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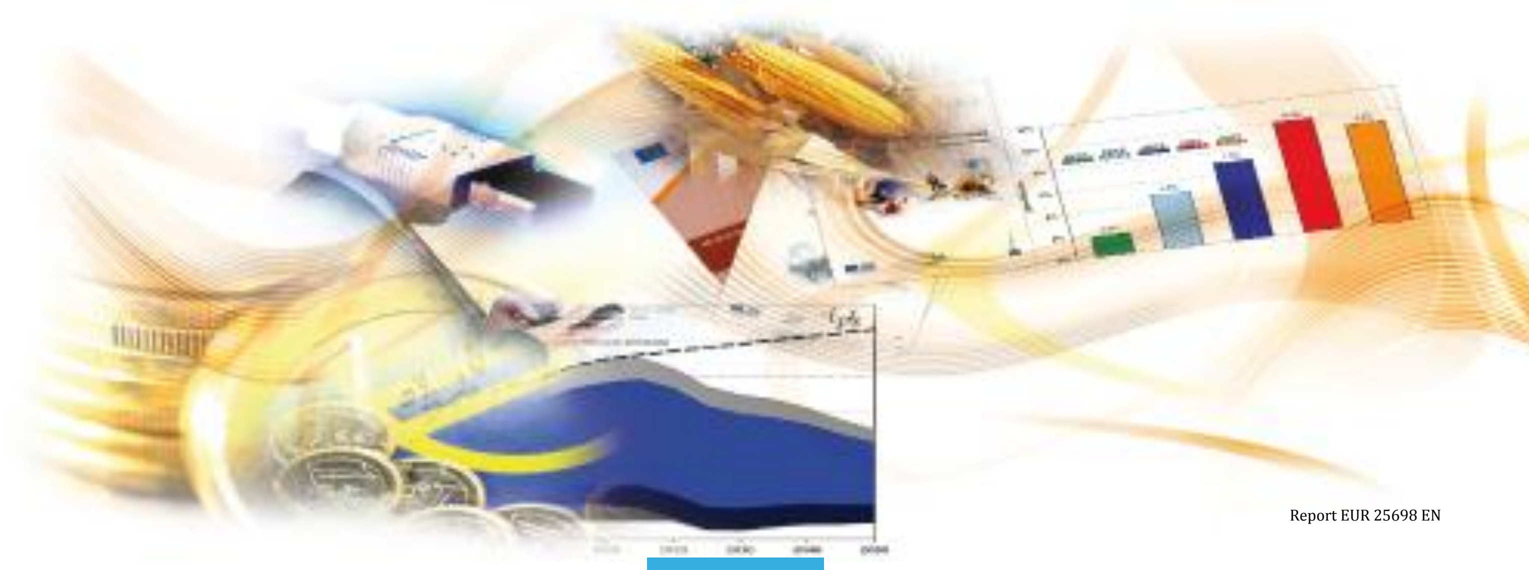

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Executive Summary

Hungary, with its population of 10 million (2% of the EU-27 total) is a medium-sized EU member state. Its GDP was 1.26% of the EU-27 total in 2010. As for economic development, measured by GDP per capita (in PPS), the country ranked 22 in the EU-27 in 2010, with 63.52% of the EU-27 average (all data from Eurostat, or calculations based on those data, unless otherwise indicated)

The Hungarian GERD was oscillating between 0.9-1.0% of the GDP in 2001-2008, increased to 1.17% in 2009, and then stayed at that level (1.16%) in 2010. The share of FTE researchers in total employment increased from 0.53% in 2009 to 0.56% in 2010. *Businesses* have maintained their position as the largest employer of (FTE) researchers since 2006, reaching 48.1% in 2010, and had the biggest share in performing GERD (59.8%), too. Private R&D and innovation efforts are conducted to a disproportionately large extent by large, mainly foreign-owned firms in 2-3 sectors. BERD increased considerably – by 9.7% in 2009, and 10.27% in 2010 – and thus the BERD/GERD ratio jumped from 52.57% in 2008 to 59.81% in 2010, approaching the EU-27 average (61.51%). This increase was financed mainly by public and foreign funds.

The *higher education sector* performed 19.9% of the Hungarian GERD in 2010. The weight of this sector was 28.3% in 2009 in the employment of FTE researchers. *The government sector*'s share was 23.6% in 2010 in the total number of FTE researchers. (CSO)

Given severe cuts in government funding to support RTDI activities since June 2010, (i) no new STI policy schemes have been introduced since mid-2010; and (ii) the balance of funding has shifted significantly towards EU sources as the largest STI policy support schemes are co-financed by the EU Structural Funds. Hungary is squeezed in a 'nutcracker' formed by advanced countries, on the one hand, and dynamic industrialising countries, on the other. The former ones are capable of controlling international production networks and markets via new technologies, financial muscles, and superior business models, while the latter ones are characterised by extremely low wages and highly disciplined work forces. To escape from this trap both technological and non-technological innovations would be needed to raise productivity and find new markets. Yet, Hungary is a 'moderate innovator', that is, belongs to a group of countries characterised by an overall innovation performance below that of the EU-27.

To underpin an innovation-based 'escape' strategy, five main challenges, which constitute bottlenecks for the innovation system as a whole, have been identified in this report. The first two ones can be understood as symptoms, which are important enough to consider them on their own; the third is an 'early warning' signal; while the last two are not only important symptoms, but also major reasons to be considered when explaining poor performance.

- *Low level of innovation activities, especially that of the SMEs: only one-fifth of enterprises introduce product or process innovations in Hungary, with no major change since 2002; 16.8% of SMEs introduced product or process* innovations in 2006-2008, that is, 49% of the EU-27 average
- *Low occurrence of co-operation in innovation activities among key actors: 6.5% of*

innovative firms reported any form of co-operation with Hungarian PROs; 7.1% of SMEs were engaged in innovation collaboration with other partners in 2006-2008, while the EU average was 11.2%

- *Insufficient quantity of human resources for R&D and innovation is forecast by 2015*
- *Unfavorable framework conditions for innovation, especially unpredictable business environment, high administrative and tax burden, competition not conducive to innovation*
- *Shortcomings in STI policy: lack of political commitment; instability; shortfalls in implementation; and slow, insufficiently informed policy learning processes*

The Government's mid-term STI policy strategy (2007-2013) defines six priorities: (i) expand business R&D; (ii) establish internationally recognised RTDI centres and research universities; (iii) enhance regional RTDI capacities; (iv) establish a knowledge market; (v) invest in large scientific facilities; (vi) increase R&D expenditures, especially BERD. The STI policy support schemes in place have further objectives, too, and on the whole those objectives seem to be appropriate.

There have been no major changes in terms of the main target groups of STI policy measures over the last three years: some schemes provide support for individual firms, while others put the emphasis on industry-academia co-operation or setting up accredited innovation clusters, and innovation activities by the members of these clusters. The balance between grants, loans, and non-direct funding measures has not changed, either.

The government's mid-term STI policy strategy (2007-2013) stresses the need to align the national and EU STI policy goals. Thus, while the national STI policy mix is not aligned with the specific ERA pillars and objectives in an explicit, purposeful way, there is no major tension between the national policy goals and the ERA initiatives, either.

Two main reasons of the poor innovation performance have been identified by independent analysts. One of these points outside the narrowly defined STI policy domain: the framework conditions for innovations influence firms' behaviour with such a power that STI policy schemes cannot offer strong enough incentives to overrule those unfavourable effects. Thus, major policy efforts are needed to create favourable framework conditions, notably a stable macroeconomic environment; endurable administrative and tax burdens on firms; strong demand for new products; a sufficient supply of skilled people for RTDI projects; appropriate regulations and standards; effective IPR policies; etc. Further, policies affecting these conditions need to be aligned with STI policy efforts to make a difference.

The second set of factors can be grouped together as shortcomings in policy-making, including lack of political commitment. R&D and innovation needs to be perceived by politicians as a major contributor to socio-economic development, as opposed to the current – although implicit – understanding, when it is taken as a burden on the budget, and thus becoming the first 'victim' when budget problems must be solved.

