, making little use of career development plans.“ ... (p. 51)

standard. This includes career development plans and their evaluation, and gender issues. The Masaryk University serves as an example.

- A statement unfounded by arguments (and incorrect) can also be found on page 52, concerning the quality of doctoral studies, namely 'traditional apprenticeship' in doctoral studies in contrast with "graduate schools" - in the implicit context of the Academy of Sciences versus universities¹⁸. This formulation impermissibly distorts the true state of affairs. First of all – the former postgraduate training (equivalent of today's doctoral studies) has not previously been a matter of the Academy only, it was carried out at universities, too. It was not a study in the true sense of the word, the corresponding CSc. degree was awarded by the Commission for Scientific Degrees. The current Higher Education Act restricts the authority of granting of Ph.D. degrees to universities; however, the quality of the study is within the responsibility of departmental councils composed of experts from universities, the Academy and other institutions. In many cases, supervisors of doctoral students are employees of the Academy, the student's workplace is the relevant Institute of the Academy, the mentoring of doctoral students is considered a regular teaching activity for the staff of the Academy, required to substantiate their pedagogical and scientific profile, for example, in proceedings for the appointment of professors. In the case of joint doctoral program or discipline accreditation, the Academy can, on the basis of agreements, use money to finance doctoral students both from education allowances and from specific university research funds. The cause for the often-observed decline in the quality of doctoral studies is certainly not the formal restriction of the authority to grant PhD titles to universities, in Annex 2 even called the monopoly of universities (p. 27 in Annex 3). However, it can be considered desirable that the Academy itself take its own steps at the level of legislative proposals aimed at the possibility of awarding Ph.D. degrees by the Academy as well. Very problematic is the number of 80%, which is meant to express the percentage of "doctoral apprentices" to "real doctoral students" if the criteria under which it was arrived at are not given. I wonder how and from which input data this ratio was determined (ratio = numerator / denominator).

3.6. Chapter 6 - Governance, Strategic Intelligence and Evaluation

This chapter is rather general and descriptive. It recaps the fundamental theses of the National Research, Development and Innovation Policy and presents the well-known scheme of research, development and innovation management in the country. It characterizes the role of ministries as the providers of funds for R&D&I, including references to problematic areas (Ministry of Health). It describes the role of the Grant Agency of the CR as effective, preserving a very traditional approach to its role as a "scientific council" - probably meant as an expression of certain undesirable conservativeness restricting proposed interdisciplinary projects, it does not suggest any solutions. It addresses in a greater detail the newly built Czech Technology Agency and (in contrast to the excessive generality of the chapter) lists ten quite specific, and therefore immediately implementable, recommendations for its activities.

Based on the formulations reported in the first and second interim report, it was natural to expect that the final report, specifically in the chapter on R&D&I organization and management, will take a

¹⁸ „Doctoral education used to be the job of the ASCR, but since the transition the universities have acquired responsibility for granting doctoral degrees. While here is some cooperation between individual ASCR and university groups on doctoral supervision, the opportunities for systematic cooperation have not been addressed. One result of this is that about 80% of PhDs are training in the traditional ‘apprenticeship’ model, rather than in graduate schools. This limits the quality and scope of doctoral training and reinforces the problems of inbreeding.” ... (p. 52)

clear, doubt-avoiding position on the role and position in the key body of the research system - the Research, Development and Innovation Council (RDIC), including very specific recommendations for the possible modification of its role and activities. Instead, however, this chapter adopts (except specific words exactly) the wording of extensive general text passages from Annex 2 (page 56 is virtually identical to the text on page 5 and 6 in Annex 2), while somewhat more specific recommendations are left in the Annex only. Consistent with the first and second interim report, it describes the RDIC role, strengthened by the inherence of the government through the Prime Minister being its Chair, quite specifically¹⁹, although very discreetly as "unusual", this time referring to the international context. It can be seen that the RDIC position RVVI gives an impression of strangeness, perhaps peculiarity, to the experts in research organization and management.

This chapter in section 6.2.2 briefly, but very aptly mentions the Methodology of evaluating R&D&I results in relation to institutional funding, without giving any recommendation (which can be found in Annex 3 only). Yet, section 6.2.2 is still very valuable. It repeats in a positive sense the goal (already mentioned several times) of introducing the Methodology (to get rid of political contexts, depersonalize the grant-awarding processes and make them transparent, eliminate nepotism, corruption and lobbying). Above all, however, it emphasizes the cons of the Methodology, the very convincing list of which directly implies the malfunction of the Methodology, the certainly well-intentioned goal of which is thus completely misguided. The items on the list are formulated so succinctly, and especially are so consistent with the comments raised in vain every year for many years within inter-departmental commenting procedures concerning the Methodology that their brief recap should be presented at this point:

- reductionism (in the sense of neglecting the complexity of R&D performance and trivializing the evaluation by its restriction to the list of output categories)
- retrospectiveness (exclusive consideration of the results achieved in the past),
- only a quantitative evaluation of R&D outputs,
- neglecting specifics and financial demands of the disciplines
- non-compliance with the given priority areas of applied research,
- arbitrary choice of the weights of outputs²⁰,
- non-differentiation between the types of research organizations depending on their roles and objectives,
- annual updates of the Methodology aimed mostly at rectifying the necessarily incurred imbalances²¹,

¹⁹ a) „Set in an international context, the R&D&I Council furthermore plays an unusual role in the management of Research and Development in the country, operating almost as a virtual science ministry.“ ... „Equally unusual by international standard is the breadth of its tasks, covering long-term strategy development, monitoring, evaluation and decision-making on budget allocations.“ ... „This imposes a heavy burden on the members of the Council and its advisory committees – and most of all on the small Secretariat.“ ... (p. 56 of Synthesis Report)

b) „In the international context, R&D&I Council plays an unusual role in the management of Research and Development in the country, operating almost as a virtual science ministry. Equally unusual by international standards is the breadth of its tasks....“ ... (p. 5 of Second Interim Report)

c) „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 ... “... (p. 11 of First Interim Report).