Frequent changes in the structure of the STI policy governance sub-system has lead to organisational instability, which, in turn, affects negatively policy formation and implementation as it hampers organisational learning and imposes unnecessary burdens on RTDI performers, too. Hence, this sub-system needs to be stabilised. Combining these explanatory factors, there seems to be no 'panacea' or a simple 'quick fix' to improve RTDI performance. Conscious co-ordination of major economic and STI policies is needed, guided by an overarching socio-economic development strategy. Foresight processes would be useful to underpin these strategies. These dialogues can also highlight how RTDI processes – advanced by appropriate STI policies – can contribute to overall socio-economic development. Policies affecting RTDI processes and performance need also to be orchestrated. Up-to-date decision-preparatory methods – most notably thorough analyses of innovation performance, combining census, R&D and innovation data; evaluation of individual policy measures, as well as that of the policy mix as a whole; and technology assessment – should be relied upon when devising and implementing STI policy measures, also assisted by recurring consultations with the major actors of the national innovation system.

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1 Introduction

Hungary, with its population of 10 million (2% of the EU-27 total) is a medium-sized EU member state. Its GDP was 1.26% of the EU-27 total in 2010 (fluctuating between 1.25-1.30% in 2004-2010).[1] As for economic development, measured by GDP per capita (in PPS), the country ranked 22 in the EU-27 in 2010, with 63.52% of the EU-27 average. In comparison with the EU-27 average, the Hungarian GDP grew slightly faster in 2008 (0.9% vs. 0.3%), the contraction was more dramatic in 2009 (-6.8% vs. -4.3%), the recovery was slower in 2010 (1.3% vs. 1.9%), and the Eurostat forecast slower growth for 2011, too (1.4% vs. 1.6%).

The Hungarian GERD was fluctuating between 0.9-1.0% of the GDP in 2001-2008, increased to 1.17% in 2009, and then stayed at that level (1.16%) in 2010. With these slightly increased efforts, Hungary still devotes significantly fewer resources to R&D than the EU-27 average: the GERD/GDP ratio was 58% of the EU-27 average in 2010. The share of FTE researchers in total employment increased from 0.53% in 2009 to 0.56% in 2010, while the share of all FTE R&D employees did so from 0.79% to 0.83% in the same period. As for scientific output, the number of books and book chapters by Hungarian researchers grew by 9.4% in 2010 (the ones published in Hungarian by 8.8%, while that of published in foreign languages by 11.1%). The total number of articles decreased by 1.4%, but that of published in foreign languages increased by 8.8%. There are significant differences by sectors: higher education staff members are the most productive (on average 108 books and 331 articles by 100 FTE researchers), followed by researchers employed in the government sector (58 books and 158 articles by 100 FTE researchers), and researchers working for businesses (2 books and 137 articles by 100 FTE researchers). (KSH, 2011, Table 24)

In international comparison Hungarian scientific output, ranked 35 in terms of publications recorded in Scopus in 1996-2007, and 24 in terms of citations in the same period. Researchers working in physics and astronomy; pharmacology, toxicology and pharmaceutics; earth and planetary sciences; and chemical engineering outperformed the Hungarian average both in terms of share of Hungarian publications in total publications, and the number of citations relative to the world average of citations in a given research field. (Schubert, 2009)

Cost-benefit analysis, conducted for the period of 1996-2005, relying on Web of Science and OECD data, shows that Hungarian researchers are fairly productive in terms of scientific output. The number of papers per researcher is close to the EU25 average (90.8%), while funding is much lower: 56.7% of EU25 R&D spending per publications[2] (Tolnai, 2006)

The poor performance in producing directly exploitable knowledge has been often identified as the major weakness of the research system. The number of patent applications, community designs and trademarks per billion GDP (in PPS €) are 37.5-60.0% of the corresponding EU averages, but some of these indicators show a modest improvement[3] (IUS 2010). However, at least two arguments should be recalled here as

[1] The report follows the template developed for the 2011 ERAWATCH country reports. It draws on the most recent Eurostat and Hungarian Central Statistical Office (KSH) data, as well as on previous ERAWATCH and TrendChart country reports (Havas, 2010a, 2010b, 2011b, and 2011c).

[2] Funding data have been taken from the OECD in PPS $.

[3] Co-patenting with foreign inventors seems to be an important phenomenon in Central and Eastern European countries. (Goldberg et al, 2008) Data are not readily available to establish how pertinent

to why one should interpret these figures with a pinch of salt. First, when assessing the performance of a NIS in general, one should bear in mind that a wide array of other means can be – and indeed, are – utilised by firms to protect intellectual property, many of which are not captured by measurable or readily available indicators.[4] Moreover, propensity to patenting is highly varied across sectors, and hence the sectoral distribution of a national economy might heavily influence the intensity of patenting activities. Thus, a low level of patenting activities does not necessarily indicate that researchers are not capable of producing exploitable knowledge, or a poor innovation performance[5] Second, concerning specifically a catching up economy and its NIS, at that stage of development it might not be a meaningful (or feasible) target at all to produce as many patentable R&D results as possible. It seems to be more relevant to concentrate on (a) fostering the diffusion of knowledge and all forms of innovation; and (b) enhancing learning capabilities for a more efficient absorption and exploitation of new knowledge, wherever it is produced. These activities, contrary to widely held beliefs, still require fairly developed R&D and innovation skills, in order to identify the most suitable pieces and types of knowledge to be acquired (often imported), and 'assemble' those in an appropriate way, suited to the new context.[6]

Manufacturing industries accounted for 21.6% of the GDP in 2008, declining to 20.1% in 2009 (when the GDP contracted by 6.8%, as Hungary, being a small, open, export-oriented economy, was hit hard by the global financial and economic crisis), and then this share increased to 22.3% in 2010. Five branches accounted for 59% of the total manufacturing value added in 2009, four of which – like most manufacturing branches in Hungary – are dominated by foreign firms. (Table 1)

Table 1: Major sectors of manufacturing industry, 2009

	Share in manufacturing value added (%)	Share of value added produced by foreign firms (%)
Transport equipment	14.5	94.4
Machinery and equipment	13.3	25.6
Food products, beverages and tobacco products	12.8	48.7
Rubber and plastics products, and other non-metallic mineral products	9.4	67.3
Computer, electronic and optical products	9.0	93.5

Source: Author's calculation based on KSH data

Given these two factors – sectoral composition of the economy and the dominant weight of foreign firms – demand for either R&D or other types of knowledge is moderate in Hungary: most Hungarian manufacturing firms perform relatively simple assembly

this phenomenon in Hungary.

[4] CIS results compellingly confirm this argument.

[5] This, of course, is not to suggest that the Hungarian NIS performs astoundingly, in spite of the picture shown in the mirror of patenting activities.

[6] In other words, adoption always requires adaptation, too, and thus it is a gross simplification to speak of 'imported' innovations (assuming that no local RTDI efforts and knowledge are needed by those firms introducing these types of innovations).

activities, producing goods that are traded inside big multinational automotive and electronics groups or global production networks. From a different angle, the OECD classification of sectors by their R&D intensity can be rather misleading from a policy point of view, given the significant deviation between the weight of 'high-tech' sectors in the Hungarian economic structure and their low knowledge-intensity.[7]

Hungary has all the major elements of a potentially successful national innovation system (NIS), and yet, its performance is 'moderate'.[8] The most important actors are listed below.

The Education, Science, and Research Committee, together with the Economic and Informatics Committee of the Parliament are the highest-level political bodies in the field of STI policy.

The National Research, Innovation and Science Policy Council, chaired by a deputy prime minister, co-chaired by the president of the Hungarian Academy of Sciences, has the mandate to co-ordinate governmental STI policy decisions. The members include three ministers with key responsibilities in devising STI policies, that is, the politicians heading the Ministry of National Development, the Ministry for National Economy, and the Ministry of National Resources.

In spite of the mandate of the NKITT, several major STI policy decisions have been made without discussing those issues by the Council, e.g. changing the Law on the Research and Technological Innovation Fund: from 2012 companies are not entitled anymore to deduct either their intra-mural R&D expenditures or the amount they spend on commissioning publicly financed R&D units from the innovation levy.[9] The President of the Hungarian Innovation Association (MISz) not only has criticised this very measure, but also protested against this practice of decision-making.[10]

The National Innovation Office (NIH) is responsible for the government's technology and innovation policy. Funds allocated through the Operational Programmes of the New Hungary Development Plan (2007-13) are managed by the National Development Agency (NFU). Both the NIH and NFU schemes are administered by an implementing organisation, called the Hungarian Economy Development Centre (MAG Zrt).

Hungary is a *unitary state with a centralised decision-making system* with regard to major policy domains, including STI policies. Although the regional level has gradually gained more influence in policy-making in general, mainly due to external pressures (EU

[7] The Hungarian case is not an 'exotic' exception, on the contrary, these features characterise many other countries. (Srholec, 2006) The Hungarian data simply confirm a more general observation: to analyse the link between economic structures and the level of demand for knowledge one should take into account the actual activities performed, and especially the knowledge content of these activities. This more demanding task cannot be spared by simply applying the OECD classification of sectors. In brief, one should make a clear distinction between high-tech sectors and knowledge-intensive activities: firms belonging to a high-tech sector might conduct activities with a low knowledge content, and in several cases that is characteristic to the sector as a whole, too, while the opposite can be observed in many low-tech sectors in certain innovation systems. (Havas, 2006)

[8] On some details of the moderate innovation performance, see sections 2-3, and on the apparent contradiction between having all the major elements of a potentially successful NIS in place and the moderate innovation performance, see e.g., Havas, 2011a, and Havas and Nyiri, 2007.

[9] On the innovation levy, and more generally, the Law on the Research and Technological Innovation Fund, see previous ERAWATCH reports, as well as the relevant policy document template in the ERAWATCH database.

[10] The President of MISz also stressed that stakeholders had not been consulted, either, prior to these major decisions. (meeting of the Presidium of MISz on 30 November 2011, http://www.innovacio.hu/ehirlevel/2011_22.html#top)

initiatives, guidelines, etc.), the central government's role in STI policy-making is still dominant.

All regions have the same status in terms of overall powers and responsibilities. The traditional sub-national levels of Hungarian policy-making were the 19 counties (plus Budapest) and the municipalities (local governments). With the exception of the largest municipalities, financing major RTDI activities would be unviable at a regional level. Local governments can influence these activities indirectly by operating local industrial parks (or co-operating with them), and offering various advantages (tax exemptions, favourable infrastructural conditions) to investments with a higher knowledge content and/ or more RTDI activities. With regard to STI policy-making, the regional and county levels have not gained a significant role, although the County Development Councils approve "county development programmes" with various STI policy measures, which predominantly follow the priorities of either the Economic Development Operational Programme (2007-2013) or the nationally funded STI policy measures.

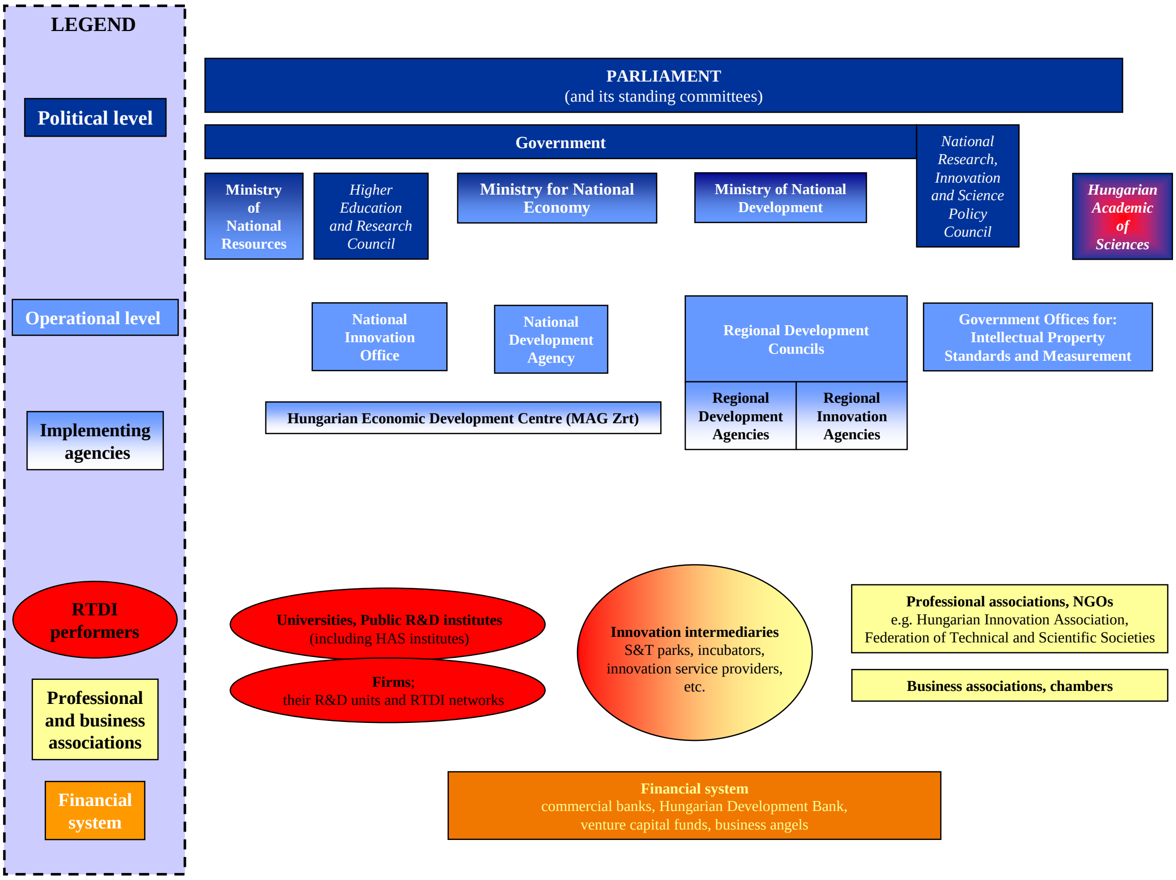
The EU Structural Funds regulations have demanded to create larger units compatible with the NUTS2 regions. As a result of the 1998 National Regional Development Concept, *seven regions* have been formed in Hungary, but mainly serving statistical-planning purposes, capable of administering the EU Structural Funds. Regions have neither democratically elected leaderships, nor any power to raise revenues.

Businesses have maintained their position as the largest employer of (FTE) researchers since 2006, reaching 48.1% in 2010, and had the biggest share in performing GERD (59.8%), too. Both R&D and innovation activities of firms are highly skewed by size, ownership and sector.

The largest number of research units is operated at *higher education* organisations (1,409 of the total 2,983 in 2010), but the average size of these units is rather small: 4.3 FTE researchers. The HE sector performed 19.9% of the Hungarian GERD in 2010, while the EU-27 average was 24.2%. The weight of this sector was 28.3% in 2010 in the employment of FTE researchers.

The government sector's share was 23.6% in 2010 in the total number of (FTE) researchers. This figure reflects a high weight of PROs in the Hungarian NIS compared to the EU-27 average (12.5% in 2009). The most important player is the Hungarian Academy of Sciences (MTA). The MTA still has a substantial – albeit declining – weight in the Hungarian research system: its share was 13.3% in the total R&D personnel (FTE) and 11.6% of the GERD in 2010.

Figure 1: The structure of the Hungarian National Innovation System (Dec 2011)



Source: compiled by the author
Note: The institutes of Hungarian Academy of Sciences conduct research, and hence the dual role of HAS is indicated by a combination of colours in the figure.

2 Structural challenges faced by the national system

Hungary is squeezed in a 'nutcracker' formed by advanced countries, on the one hand, and dynamic industrialising countries, on the other. The former ones are capable of controlling international production networks and markets via new technologies, financial muscles, and superior business models, while the latter ones are characterised by extremely low wages and highly disciplined work forces. It is possible to escape from this trap, and enhance international competitiveness, improve economic performance and hence quality of life by introducing new products, production processes and services, as well as organisational innovations, leading to higher productivity and entering new markets.