²⁰ „... a long list of differently weighted output categories, the weights are in practice arbitrary.“ ... (p. 62)

- lack of support for the Methodology by scientists and science managers,
- The Methodology discourages cooperation,
- The direct link of the Methodology to institutional financing induces its mechanical use not only within institutions but also within research groups, thus not allowing strategic decision-making on preferentially supported research areas.

I have two comments on Chapter 6, the first of which I consider to be serious:

- The text on page 56 (third paragraph) notes the significantly limited capacity of the RDIC in ensuring its key roles and mentions the size of its secretariat²². However, the text does not assess whether the determination of the RDIC roles is wrong, or whether the roles are properly formulated, and the only step needed is to strengthen the RDIC personnel. The meaning of the comment can only be learnt by the reader from Annex 2. When reading just the actual text of the summary report, the interpretation will be clear within the Czech context - to strengthen the personnel (how and by whom??) The RDIC and the advisory bodies and to increase the Secretariat. (During the last reconstruction, the RDIC and the advisory bodies generally grew in size, without any significant positive impact on the quality of RDIC outputs²³.) It would be entirely wrong to allow just such an interpretation. The report itself should be clear to say that it is the concentration of various roles, including decisions on the draft budget, what makes the RDIC in a negative sense different from common international practice, that it is necessary to divide these roles and to suggest how.
- The reports show gradually modified references to the importance of the Prime Minister's role in the RDIC (the Czech R&D&I Council **benefits** from the presence of the Prime Minister → **legitimacy is enhanced** by a member of Government, normally the Prime Minister → Prime Minister, acts as a Chair of the Council, thus **ensuring its legitimacy**²⁴). The role of the Prime Minister, however, remained unchanged during the Audit. Its illogic nature stems from the fact that if the Prime Minister is the Chair in the government advisory body, this fact makes the independence of this body questionable and, on the contrary, it basically threatens its legitimacy in terms of its key roles in the organization of R&D. The RDIC legitimacy as an advisory body is given by law and by the appointment, it does not have to be secured or strengthened by the Prime Minister's "supervision". Therefore, the description of the Prime Minister's role as the RVVI Chair mentioned in the first interim report is close to the reality. The report should also take a clear position on the above issue, without any diplomatic tricks.

²¹ „We have found that the frequent changes of the Evaluation Methodology case confusions, with researchers no longer being sure what counts and what does not.“ ... (p. 62)

²² „At least from the structural point of view, we see serious limits to the capacity of the R&D&I Council to perform one of its key roles, i.e. coordination of all actors involved in R&D and Innovation: ...” ... (p. 56 of Synthesis Report)

²³ Funding proposals, non-transparent and non-complying with legislative standards calculations of institutional support for the development of research organizations in relation to financial commitments to research projects - universities versus other organizations.

²⁴ a) „A member of Government, normally the Prime Minister, acts as a Chair of the Council, thus ensuring its legitimacy.“ ... (p. 56 of Synthesis Report)

b) Its legitimacy is enhanced by a member of Government, normally the Prime Minister, acting as Chair of the Council. (p. 2 of Second Interim Report)

c) “The Czech R&D&I Council benefits from the presence of the Prime minister. However, the absence of other ministers combined with the fact that it seeks to influence the R&D&I policy of those absent ministers risks undetermined its work....“ (p. 13 of First Interim Report).

3.7. Chapter 7 - Conclusions and Recommendations

On four pages, the chapter contains condensed recommendations for the desirable changes at key points in the research, development and innovation system, especially in the very structure of the R&D&I system, in the evaluation principles and rules and in the level of R&D&I funding. The recommendations are formulated primarily as strategic, i.e. at the level of identifying the key elements of the R&D&I system that should be modified, or reinvented, the nature of the desirable changes is described in general and qualitatively. In some cases, the recommendations could be quantified based on the analyses performed: the ratio of various types of funding, ratio of funding various types of research institutions, the proposed formula for determining institutional support (funding formula) and the performance or at least the proposal of basic tests of this formula using data that are available in a sufficient volume. Recommendations concerning the R&D&I system itself could be formulated so that they could more precisely specify the steps needed to reorganize the system (such as rebuilding the RDIC, formulation of its role towards the desired reduction, conceptual proposal of its composition, formulation of the concept of establishing other bodies that will take over the currently concentrated RDIC roles, involvement of "performers" of research activities as the main actors in the R&D&I system, etc.). Yet the final recommendations clearly indicate the direction of future development in the R&D&I system, which can further support the steps already initiated to reduce the "distance" from the Czech Republic to European research "superpowers" (Holland, Great Britain, Finland, Sweden, Austria, Germany, France). In particular, the following recommendations seem to be key and ready for immediate implementation:

- To increase R&D&I support from the state budget over several years at least to the level of the European average²⁵.
- To stabilize the funding system by reducing the proportion of targeted support to the institutional one to at least 1: 1, but necessarily combined with the evaluation of institutions in a period of five years or more.
- To replace the Methodology with an informed peer review in combination with performance contracts²⁶ and to establish "standard" evaluation practice usual elsewhere in Europe²⁷.
- RDIC transformation into an institution whose role is strategic and conceptual (e.g. copying the model of the Finnish Council)²⁸.
- The analytical and managerial roles must be performed by the state structures providing R&D&I support, not centralized in the hands of RDIC.

²⁵ The proposal in Annex 1 can be considered a specific recommendation; it explicitly reads as follows: „...we recommend to exempt public R&D expenditures from public budget cuts to further increase the level of public R&D investments.” ... (p. 5 of Annex 1)

²⁶ „The Evaluation Methodology should be replaced by a system that combines the use of indicators, peer review and an element of prospective thinking. This can be implemented in conjunction with performance contract but the whole process needs to remain transparent.“ ... (p. 66)

²⁷ „Leaving aside the Evaluation Methodology, ... the remainder of R&D&I evaluation in the Czech Republic is infected by over-focus on outputs – to such an extent that it is barely useful for understanding whether policies meet their objectives of for policy learning.” .. (p. 69)

²⁸ „The R&D&I Council should change the thrust of its work from micro-management and budgeting to providing broad-brush policy direction, inspiration and key pieces of strategic intelligence ...“ ... (p. 69)

The formulation given in footnote 26 cannot be agreed with completely. The main focus on outputs is a very specific feature of the Methodology. The CR also applies qualitative approaches to evaluation - for example, the evaluation of the period 2005 to 2009 by the Academy of Sciences at the turn of 2010-2011 already has the distinctive features of informed peer review, research projects are also evaluated qualitatively, the level of assessment, however, depends on each evaluation committee.

4. General factual and formal comments

Despite the overall positive tone of my assessment of the report and the undisputed importance and usefulness of the Audit, it must be acknowledged that the report is not without shortcomings. It is natural for its comprehensiveness, thematic breadth and scope. In this part of the report I present some critical comments on the structure of the report, the consideration of which in the final version I will not request, though, primarily due to the fact that the mentioned shortcomings do not reduce the informative value of the report's content, but also because the updating of the report according to the comments would be impassable not only timewise, but even in principle - it would mean rebuilding the structure of the report. However, the final version could or should be accompanied by a brief annex described in section 5 of my review.

4.1 Structure of the report

The structure of the report appears to comply with the standard situation in the processing of comprehensive studies of research organization and management. In terms of audit assignment specification, however, it is not very appropriate as, for example:

- Responses to single, clearly formulated questions from the audit assignment have to be assembled in a complicated way after relevant passages in different parts of the summary report and its annexes are found. The large degree of penetration of the same issues into different parts of the report (chapters, sections, annexes, various sections of the same Annex, ...) gives an impression that the authors of these parts did not discuss their overlapping thoroughly. (See also section 2 of this review.)
- It is often the case that information and figures referring to one simple question are contained in several different chapters of the report and various annexes - for example, the data and repeated comments on the ratio of institutional and targeted support (Chapter 3, Chapter 6, Annex 1, Annex 2).
- A drawback is the verbosity of the text and its excessive generality in the key passages, instead of the expected specific recommendations, which may in some cases be found, but only in the Annexes.
- An unforgivable drawback, both in general terms, and especially given the total difference between the structure of the report and that of the assignment specification and the dispersion of the text relating to specific parts of the assignment specification into various chapters and annexes, is the absence of links from the main text to the Annexes (see section 2 of the review).

Again, I emphasize that the information value of the report content does not suffer from the shortcomings mentioned above, only the reader gets to it with more difficulty and at the expense of higher demands on time than if the report was designed according to the Audit assignment and if concise and compelling arguments and the resulting specifically and explicitly formulated recommendations on all points of the assignment specification were contained mainly in the summary report.

4.2. Formal comments

I consider the following to be a formal shortcoming in the processing of the annexes and the text of the report

- Frequent and often unnecessary repetition of text in different places, in many cases whole paragraphs are literally copied; this unnecessarily increases the extent of the report and reduces its clarity.
- Also, I have reservations to the notes to the charts (see examples of comments on individual annexes in an annex to the review). For a reader experienced in reading charts and understanding their meaning, the content of the chart is crucial, any verbal notes are basically useless, provided that the chart is correctly described (i.e. it is clear exactly how values are plotted on the axes and in what units, etc.). Unfortunately, some charts do not meet this requirement - see specific comments on the annexes. On the contrary, for a reader preferring verbal comments, it would be required that this commentary allow to get the same information as a chart. This does not apply for a number of comments in the report. Formulations relating to various percentages and other figures are complicated and confusing, when the percentage is verbally stated, it is not clear from what it is derived (i.e. what figure represents 100%), etc.
- Frequent and disorganized use of abbreviations, the meaning of which is usually given at their first appearance (but not always, sometimes an abbreviation is used without explanation, which then appears later in the text²⁹). It is absolutely necessary to add a list of abbreviations to the report.