Yet, Hungary is a 'moderate innovator', that is, belongs to a group of countries characterised by an overall innovation performance below that of the EU-27, together with the Czech Republic, Greece, Italy, Malta, Poland, Portugal, Slovakia and Spain. (IUS 2010) At a first glance, these countries are rather diverse, e.g. in terms of their size, structural composition of the economy, level of socio-economic development, and historical legacy. Thus, it is crucial to identify the major structural features and challenges of the Hungarian national innovation system (NIS). That is a first step to better understand these issues, to be followed by adequate policy replies, bearing in mind the limitations of policies.

This chapter highlights five major structural challenges of the Hungarian NIS. It should be stressed, however, that these are not at the same level of 'granularity'. The first two ones can be understood as symptoms, which are important enough to consider them on their own; the third one is an 'early warning' signal; while the last two ones are not only important symptoms on their own, but also major reasons to be considered when explaining poor performance. Obviously, for a full explanation other factors should also be included.

1) *Low level of innovation activities, especially that of the SMEs*

Given the strong need for being innovative to "escape from the nutcraker", it is a challenge itself that only one-fifth of enterprises introduce product or process innovations in Hungary, with no major change since 2002.[11] This ratio is even lower for SMEs: only 16.8% of them introduced product or process innovations in 2006-2008, that is, 49% of the EU-27 average. (This figure was the same in 2004-2006, and slightly higher in 2002-2004: 17.6%.) The occurrence of organisational and marketing innovations among SMEs is also low compared to the EU average (52%), and declined from 25.3% in 2002-2004 to 20.5% in 2006-2008. (IUS and CIS)

2) *Low occurrence of co-operation in innovation activities among key actors*

Innovation processes draw on different types of knowledge and skills, often possessed by various types of actors. Co-operation among them is, therefore, indispensable for successful exploitation of knowledge. At an aggregate level, the frequency of innovation co-operation reported by Hungarian firms is higher than in most EU countries (Hungary is ranked 6 with 41.3% in CIS 2008; the EU average is not available). Yet, only 6.5% of innovative firms reported any form of co-operation with Hungarian "government or public research institutes", and with that figure Hungary ranked 16 among the EU countries. Moreover, the occurrence of this type of co-operation has declined from 8.6% in 1999-2001. (It was 6.4% in 2002-2004, and 6.1% in 2004-2006.) Further, the weight of the public research institutes is high in Hungary, albeit declining: this sector accounted for 23.4% of GERD in 2008 and still for 18.5% in 2010, while the EU-27 average was 13.3%. (Eurostat) Thus, the low intensity of co-operation in this category is certainly a challenge.

As for SMEs, only 7.1% of them were engaged in innovation collaboration with other partners in 2006-2008, while the EU average was 11.2%. Similar data are not available for large firms. As for innovative firms – those with technological innovation –, co-operation patterns of SMEs and large firms can be compared. The share of large innovative companies co-operating with suppliers of equipment, materials, components or software was 43.2% in 2006-2008, and thus Hungary ranked 15 among the EU countries. The same figures for small innovative firms (with 10-49 employees) and medium-sized ones were 24.8%, and 26.7%, respectively. It is even more worrisome that only 16.2% of small innovative firms were co-operating with their clients or customers, and 18.5% of the medium-sized ones did so. This issue can be taken as a specific feature of a broader challenge, that is, the dual economy syndrome: the Hungarian economy is composed of highly productive and technologically advanced foreign-owned large firms, on the one hand, and fragile, financially and technologically weak indigenous SMEs, on the other. This challenge, therefore, would need attention both by STI and economic policy-makers.

3) *Insufficient quantity and of human resources for R&D and innovation is forecast for*

[11] The weakest performers in the EU were Hungary, Latvia, Poland, and Romania in 2006-2008, with 20.8%, 20.1%, 19.8%, and 19.7%, respectively, while the EU average was 51.6%. (CIS 2008)

2015

The future of R&D and innovation activities is predetermined by the quality and quantity of scientists and engineers, and the level of skills more generally. Yet, both the share of S&E graduates and the rate of participation in life-long learning are rather low in international comparison. A significant gap might be opening between the supply and demand for qualified science and engineering (S&E) personnel in the near future. The number of graduates (ISCED 5-6) in mathematics, science and technology per 1 000 of population aged 20-29 grew from 5.8 in 2006 to 7.5 in 2009, that is, 52.4% of the EU-27 average (14.3) The share of doctoral graduates in the 25-34-year age group increased from 0.6 (per 1,000 people) in 2006 to 0.9 in 2009, but it was still only 60% the EU-27 average (1.5). Even though the trend shows improvement, the number of PhD degree holders is forecast to be insufficient in the medium run for maintaining the quality of the Hungarian research system. (Tamás *et al.*, 2005) The share of population aged 30-34 having completed tertiary education increased from 14.8% in 2000 to 23.9% in 2009, reaching 74% of the EU average (32.3%). Further, brain drain seems to be an element of this broad challenge: it is primarily the highly qualified, young workers, especially those with S&E degrees that are overrepresented within the group of Hungarians working abroad. (Csanádi *et al.*, 2008)

4) *Unfavourable framework conditions for innovation*

The macroeconomic situation, the structure of the economy, the overall entrepreneurship culture together with the intensity and type of competition seem to influence firms' behaviour with such a power that STI policy schemes cannot offer strong enough incentives to overrule these unfavourable effects.[12]

5) *Shortcomings in STI policy*

The OECD Review on Innovation Policy has identified five aspects of policy failures, of which four are highlighted in this report: (i) lack of political commitment, (ii) instability, (iii) shortfalls in implementation, (iv) slow, insufficiently informed policy learning processes. (OECD, 2008, pp. 15-16; details are discussed in section 3)

3 Assessment of the national innovation strategy

3.1 National research and innovation priorities

The Government's mid-term STI policy strategy (2007-2013) defines six priorities:

- "Expansion of companies' research and development activities;
- Establishment of internationally recognized research & development, innovation centres and research universities;
- Enhancing of the regions' research & development & innovation (R&D&I) capacity;
- Establishing a knowledge market which works on the principles of performance recognition and competition through the globalization of knowledge production and dissemination;
- Investment in large scientific facilities, primarily in the regional centres and the development poles, reducing regional differences (regional cohesion);

[12] For more details, see, section 3, as well as Havas, 2011a; Havas and Nyiri, 2007; and OECD, 2008.

- The dynamic increase in yearly R&D expenditure, above all as a result of growth in corporate expenditure." (Government, 2007, p. 3)

A new science and innovation policy document, entitled Science - Innovation Programme, was published in January 2011. It is a chapter in the broader New Széchenyi Plan (Hungarian acronym: ÚSzT), often referred by politicians to as the basic development strategy document of the second Orbán government.[13] Most likely, however, priorities set for the planning period of 2007-2013 – already approved by the European Union – cannot be altered in 2011-2012.[14]

The Science - Innovation Programme offers an overview of the Hungarian national innovation system, highlights strengths and weaknesses – based on the 2009 European Innovation Scoreboard indicators, as well as on the OECD review of the Hungarian innovation policy (OECD, 2008) –, sets STI policy goals, and identifies thematic/ sectoral priorities. The latter ones are as follows: mobility,[15] automotive industry, and logistics; health industries (pharmaceuticals, medical biotechnologies and instruments, balneology); ICT; energy and environmental technologies; creative industries.[16]

The Science - Innovation Programme highlights the role of tax incentives, favourable loans, and seed capital in advanced countries. On that basis it stipulates that the Hungarian STI policy mix should be reconsidered, e.g. tax incentives, vouchers for innovation services, loans, guarantees, and seed capital should play a more prominent role in the innovation policy toolbox than it is the case currently. Since the launch of this document, however, no such changes have occurred.