If the authors of the report refrained from frequent repetition of the same formulations, or their minor modifications, and skipped the verbal notes to the charts, or limited their use to their succinct but accurate and properly formulated version, I believe that the scope of the report and its annexes could be at least half. I would definitely respect the rule that "less is sometimes more" in this case.

5. Desirable adjustment of items for the next version of the report

- 1) The addition of a brief annex containing specific recommendations directly related to the individual sections of the Audit assignment, for example in the following structure (I think that for each section of the assignment, an annex of one to two pages would be sufficient, which would remarkably raise the overall quality of the report):

²⁹ For example, the PNP abbreviation is first used on p. 19 in Annex 1; however, it is not explained before p. 21.

a)-i)

Assignment:

The ratio of targeted and institutional funding, the ratio of expenditure on basic and applied research, development and innovation as well as the proportion of expenditure on R&D in different sectors (universities, R&D institutions, and others), the total amount of public funds by private entities.

Findings:

To summarize specific figures, for instance, in a summary table, to add references to the report and its annexes.

Evaluation:

To evaluate the findings briefly, concisely, and convincingly (the situation is good / bad and why, the ratios of institutional versus targeted funding, public versus private, ... are appropriate / inappropriate and why ...)

Recommendations:

To provide very specific recommendations. If the assignment relates to figures, then give the recommended values or trends (growth / decline, how fast, how to achieve it). For example: the suitable I/U ratio of institutional and targeted funding is ... and should be achieved in ..., the appropriate ratio of funding universities and government institutions (RDI and others) is ... and should be achieved in ...)

- 2) If it is not possible for time reasons to process the additional texts according to section 1), it is at least necessary to complement the report with a list of audit assignment sections with precise references indicating on which pages of the summary report and its annexes specific conclusions and recommendations can be found.
- 3) Recommendations on the following points should be specified in a greater detail:
 - A specific proposal of the annual increase in R&D&I support from the state budget over the next years, which will make it possible to reach European levels within a period that is considered appropriate (the report states a "few years" - p. 66).
 - A suitable ratio of targeted and institutional funding is given in the report as "at least 1:1". In many European countries, with the performance of which the CR should be comparable over time (e.g. Austria, France, Norway, the Netherlands), this ratio is significantly shifted in favour of institutional funding - about 3: 7. When the ratio of at least 1:1 should be achieved? What ratio appears to be the optimum for the CR and when should it be reached?
 - The optimum ratio of institutional versus targeted funding of universities.
 - The optimum percentage of public expenditure on R&D&I directed at universities in the form of GUF - see Table 3 of Annex 1. In what period the recommended level should be achieved?

- The optimum ratio of research funding in general and university research funding by the private sector. When the optimum is to be achieved and, in particular, how?
- To specify the RDIC role in a greater detail, not only at the level of a general statement of the type of the recommendation on page 69 of the summary report, but to specify it in more detail by a list of specific conceptual tasks, which should be entrusted to the RDIC.
- To be more specific on the formal RDIC position in the R&D&I system (it obviously continues to be an advisory body to the government), to formulate requirements to ensure the independence of this authority (express a clear view on the direct inherence of the government in the RDIC decision-making process - a cabinet member or the Prime Minister acting as the RDIC Chair).
- To specify RVVI composition with regard to its role formulated based on the above requirement (participation of "R&D&I performers?", participation of representations of the academic and scientific communities?", appointment of VIPs in science and prominent science managers?)
- To describe the procedure, which will effectively provide the formulation of new evaluation rules (informed peer review) and new funding rules (funding formula in combination with performance contracts). To determine the role of the academic and the scientific community in the process of proposal development, not to restrict it just to the comment procedure.
- To complete the assessment of the financial impact of projects within the R&D&I Operational Programmes (the report does not answer the last sub-question in section a)-ii)).
- To complete the findings and overall conclusion on section a)-iii) (critical masses)
- Did the auditors also deal with the issue of the so-called large research infrastructures in the Czech Republic, namely the concept and structure of the Large Infrastructure Roadmap? If so, what conclusions were reached?

4) To add a full inventory of used abbreviations and their meanings.

5) To remove errors and inconsistencies – this is not necessary before the conference, but it would be appropriate for the project team to set a deadline.

6. Conclusion

Overall, the final report of the International Audit of Research, Development and Innovation in the Czech Republic can be characterized as drafted on a very good level in terms of expertise and in terms of professional approach. The aggregate information value of the paper is high. It consists mainly in the professional quality and information content of the analytical material of its large annexes. Its comprehensiveness and coherence exceeds the level of available data and analytical material on research, development and innovation in the CR in comparison with other countries of similar orientation created by Czech institutions processing such analyses based on public statistical data, but only on a descriptive level, without appropriate assessment and conclusions. Unlike the first and second interim report, however, this time the mere text of the report (Synthesis Report) is

not a synthesis in the usual and desirable sense, but rather a separate, more general study. Even this, however, has its meaning in the form of an overview text, which may well serve as the primary information material. Its general formulations are contained in the annexes in a more specific form, where they are supplemented with in-depth qualitative and numerical analyses. This way, the report is a qualified and relatively objective assessment of the status of the research and development system in the CR, of the method of its management, research funding, evaluation of its results and links between funding and the evaluation of results. It provides guidance on the structure and (non) functionality of the system of support for science, research, development and innovation in the Czech Republic and presents, both on a general and a more specific level, recommendations on some key aspects of the system, showing the direction of needed changes.

The report, quite logically, implies that if the Czech Republic wants to be able to compete in research, development and innovation with well-established European countries, the procedures in organizing and managing R&D&I, and perhaps the whole concept, will have to be quite significantly altered. Fundamental changes should take place in the area of institutional versus targeted R&D&I funding, in the terms of funding different types of research organizations, private sector contribution to R&D&I funding and, in particular, in the evaluation of R&D&I: departure from the principle of "the point value of R&D&I outputs as a single parameter for evaluation", the cancellation of the linear dependence of the institutional support amount on this parameter (and generally, the loosening of tight links between the results of evaluation and institutional funding, quite unusual anywhere abroad).

The Research, Development and Innovation Council, as a policy-making and strategic R&D&I institution in the Czech Republic, should, when considering the R&D&I concept, definitely use the report as a basis, formulate relevant specific conclusions quite specifically and quantitatively based on its broader and qualitative conclusions, and finally use the report to process its own analytical material on the changes in the concept of R&D&I organization. After its publication, to give an explicit incentive to draft strategic and legislative documents for organizing and managing R&D&I through a direct call to the academic community to participate in this process. This does not rule out the involvement of the academic community and its representations in the conceptual and legislative activities in the R&D&I activities.

I recommend that the report International Audit of Research, Development and Innovation in the Czech Republic (Synthesis Report), including Annex 1 to Annex 7 be approved, with a list referred to in section 5(2) of this review to be attached to the next version and recommendations to be clearly specified within the meaning set out in section 5(3) of the review (I think that annexes to the report provide a sufficient analytical background for that).

7. Annex: Notes, comments and questions to some annexes to the report

In the following text, I will focus on brief characteristics of the content of certain annexes and mention some specific comments, the most important of which should be taken into account in the final version of the report.

7.1. Annex 1 to the Final Report: Assessment of Public R & D Expenditures in the Czech

Republic

Annex 1 is an expertly processed analytical material with which it is possible to become well-oriented in different types of R&D&I funding in the CR in the international context and make the most important conclusions and recommendations for changes in the funding system in the country. In the Annex, such recommendations are summarized in the Executive Summary section, although on the qualitative level, but clearly formulated. In particular, Annex 1 clearly states (on page 8) specific reasons why it is undesirable to further increase the share of public support for R&D&I in favour of targeted support³⁰. I also consider the statement on the issue of thematic programmes (p. 12 and 13) and the criticism of the TIP³¹ programme to be important. Compared to Annex 1 to the second interim report, the Executive Summary chapter has been prepared anew, otherwise the text and graphical presentations in Annex 1 to the second and the final report show significant sameness, I estimate it at least at 70%.

Further, I present my notes and comments to Annex 1. The example of Annex 1 is also used to show the type of the small and larger gaps throughout the text of the report that would deserve an adjustment, but do not reduce significantly the value of the whole work. Other annexes are not commented in such a detail. In Annex 1, I focus on the Executive Summary and the section containing graphical and tabular outputs, the pure textual part (from p. 72 onward) has not been commented.

- Annex 1 is significantly affected by the comment in sec. 5.2 of the review (second indent) - unnecessarily lengthy and confusing notes to the charts and tables, which themselves would be sufficiently instructive, if their axes or columns were clearly described and specified. The verbal commentary is often not even related to the appropriate chart by reference. (Examples of specific situations are given below).
- It is necessary to clarify the arguments for increased funding of humanities and social sciences³² and supplement the quantitative estimate.
- What quantitative data are the basis for the claim that the higher education sector specializes in engineering technologies, medicine, agricultural science, and the government sector in natural sciences and humanities³³ (publications??, spending?? something else??)

³⁰ „...we see no need to further expand this share on cost of institutional funding.“ ... (p. 8 of Annex 1)

³¹ „The TIP programme of the Ministry of Industry and Trade does not provide sufficient incentives for science-industry collaboration ... „ ... (p. 13 of Annex 1), „...and TIP, which should be substituted by a more advanced programme that incorporates training measures, exchange schemes with the academic sphere, and tailored approaches for SMEs and larger companies.“ ... (pp. 13, 14 of Annex 1)

³² „We therefore recommend increasing of level of R&D financing of humanities and social sciences, as these fields also need to catch-up in terms of scientific quality...” ... (p. 6 of Annex 1)