No major new policy tools have been introduced since the end of 2009, and thus there have been no noteworthy changes in the STI policy mix. There was an abrupt disruption in using domestic public funds for promoting RTDI activities: ~€58.2m (HUF16b) was "blocked" from the Research and Technological Innovation Fund (RTIF) in June 2010, that is, 36.6% of the Fund's 2010 budget. To achieve this target, all disbursements from the RTIF were suspended; and new project proposals were not accepted, either. The law on the central budget for 2011 (Act CLXIX of 2010) did not allow to make new commitments to finance RTDI projects from the RTIF in 2011. Thus, new calls of the on-going STI policy support schemes were not launched, let alone new schemes.[17] As for the STI policy support schemes co-financed by the EU Structural Funds (as part of the Economic Development Operational Programme, GOP), three of them were suspended in

[13] In 2002-2010, governments were supported either by a coalition of the socialist and a liberal party, or the previous one (in minority in the Parliament). The 2010 elections brought a fundamental change: a coalition of two right wing parties obtained a two-third majority in the Parliament. The current prime minister was in office in 1998-2002, and hence the current government is the second Orbán government.

[14] It is telling that not even the previous acronym in the codes denoting these schemes have been changed: the ones launched in 2011 are called GOP-2011-1.1.1; GOP-2011-1.2.1., etc.

[15] Mobility is to be understood here as transport, that is, not as researchers' mobility.

[16] Agriculture is also mentioned briefly as an important field for R&D and innovation, but unlike in the case of the other sectors/ technologies, no sub-section is devoted to these technologies.

[17] In more details, it was allowed to use the RTIF in 2011 to finance (a) on-going RTDI projects – that is, to meet contractual obligations, based on previous funding decisions –; (b) the activities of S&T attachés; (c) the creation and operation of databases, as well as analyses and monitoring activities to underpin STI policy decisions; (c) the domestic co-funding of STI policy schemes financed by the EU SF and research infrastructure development projects in EU co-operation; (d) membership fees/ contributions stemming from international STI co-operation agreements, organisations and research infrastructure; (e) the operation of the RTIF; (f) other relevant international commitments, especially those related to the EU membership of Hungary.

2010, and two of these were not re-launched in 2011, either. The other major GOP schemes were continued in 2011.

In sum, practically 'freezing' the main domestic fund to finance STI policy support schemes has hindered the launching of any new measures, while previous commitments – both in terms of actual granting decisions on-going RTDI projects and the Operational Programmes stipulating the types of schemes co-financed by the EU Structural Funds – impeded the reallocation of available funds. Due to these financial constraints, it has not been possible to amend the policy mix.

From a different angle, although the so-called New Széchenyi Plan sets several new thematic/ sectoral priorities for STI policy – as already mentioned –, no new schemes have been introduced to support RTDI activities in these S&T domains/ economic sectors.

Besides an on-line consultation on the Science – Innovation Programme there has been no major event devoted to national innovation policy discussions since 2009. Sporadic exchanges – e.g. short articles in dailies or weeklies, radio interviews – are dominated by budget cuts and organisational changes in the STI policy governance sub-system. The role of innovation in addressing societal challenges, and social innovation are non-issues in Hungary.

Evaluation of individual innovation policy measures or the policy mix as whole is still not a widely used practice in Hungary, either, especially in the case of nationally financed schemes. (ÁSz, 2008b, p. 48) As for nationally funded support schemes, one of the basic principles of the Law on Research and Technological Innovation was that publicly financed STI policy measures shall regularly be evaluated by independent experts. Despite these stipulations, only four nationally funded STI policy schemes have been evaluated since 2006.[18]

An evaluation report on the operation of the Research and Technological Innovation Fund in 2004-2009 was published in July 2010. As this is the main source to fund domestic STI policy support schemes, the assessment offered in this report can be used as good 'proxy' to gauge an important chunk of the innovation policy mix. Three key findings are highlighted in the executive summary of this report:

- uncertain support for innovation at the government level,
- the Fund has a marked and significant impact on the economy,[19]
- managing the Fund calls for significant improvements. (Ernst & Young and GKI,

[18] This 'sporadic' evaluation practice is not unique to STI policies in Hungary, and hence the State Audit Office has stressed that several billion euros for economic and regional development purposes had been allocated without clearly defined goals, rationales for state intervention, and efficient co-ordination of sectoral strategies. The impact of state intervention cannot be established due to the lack of clearly defined targets and systematic evaluation. (ÁSz, 2008a)

[19] This heading is more optimistic than the detailed observations: "The KTI Fund was necessary to keep the level of Hungarian public funding on RDI. (…) The concentration of support financed by the Fund varies significantly in the different sectors. (…) e.g. the Academy, large universities received significantly more support than organisations in other sectors. (…) about 10-15% of the 2,600 companies that received grants had success on the market. (…) Indirectly, in certain sectors (e.g. IT, engineering), the return on funding provided by the KTI Fund is often multiplied. (…) At the level of the macro-economy, the public funding on R&D resulted considerable additional welfare effects, and not necessarily at the economic agent that received funding. (…) the corporate sector and the universities/ public research institut[e]s have definitely come closer to one another." (pp. 5-6)

As already highlighted in section 2 of this country report, the share of innovative companies has remained at a very low level since 2002. The full text of the evaluation report – only available in Hungarian – also acknowledges that there has been no noticeable improvement in terms strengthening innovation activities of businesses. (Ernst & Young and GKI, 2010b, p. 134)

2010a)

Schemes co-funded by the EU Structural Funds must be evaluated, following the EU rules.[20]

The most recent assessment concerning the entire innovation policy mix was published in 2008 as part of the OECD review on the Hungarian NIS.[21] (OECD, 2008) The "Shortcomings in science, technology and innovation policy" are discussed under the following headings, which can be understood as a forceful, concise summary: lack of political commitment; instability; shortfalls in implementation; slow pace of reform; slow, insufficiently informed policy learning process. (ibid., pp. 15-16)

Impartial observers would agree that not much improvement has occurred since 2008; in fact, in some respects the current situation is even worse: decreased government funding indicates an even lower level of political commitment; yet another wave of reorganisation of major STI policy-making bodies has further undermined stability, prevented organisational learning, and thus hampered improvements in policy design and implementation. Framework conditions for innovation have not become more favourable, either.[22]

In conclusion, the innovation policy challenges identified in the above reports are so many and so fundamental that no 'quick fix' is possible; and thus no major improvement can be expected in 2012-13.

3.2 Trends in R&D funding

The government's mid-term STI policy strategy (2007-2013) stipulates that GERD should increase to 1.8% of the GDP by 2013 (up from 1.0% in 2006), while BERD should reach 0.9% of the GDP (from 0.45% in 2006). These goals seem to be overly optimistic: independent analysts had expressed serious doubts concerning the feasibility of these targets even before the global financial crisis. (OECD, 2008)

The Science – Innovation Programme, launched in January 2011, sets similar broad aims as the government's mid-term STI policy strategy (2007-2013), but it stipulates revised quantitative targets:

- R&D and innovation expenditures (that is, not GERD) should reach 1.5% of GDP by 2015, and "approach" 2% by 2020;
- innovation performance, measured by the Summary Innovation Index, should reach the EU average, and Hungary should belong to the top third of EU members in the "next cycle". (p. 234)

The National Reform Programme, launched in April 2011, sets yet again different quantitative targets: "*Hungary intends to achieve an increase in the level of research and development expenditures up to 1.8 per cent of GDP by 2020*, in such a way that the share of corporate R&D spending should rise relative to overall research and development expenditures. As an intermediate target, the New Széchenyi Plan aims to achieve an R&D expenditure rate of 1.5 per cent by the middle of the decade." (NRP 2011, p. 21; emphasis in the original)[23]

[20] Ex-ante, mid-term, and ex-post evaluations are published at the National Development Agency's website.

[21] The overall assessment and recommendations of the OECD report are summarised in 20 pages, of which 3 dedicated to a SWOT table. It cannot be summarised in a few sentences in this report.

[22] Section 3.3 describes the framework conditions in more details; see also, e.g. Havas, 2009, 2011.

[23] Lack of a consistent terminology adds to the already existing difficulties to comprehend what

Data have confirmed the doubts of independent analysts: the Hungarian GERD/GDP ratio remained at 1% in 2007-2008; then reached 1.17% and 1.16% in 2009 and 2010, respectively.

Table 2: Basic indicators for R&D investments in Hungary

	2008	2009	2010	EU average 2010
GDP growth rate	0.9	-6.8	1.3	2,0
GERD as % of GDP	1.0	1.17	1.16	2.0
GERD per capita (€)	105.4	106.4	112.4	490.2
GBAORD (€ million)	453.5	426.6	468.6	92,729.05
GBAORD as % of GDP	0.43	0.47	0.48	0.76
BERD (€ million)	556.8	610.8	673.5	151,125.56
BERD as % of GDP	0.53	0.67	0.69	1.23
GERD financed by abroad as % of total GERD	9.27	10.90	12.35	N/A[24]
R&D performed by HEIs (% of GERD)	22.04	20.94	19.93	24.2
R&D performed by PROs (% of GERD)	23.39	20.06	18.52	13.2
R&D performed by businesses (as % of GERD)	52.57	57.24	59.81	61.5

Source: Eurostat

The increase in the GERD/GDP ratio is due to a combined effect of two factors: (i) given the global financial and economic crisis, the Hungarian GDP shrank by 6.8% in 2009, and grew only moderately in 2010, while (ii) GERD continued to rise in nominal terms (by 0.76% in 2009, and 5.52% in 2010).

The Hungarian GERD/GDP still trails the EU-27 average (2.0% in 2010). In relative terms GOVERD is the closest to the EU-27 average (78%), while the share of BERD and HERD in GDP is 56% and 47% of the corresponding EU-27 indicators (Table 2).

Table 3 : The Hungarian GERD, BERD, HERD, and GOVERD, 2010

	€ million	Share in EU-27 total (%)	% of GDP, Hungary	% of GDP, EU-27 average	% of GDP, EU-27 average = 100
GERD	1,126,1	0.46	1.16	2.0	58
BERD	673.5	0.45	0.69	1.23	56
HERD	224.4	0.38	0.23	0.49	47
GOVERD	208.5	0.64	0.21	0.27	78

Source: Eurostat data, and author's calculation

BERD increased considerably – by 9.7% in 2009 and 10.27% in 2010 – and thus the BERD/GERD ratio jumped from 52.57% in 2008 to 59.81% in 2010, approaching the EU-27 average (61.51%). This increase was financed mainly by public and foreign funds: while the share of businesses in financing BERD decreased from 79.8% in 2008 to 71.0% and 70.8% in 2009, and 2010, respectively, the share of public funds[25] grew from 8.6%

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document is to be taken as the one reflecting the government's intentions, and what quantitative targets are to be used as yardsticks: the New Széchenyi Plan – only available in Hungarian – speaks of *R&D and innovation* expenditures, while the NRP 2011 refers to the New Széchenyi Plan as if it speaks of *R&D* expenditures.

[24] 8.4 (2009), 9.04 (2005)

[25] It should be noted that public funds include the EU Structural Funds, too.

in 2008 to 15.5% and 14.0% in 2009-2010, and the same figures for foreign funding are 11.4%, 13.4%, and 15.0%, respectively.

Institutional – or core – funding is vital for the operation of research units at HE organisations and PROs. There are two principal channels for providing such funding: normative support for R&D activities conducted at HEIs, and support to the Hungarian Academy of Sciences. Using GBAORD figures as a proxy for institutional funding, R&D financed from General University Funds (GUF) accounted for 27.7% and 22.9% of GBAORD in 2009, and 2010, respectively, while the figures for R&D financed from other sources than GUF were 21.6% and 20.1%; that is, nearly half of the GBAORD was allocated via core funding in 2009, and 43% in 2010. (Eurostat)

Competitive funding is also a major mechanism for public support to RTDI activities. The largest funds are the Research and Technological Innovation Fund (KTIA),[26] and the various Operational Programmes of the New Hungary Development Plan,[27] while for bottom-up funding is provided by a smaller one, called Hungarian Scientific Research Fund (OTKA).[28] The largest STI policy support schemes are co-financed by the EU Structural Funds, and given the cuts in domestic public funding, the balance has shifted significantly towards EU funds taking into account commitments made in 2010. Actual funding figures are not publicly available, and using that metrics might lead to a somewhat different picture, but probably still with a larger share of EU funds.

The dominant form of support is to provide grants; yet, other tools are also part of the Hungarian STI policy mix. Venture capital, favourable loans, and guarantees do not feature in the financial figures on commitments made in 2010: funds had to be set aside when these schemes started, and then can be used for 10-15 years. Given the nature of tax incentives, they do not appear in commitments figure, either.[29]

There are hardly any thematically or sectorally focused support schemes in the Hungarian STI policy mix.

Businesses have to cover certain share of the costs of publicly supported RTDI projects, but public-private partnerships, *per se*, are not used to leverage additional funding. On the contrary, the current government has started revising PPP contracts initiated by the previous government in other domains (e.g. sport, culture, higher education, infrastructure and prison investment projects). (Cseke, 2010)

3.3 Evolution and analysis of the policy mixes

The Policy Mix Project, which has identified the following six ‘routes’ to stimulate R&D investment:

1. promoting the establishment of new indigenous R&D performing firms;
2. stimulating greater R&D investment in R&D performing firms;
3. stimulating firms that do not perform R&D yet;
4. attracting R&D-performing firms from abroad;
5. increasing extramural R&D carried out in co-operation with the public sector or other firms;

[26] The annual budget of the KTIA is in the order of €180-200m.

[27] The most important element is Priority 1, “R&D and innovation for competitiveness” of the Economic Development Operational Programme (EDOP). Its budget is €990m for 207-2013, including 15% national contribution.

[28] The annual budget of OTKA is around €20m.

[29] R&D tax incentives amounted to 0.08% of GDP in 2007. (OECD, 2010, p. 77)

6. increasing R&D in the public sector.

Hungarian STI policy measures are not planned following this logic, e.g. firms that do not yet perform RTDI activities and those that do are not differentiated. Thus, it is not possible to estimate the relative importance of these routes in Hungary. In general, promoting RTDI activities of firms (routes 1-3) is clearly at the centre of policy attention. As a rough estimate, around 50% of the amount allocated to competitive RTDI funding directly promoted firms' RTDI activities until mid-2010. R&D and innovation is usually targeted simultaneously, therefore most measures have a wider scope than fostering R&D investments. Finally, several of the larger programmes (e.g. the National Technology Programme) support joint research projects with the participation of private and public research units.

The EWN categorisation of STI policy measures cannot be used either, to characterise the evolution of the STI policy mix in Hungary. Annual data on actual spending by schemes is not publicly available, and thus an aggregate figure cannot be calculated by the broad categories of policy measures. Reliable, sensible estimations can hardly be calculated, either: commitments are rarely made for a single year, and it would be a very strong – unsubstantiated – assumption to suppose that actual spending is evenly spread across years, and hence averages can be used as a good approximation of actual spending.

With these caveats, only some very rudimentary observations can be made as to the balance of funding allocated to different types of measures. "Promote and sustain the creation and growth of innovative enterprises" is by far the most important group of measures, followed by "Governance & horizontal research and innovation policies" (due to commitments made in 2010 to support clusters), and "Research and Technologies" (thanks to the funds devoted to infrastructure development at universities). Several schemes promote the development of "Human Resources", with small funds compared to other schemes, which are much more costly, given their different nature (modernisation of production equipment or research infrastructure). Finally, there was only one scheme operational in 2010 under the heading of "Markets and innovation culture".

There have been no major changes in terms of the main target groups of STI policy measures over the last three years: some schemes provide support for individual firms, while others put the emphasis on industry-academia co-operation or setting up accredited innovation clusters, and innovation activities by the members of these clusters. The balance between grants, loans, and non-direct funding measures has not changed, either.

Space limits would not allow conducting a thorough analysis of the Hungarian STI policy following the Innovation Union self-assessment tool [IU SAT], but several key points can be highlighted, drawing on recent reports by independent experts.