- Chart labels, the legend to them and to the tables, are not sufficient; the reader must wade through to the merits. Notes to the charts are often unnecessary and placed without reference to a specific chart – the chart itself gives very good information, the notes often act as misleading. For example:
 - Table 1 (p. 19) - it is not clear on what basis the percentages are calculated; there is no obvious relationship between the table and the corresponding chart in Figure 2. How exactly the R & D ratio is defined (the last column of Table 1)?
 - Comments in section 3.3.1 relate to the chart in Figure 8 (reference is not provided). Given the clarity of the chart itself, they are completely unnecessary.
 - There is no understandable legend to the chart in Figure 9. It is obvious that the chart shows the GBAORD trend, the vertical axis of the chart, however, should be properly described (the variable represented by the axis should be precisely defined; the reader has to check the tables to find it). In comments to Figure 9, Italy is mentioned as an EU member, but it is not included in the chart. Verbal comments also compare the data for the CR according to Figure 9 with Luxembourg, Romania, Estonia and Cyprus; in the chart, however, only data for Estonia are included of all these countries.
 - The charts in Figure 10 are titled as Average Annual Growth Rate of GBAORD. However, it is not defined how the averages are arrived at. The chart title is misplaced. It gives the primary impression that that the Average Annual Rate for GBAORD is on the left and the GDP on the right, but both graphs represent the same, just for different periods (2004-2009 left, 2002-2007 right, GBAORD red, GDP blue).
 - It is not clear what value is plotted on the axes of the spiderweb chart in Figure 12, according to the legend designed as "based on the RCA indices" (field values on the axes are in the interval [-100, 100], i.e. directly as the RCA). How scaling has been performed in order for the EU-27, $x = 1$? Since the numerical table does not contain all the EU-27 countries, it is not possible to verify the calculation. Thus, the chart operates only "visually", without deeper understanding. A similar remark applies to all charts of this type in Annex 1 (e.g. 34, 36, 38, 40,...).
 - For instance, the wording on page 35 concerning the data that are immediately obvious from the chart in Figure 14, is needless.
- The chart type is often not chosen very appropriately. For example, the often used bar charts showing different percentages adding up to 100%, without any marked numerical values for different parts of the columns (Figures 5, 15, 16, 22, 32, 33, etc.), do not allow to easily determine and compare the percentage shares, with the exception of column sections placed at the bottom and at the top of the column. The informational value of such a chart is reduced to a mere "optical impression". In such situations, the information value of the table is definitely higher, even if the table does not present such an optical effect. Given that the report should not be primarily a picture book, I would rather opt for the tabular expression.
- Judgments based on some data from charts and tables, especially as far as quantities having the character of ratios are concerned, are sometimes wrong. Example: The claim at the bottom of page 26 is misleading³⁴. The ratios of 0.68 and 0.74 can indeed be regarded as close. But it is a percentage ratio calculated from different bases - the share of R&D&I expenditure in the GDP for the CR and the EU-27 is different (CR ... 1.53% of the GDP, EU-27 ... 2.01% of the GDP).

³³ „The Higher Education Sector shows specialization in engineering Technologies, Medicine, and Agriculture Sciences, while the Government Sector is strongly specialized in the Natural Sciences and the Humanities“ ... (p. 10 of Annex 1)

³⁴ „With a GBAORD of 0.68% of GDP, the Czech Republic comes close to the level of the EU-27.“ ... (p. 26 of Annex 1)

A good idea about the level of R&D&I funding from the state budget is given by the ratio of R&D&I expenditure from the state budget and expenditures spent by other entities in the state (GBAORD / private), which is 0.68 for the CR / $(1.53 - 0.68) = 0.80$ and 0.74 for the EU-27 / $(2.01 - 0.74) = 0.58$. This difference is already significant and indicative of significantly lower R&D support by the private sector in the Republic.

- The selected evaluated periods in various charts and tables are different, often making it impossible to compare the data. For example. Figure 1 and Table 1 - the period 1995-2009, the Table in Figure 2 - the period 1999-2009, Figure 3 – the period 2005-2009 (why the reference year was 2005?), Figure 10 - the period 2004-2009 and 2002-2007, ...
- The text contains a number of terminological inconsistencies that have a confusing impression on readers unfamiliar with the issue in depth. The use of undefined terms is not unusual. Examples:
 - State Sector versus Government Sector (on page 20 as the performer of R&D&I, the Government Sector as a source of R&D&I funding, on page 9, however, the Government Sector is the performer), in Table 2 it is also listed as the performer (State Sector in Table 2 does not appear). On the contrary, on page 45 the term "Public Sector" appears, without being introduced before.
 - What is meant by "research activities"? On page 11, shares of research activities in various research sectors are specified in percentage values, even for three valid decimal points. Based on what data is the variable defined?
 - On page 20 in sec. 3.2, 5 sectors are mentioned as sources of funding, after the colon only four are specified.
 - The terms "government spending" (GBAORD) and "public expenditure" is confused in many places, it is necessary to constantly follow the context. (Public expenditures are not only provided by the state budget of the country, they also include certain funds provided by the EU - FP7, etc.).
- Table 2 is very instructive; however, a drawback is that only its version for the period-ending year (2009) is provided. The information value would significantly increase by including the table for the initial year.
- Arguments based on the chart in Figure 6, aimed at claiming that private sector spending on R&D&I is adequate, are somewhat misleading and somewhat purpose-made - the proportion of each source to the percentage of R&D&I expenditure in the GDP (R&D intensity) as a value characteristic of the contribution rate of a given source is not justified. Data from the chart in Figure 5 should rather be considered authoritative for assessing the adequacy of support from the private sector.
- I consider the data in Table 3 to be very important. They show that the percentage of public R&D&I expenditure directed at universities via the GUF (General University Funds) is very low compared to many developed European countries in terms of R&D&I. Data in [%]: Sweden 62, Switzerland 62, Austria 57, Denmark 44, Netherlands 44, Germany 37, Norway 34, the CR only 27!!
- An unanswered comment that I have already made in the review of the second interim report: Missing arguments to support the choice of functional RCA parameter dependence (p. 32). After adjusting the hyperbolic tangent of the logarithm of base variable x , we arrive at a trivial functional dependency (the motivation for its choice should be clarified),

$$RCA = 100 \tanh \ln x = 100 \frac{\exp(\ln x) - \exp(-\ln x)}{\exp(\ln x) + \exp(-\ln x)} = 100 \frac{x^2 - 1}{x^2 + 1} = 100 \left(1 - \frac{2}{x^2 + 1} \right).$$

The summations in the expression of variable x in the RCA formula on page 32 contain errors in the summation indices (they were already present in the annex to the second report, but remained uncorrected).