Promoting research and innovation is often mentioned as a key policy instrument to enhance competitiveness and job creation, address major societal challenges, and improve quality of life. [IU SAT, item 1] Yet, several reports have identified the lack of political commitment as a major problem.

> "While important policy documents stipulate science, technology and innovation as a policy priority, the requisite public investment and constant high-level policy attention to issues related to innovation have too often not followed." (OECD, 2008, p. 15)
>
> "Managing the [Research and Technological Innovation] Fund was continuously hampered by government/Parliamentary decisions, which repeatedly restricted the use of the Fund's cumulated residual funds and which occasionally suspended grant

> payments already duly awarded. The Fund's original goals, as set out in the underlying act, have been amended by state budget acts several times, when certain budgetary obligations were transferred to the Fund (e.g. payment of Hungary's contribution to the European Coal and Steel Research Fund). These unfavourable external interventions had a substantial disturbing impact on the Fund's independence and on planning use of the Fund. (Ernst & Young and GKI, 2010a, p. 4)

Moreover, as already mentioned, almost 40% of the most important domestic fund earmarked to support RTDI activities was frozen in 2010, practically no new commitments were allowed to make in 2011, and the Bill on the 2012 budget contains the same restriction. Hence, political commitment has not become stronger since the period covered by the above two reports. Further, the current Hungarian situation is also at odds with the requirement of having adequate and predictable public investment in research and innovation focused in particular on stimulating private investment [IU SAT, item 4].

Design and implementation of research and innovation policies is steered at the highest political level and based on a multi-annual strategy [IU SAT, item 2]: There has (almost) always been a high-level political body to co-ordinate policy efforts. However, this body had been reorganised constantly since the 1990s.[30] Thus strategy formation has been severely hampered.

> "Operations of the KTI Fund have continually been characterised by institutional and legal uncertainty to date. Developing and executing the grant schemes could not be aligned with a long-term strategy. (…) In the period between the [Research and Technological Innovation] Fund's foundation in 2004 up until early 2007, there was *no written, government approved innovation strategy*. In this period managing the Fund was based mostly on the vision of NKTH's [National Office for Research and Technology, the government agency administering the Fund] senior management (…) and this remained at the core of NKTH's programmes and calls for proposals for the ensuing years. (…) The STI strategy approved in 2007 and NKTH's institutional strategy dated December 2007 have set general goals *without defining a clear hierarchy of goals or priorities*. These documents do not specify the tools to attain the set goals and they do not define the role of the KTI Fund in executing the STI strategy. (…) in the absence of mandatory regulations or a properly authorised and competent co-ordinating organisation, the status of the KTI Fund and its connection to the other related policy tools remains unclear.
>
> This situation was aggravated by the fact that decisions taken regarding the Fund were not supported by evaluations, therefore there was almost no feedback regarding the impact of the interventions implemented during the period under review. (…) Despite the efforts made, the fragmented nature of NKTH's databases about the proposals and projects as well as the occasionally inaccurate, in other cases missing data records equally hamper strategic management, organisational learning and evaluations.

[30] For a long period this body was called the Science and Technology Policy Council (TTPK), and for several years it was headed by the prime minister, and at the end of the 1990s by a representative of the prime minister; its secretariat had also been moved around the Prime Minister's Office and other ministries. These organisational changes had clearly reflected its diminishing political clout. Moreover, it had rarely met since 1998; between 2003 and 2006 on average it met once a year. Then it had not met until it was dissolved in March 2009. Half a year later a new high-level STI policy co-ordination body was created, called Research and Science Policy Council. It held its first and only meeting on 17 February 2010, chaired by the prime minister. It was disbanded on 15 December 2010 by a government decree stipulating the creation of the National Research, Innovation, and Science Policy Council.

> Until the end of the reviewed period, NKTH performed rather poor monitoring. As a result, the Fund's programmes and projects could not provide the feedback important for programme planning or evaluating the proposals. The Fund does not use indicators to monitor the progress of its mid-term strategy, programmes or projects or to monitor direct and indirect impacts.
>
> In the reviewed period, NKTH commissioned independent experts only occasionally with the task of evaluating the Fund's operation, and no such evaluation was directed towards the Fund's operations or the programmes as a whole. Thus, NKTH could not experience the benefits of constructive feedback. The majority of these evaluation reports were not disclosed to public. (Ernst & Young and GKI, 2010a, pp. 2-5; emphases added)

Innovation policy is pursued in a broad sense going beyond technological research and its applications [IU SAT, item 3]: It is telling that the major domestic fund, set up in 2004 to support RTDI activities, was named Research and *Technological* Innovation Fund, although several experts suggested to embrace the broader concept of innovation. More recently, several schemes, co-funded by the EU Structural Funds, have been introduced to promote improvements of processes and organisational change, introduction of new business models, and marketing.

Partnerships between higher education institutes, research centres and businesses are actively promoted [IU SAT, item 7] by several schemes, and for years in Hungary. Evaluation reports offer somewhat contradictory assessments: Ernst & Young and GKI, 2010b concludes that industry-academy co-operation has strengthened (pp. 87-90), while foreign experts have claimed that business-academia linkages are weak primarily due to the mismatch in the incentive structures of these different types of players, as well as the insufficient understanding of the industry's needs in academic circles. (Arnold *et al.*, 2007)[31] This issue needs to be revisited when CIS 2010 data become available.

Framework conditions to promote business investment in R&D, entrepreneurship and innovation [IU SAT, item 8]: Macroeconomic policies have failed to create a stable, predictable environment for businesses. Economic growth has been volatile at least since the mid-1990s, due to the stop-go type policies to a large extent. Inflation has constantly been above the target, and thus making business planning a more demanding task. Government behaviour has also been unpredictable (e.g. the tax code has been rewritten frequently). Both the general government deficit and the general government debt (as a percentage of GDP) have been rather high, i.e. the economy has suffered from twin deficit, as well as a high level of government borrowing. Businesses, in turn, felt the crowding out effect of the mounting fiscal deficit. In sum, the macroeconomic environment has been unfavourable for RTDI activities of firms.[32]

Administrative costs incurred by businesses are high by international standards, and that is especially unfavourable for SMEs. It takes just a little bit longer in Hungary to register a new company than the OECD average (16 vs. 14.9 days), but costs are around

[31] Similarly, a report by the Ministry of Economy and Transport points out that despite the relatively good performance of public research institutes (in terms of scientific output, in international comparison), there is a weak or no consideration for industrial needs in these units. Scientific excellence is still considered the first and foremost criterion for advancement in the HE and government research sector; economic relevance of research is given far less attention. Economic aspects are not considered in the management of such institutes, whereas knowledge transfer is impeded by an alarmingly low level of researcher mobility between research performing sectors. (GKM, 2008, p. 43-44)

[32] For further details, see, e.g. Havas, 2011a and 2011c

3.5 times higher (17.7 vs. 5.1% of GNI per capita), and the capital requirement is two times higher (65.1 vs. 32.5% of GNI per capita). Closing down an operation takes double amount of resources, and 8.4 months longer compared to the OECD average. The tax system is also putting a significantly higher administrative burden on companies; moreover, the total tax rate is notably higher than the OECD average (55.1% vs. 46.0% of profit).[33]

The Hungarian competition and IPR rules are in accordance with the EU legislation and international treaties. (OECD, 2008) It seems, however, that regulation is a necessary but not sufficient condition for an intense market competition, inducing innovation. Most firms do not feel the pressure to innovate. When asked about the factors hampering innovation, financial constrains are mentioned with the highest frequency by Hungarian respondents, but market conditions also play a non-negligible role.[34] (Table 4)

Table 4: Major factors hampering innovations, 2004-2006

	Enterprises with technological innovation	Non-Innovative enterprises
Lack of funds within enterprise or enterprise group	28.8%	25.5%
Lack of finance from external sources	19.9%	17.0%
Innovation costs too high	27.3%	28.2%
Lack of qualified personnel	14.0%	8.9%
Markets dominated by established enterprises	15.4%	17.6%
Uncertain demand for innovative goods or services	14.0%	20.4%
No need to innovate because no demand for innovations	4.0%	10.5%

Source: Eurostat, CIS 2006

Notes: 1) These replies refer to those firms that selected these factors as highly important ones. 2) Not all hampering factors are included in this table. 3) These questions were not included in the CIS 2008 questionnaire, and thus more recent data are not available until the results of the CIS 2010 survey are published.