- The wording on page 33 deals with the ratio of the total institutional and targeted expenses³⁵. On page 8 a ratio that is just the opposite is presented; however, it is noted that it concerns public expenditure³⁶. On the other hand, the chart in Figure 13 shows the institutional / targeted GBAORD ratio of = 54 / 46. These data should be brought into order.
- In terms of the ratio of R&D&I funding of research organizations in the government and the higher education sector, the data in the chart in Figure 15 are important. The ratio is not easy to read, though (in the final version of the report, it would be appropriate to convert chart 15 into a table). The chart seems to indicate that the comments on page 36 concerning this ratio³⁷ for the countries of Central and Eastern Europe were completely justified; however, this shows a considerable disparity with the countries of Western Europe, but also with EU-15 and EU-27 - even "visually" the share of funding for universities (numerator) and government institutions (denominator) in the EU-15 and EU-27 is significantly higher than 1 in the CR, where it is slightly less than 1. For selected developed countries of Europe the mentioned disparity is even greater.
- The chart in Figure 19 should be completed with a corresponding chart for private universities.
- The text on page 40 refers to Annex D - no such annex is attached to the report. The correct reference should apparently be numeric - it needs to be corrected everywhere in the Annex.
- Table 5 on page 41 should be entitled to indicate directly, which years it specifically covers (the text reads "last three years," only by the source, it can be concluded that this is probably the development compared with 2007 or 2008). What does the number 308 in the "Tot." column mean? Probably a mistake, it should be 100.
- On page 46: "At the research group level ...": How were conditions at the research group level monitored? How were the research groups selected? Is it a quantitative assessment, or just an estimate (as would result from the formulation)?
- On page 57, last paragraph: "By large, the group of countries ..." - which countries, for example, are included?
- On page 58: On page 58, the ratio of research output (publications in particular) of universities and the Academy of Sciences³⁸ is discussed. What exactly is compared? Undoubtedly, this cannot be an absolute number of publications; it has to vary due to the completely different number of scientists involved in these outputs. On page 58 universities are classified into three types, which is not reasoned.
- The chart in Figure 36 versus Table 8: some values in the table (for example, relating social sciences) are very small. The relevance of the graphic expression is therefore questionable.

7.2 Annex 2 to the Final Report: R & D Governance in the Czech Republic

³⁵ „In 2008 about 54% of total R&D expenditures are distributed via institutional funding mechanism and 46% via project funding mechanisms in the Czech Republic.“ ... (p. 33 of Annex 1)

³⁶ At present 54% of public R&D funds are distributed via project financing mechanisms.” ... (p. 8 of Annex 1)

³⁷ The shares of public R&D performed by the Higher Education Sector and Government Sector are not much different to that of many Central and Eastern European Countries...” ... (p. 36 of Annex 1)

³⁸ „Nowadays, both type s of institutions have a comparable amount of scientific output measured by publications...” ... (p. 58 od Annex 1)

I already commented on Annex 2 in the previous sections of this review (sections 2 and 3.6 of this review) and in the review of the second interim report – it is well prepared and contains the reworked Executive Summary section. This chapter and the whole annex are a basis for some substantial recommendations concerning R&D&I organization and management in the Czech Republic, which are summarized in Chapter 7 of the summary report. I recapitulated most of them in section 3.7 of this paper, and requirements for their specification are given in section 5 of this paper.

7.3 Annex 3 to the Final Report: The Quality of Research, Institutional Funding and

Research Evaluation in the Czech Republic and Abroad

Annex 3 is very valuable for the assessment of the R&D&I evaluation system in the Czech Republic and its links to funding.

The first part of the Annex deals with the quality of research in the CR, using the bibliometric analyses and peer review of selected research groups, whose number is 17 according to the figure on page 1 and 18 according to the figure on page 8. I assume that they are the same groups, whose evaluation was already performed for the purpose of the second report - and their number was 16. The correct number should be provided. In the final report, the selected groups are anonymous. The reported conclusions are general and qualitative; conclusions for groups in different disciplines are somewhat unbalanced in scale (such as engineering sciences versus natural sciences). The Panel Reports that were available to external examiners with the second report included more specific conclusions. My comments on the selection of groups are included in the review of the second report, to which I refer. They are briefly recapped in this report as well - in footnote 16.

A large part (with respect to the evaluation of the Methodology in the first and second interim report, perhaps too much) of Annex 3 is devoted to the Methodology of evaluating R&D results, its impacts on institutional funding and the scientific community's views on methodology (pp. 28 to 64). The evaluation of the Methodology, compared with the second interim report, is enriched with entirely justified criticism of the so-called renormalisation, used in recent versions of the Methodology (the report evaluates the 2010 Methodology); the conclusions are essentially identical to the second report.

Conclusions regarding the impact of the Methodology on financing and resulting from the analyses are consistent with the known facts: For many years it has been known in the academic and scientific community of the CR that no evaluation system basically exists (except for the internal evaluation in the Academy of Sciences, some examples of evaluation of research projects, or the internal assessment of R&D component aspects at some universities). The system of institutional fund allocation for the development of research organizations (after the completion of research projects, this will include almost all institutional R&D funds) is based on a superficial and trivial, mechanistic principle - linearly according to the points obtained for results in the previous five-year period. In principle, the negative opinion of the scientific community on the Methodology could be expected and this expectation has been confirmed by the professionally performed investigation carried out by the auditors.

Chapter 5 is a very useful and interesting case study of various approaches to evaluation and funding abroad. The evaluation procedure, which is described as an example of good practice (Holland), was to some extent used by the Academy of Sciences in the evaluation of 2010-2011. Conclusions and recommendations arising from these studies are again general, though. It is proposed to use the "funding formula" in combination with performance contracts, but no model example is given that would be suitable for CR as a result of the performed analyzes. The recommendation for evaluation - informed peer review, however, can be considered absolutely essential.

As an example of good practice in evaluation, the ASCR rating is mentioned – in the CR apparently the only case of a large-scale evaluation involving peer review.

The SWOT analysis of the Methodology in Chapter 7 is accurate.

Minor comments on the text:

- In the paragraph Trends in Outputs & Impacts on page 5, impact development as a percentage³⁹ is discussed. How is the term "impact" defined and the percentage increase counted? Similarly, on page 7 - what does the average publication impact or the normalized impact mean?
- Footnote 3 on page 6 refers to "the appendix to this report." However, there is no further annex to Annex 2. Is it Annex 6b?
- Footnote 4 on page 6 shows 85575 records processed for the purposes of bibliometrics. Only from Annex 6b it is obvious that these are publications registered in the WoS database. On page 6 of Annex 6b, „more than 85,600“ publications are reported, on page 4 their number is 85635.
- At the turn of 2010 and 2011, the Academy of Sciences carried out an internal evaluation by evaluation committees and a foreign expert panel. Was this assessment compared with the assessment made by Technopolis for those ASCR institutes which were evaluated in both ways? If not, why? If so, what are the conclusions?
- One cannot agree with the conclusion of the expert panel for natural sciences relating to the availability of professorship for the staff of the Academy of Sciences⁴⁰. This statement is a strong distortion of reality. The title of a Professor is both scientific and pedagogical, in assessment of the materials for professorship, both the components should be balanced. Recently, however, on the contrary, the scientific boards of universities have tended to prefer the scientific component. For the ASCR staff, their teaching ability is proven, for instance, by guidance provided to doctoral students, regular weekly lessons are not required or are assumed in the form of optional special lectures, carried out in the form of teaching blocks as well.
- The chart in Figure 10: The meaning of coordinate axes is not obvious - "CEZ %" means the percentage share of the given discipline in funds designed for research purposes? Does "Evaluation 08%" mean the percentage of the relevant discipline in the results reported on

³⁹ „...namely an increase of the Czech impact of nearly 25% making this the strongest increase...“ ... (pp. 5, 6 of Annex 3)

⁴⁰ „Requirements for full professorships in the Czech Republic seem to be mainly based on education-related factors.“ ... (p. 14 of Annex 3)

research projects? The missing meaning of abbreviations of disciplines makes orientation in the chart impossible.

- The table in Figure 12 deserves a more detailed description.
- P. 63: The claim that different types of organizations cannot be "lumped" together⁴¹ when assessed, is not new. The RDIC tried to "respect" this fact using the so-called sectoral factor, which has never been introduced (for its incompetence).

7.4 Annex 6a to the Final Report: International Co-operation in R&D, Annex 6b to the

Final Report: International Co-operation in R&D: Bibliometric Analysis

Both the annexes well characterize the issues of international cooperation, particularly useful is Annex 6b containing tabular and graphical output; in some cases, however, it would be still useful to define more precisely the meaning of variables on the axes of the charts.

Comments on Annex 6b:

- The chart in Figure 3 is entitled "Comparison of Czech ICP and NCP, by journal subject categories, 1980-2010." It should be explicitly noted that it is the ratio of the number of publications that have arisen in the relevant discipline through international or national cooperation and the number of all Czech publications in this discipline, expressed as a percentage
- The charts in Figure 5 and 6 contain normalized values. It should be more accurately indicated how the normalized values will be identified.
- The note on page 9 "... percentage total exceed 100%..." is unnecessary, the fact itself and its reasons are obvious.
- For each discipline, the charts in Figures 14, 15, 16 show the time development of the share of publications in the relevant discipline resulting from international cooperation in all publications in this discipline for three different countries (Czech Republic, Austria, Hungary). In all three cases, the share is significant for physics. The text of the Annex notes this decrease (visible even without comments directly from the charts), but does not try to identify the reasons. What may be the cause of such a development only in physics?

⁴¹ „...Similarly, our own conclusion was that the different organisations cannot be lumped together...“ ... (p. 63)