Public support to research and innovation in businesses is simple, easy to access and high quality in a well performing innovation system. [IU SAT, item 9] The Hungarian NIS cannot be characterised by this feature:

> "Owing to a lack of stability and to frequent organisational changes, the timing of managing the grants and the projects (e.g. contract preparations, reimbursement of costs) was highly hectic and this has had a damaging effect on the quality of technical performance.
>
> We have observed weaknesses in the process of evaluating the proposals (e.g. there were incomplete procedure manuals, sketchy documentation, not sufficient

[33] For further, regularly updated data, as well as details of the methods, see http://www.doingbusiness.org/economyrankings.

[34] There are no readily available analyses on the impacts of competition on innovation, only on R&D. (Halpern and Muraközy, 2011)

> information contained in the letters explaining rejection of proposals etc.). In addition, in some cases and referring to the first half of the period evaluated, some interviewees reported professional and ethical types of conflicts of interest and other not purely professional considerations (about external impacts beyond the operation and regulation of the Fund) experienced in the decision making process (…).
> In the reviewed period many organisations contributed to managing the tendering system and the projects from the government side. The parties involved and their respective roles in the system (for example between NKTH and MAG Zrt.) have often changed. This often slowed down and hindered the Fund's efforts to meet its contractual obligations, especially regarding the reimbursement of costs." (ibid., pp. 4-5)

The Hungarian Association for Innovation has also pointed out at several occasions that even once a decision is made, it takes unduly long time before the contracts are signed (let alone disbursements), not least because new project documents are demanded even at this stage of the procedure.

- The number of STI policy schemes is rather high, and thus some schemes tend to overlap. Thus, well-targeted efforts are needed, such as fine-tuning the direct and indirect instruments, sector-specific and generic schemes, streamlining the portfolio of measures to avoid overlaps and make it more transparent. (OECD, 2008) The policy mix has been deemed insufficiently transparent and potentially inefficient by the State Audit Office, too. (ÁSz, 2008b, pp. 43-44) The high number of schemes in itself indicates the ad hoc nature of policy-making: the current policy mix is rather a collection of otherwise stand-alone, isolated initiatives and actions, than a result of conscious and co-ordinated (re-)targeting of policy strategies.
- As already mentioned, funding schemes are irregularly evaluated and benchmarked against comparable schemes in other countries.
- However, specific schemes offer support to young innovative companies to help them commercialise ideas.

Public sector as a driver of innovation [IU SAT, item 10]: measures are in a preparatory phase both at a regional and national level to introduce pre-commercial procurement as a policy tool. The Public Procurement Council considers this issue as a priority, and aims at disseminating relevant information among stakeholders. Further, the Science and Innovation Programme of the New Széchenyi Plan highlights pre-commercial procurement among the priorities, with proposed actions including: (i) dissemination the culture of pre-commercial procurement, and (ii) application of pre-commercial procurement in tendering in order to enhance developments in the ICT sector.

3.4 Assessment of the policy mix

The overall paradoxical feature of the Hungarian NIS is that innovation performance is 'moderate' (IU Scoreboard 2010) in spite of an impressive number and range of STI policy measures, which seem to be appropriate. Further, there are 'recurring' severe macroeconomic imbalances, too, at least for years, if not decades. In such an uncertain environment firms tend to focus on day-to-day survival, and thus RTDI activities are rarely in the focus of business strategies.

A comprehensive project would be needed to analyse (a) the impacts of the various policies affecting economic and innovation performance; (b) the links between these policies; (c) as well as the interrelationships between innovation and economic performance (at micro, mezzo, and macro levels). Clearly, this report alone cannot offer such a complex treatise of these issues. Moreover, a proven and operational general theory on these issues is yet to be developed. These links are always indirect, complex, and occur with considerable delays. Moreover, it is hardly possible to disentangle the effects of various economic and other macro-level policies and STI policies *per se*.

As to the individual challenges highlighted in Chapter 2, at least the first three of them have been identified in various policy documents by the government, while the other two ones by independent experts and international organisations. None of them are recently identified challenges, and hence several measures have been introduced to promote RTDI activities of firms, strengthen industry-academia co-operation, and increase the supply of S&E graduates. In brief, somewhat modest improvement has been achieved in these three fields, and hence STI policy measures have not been highly effective.

As already shown, the share of **innovative firms** has not increased – at least not up to 2008, i.e. the latest available CIS results. The BERD/GDP ratio, however, has escalated from 0.36% in 2004 to 0.69% by 2010, but still lagging considerably behind the EU-27 average (1.23%). From a different angle, it is not only way below the Barcelona target, but also the government's own target of 0.9% of GDP to be reached by 2013 (according to the mid-term STI policy strategy).

Private research efforts are conducted to a disproportionately large extent by large, mainly foreign-owned firms in a handful of sectors.[35] Large firms accounted for 57.0% of BERD in 2010, but their weight had been even higher, that is, between 70 and 80% in 2000-2007. While the share of research units operated at foreign-owned businesses remained below 15%, these firms accounted for 66-74% of BERD in 2003-2007, decreasing to 60.9% in 2010. Notably, the manufacture of pharmaceuticals, medicinal chemicals and botanical products accounted for 58.0% of the total R&D spending in manufacturing industry in 2006 (Eurostat), and still 47.9% in 2010. (KSH) That implies that RTDI strategies of the parent companies of these subsidiaries are at least as important as Hungarian STI policies.

As for **industry-academia co-operation**, mixed assessments are offered by evaluation reports (see section 3.3). One indicator shows some improvement: the number of public-private co-publications per million inhabitants has increased from 15.5 in 2003 to 19.6 in 2008, but it is still 54% of the EU average.

With regard to **human resources for R&D and innovation**, although several indicators have shown improvement, Hungary is still way below the EU-27 average. (Figures are reported in section 2.)

A 'desirable' ratio of S&E students cannot be achieved in the short-run: it is not a question of mechanically increasing the number of enrolled students at the relevant faculties.[36] First, as a basic precondition, S&E education has to build on high-quality primary and secondary education. Second, more attractive job prospects are needed to lure young talents towards S&E careers. Government policies alone can create these prospects in the public research sector only. When economic development, education, employment, and STI policies are pooled together, devised and implemented in an orchestrated and effective way, they can also induce businesses to create this type of jobs, but the actual decisions and investment should be made by businesses. Thus, a much wider policy perspective is needed, as well as concerted public and private efforts, sustained for a longer time-horizon, to deal with this complex challenge.

[35] R&D data are available either by size or ownership, and thus reported here in this way. Yet, one should bear in mind that most large firms are foreign-owned in Hungary.

[36] Both the absolute number and the share of S&E students (all levels) has increased in recent years, from 76,217 (18.0%) in 2005 to 82,196 (22.8%) in 2010, while that of S&E graduates from 7,227 (10.3%) to 10,786 (16.4%) in the same period. (KSH)

Framework conditions for innovation have not improved, as already stressed in section 3.3.

Shortcomings in STI policy, as identified by the OECD Review on Innovation Policy (2008), have not been rectified, either. *Lack of political commitment* is still a major problem. For many years, innovation has not been a major policy issue in Hungary. Politicians' agenda has been almost permanently preoccupied with short-term macroeconomic tensions, the complex challenges of the transition process in the 1990s, and then joining the European Union, as well as 'burning' domestic political issues. Further, RTDI is still mainly perceived as burden on the budget, rather than part of the solution, i.e. a major factor to socio-economic development. Thus, the potential – and obviously long-term – contribution of innovation to socio-economic development is not in the centre of political and policy discussions in Hungary: STI policies are eclipsed by the immediate political and economic policy goals.

The last two years have only strengthened this feature. STI policies received hardly any attention from politicians in 2010, given the two elections held in the same year (general elections in April, followed by local elections in October). Hence, no STI policy changes occurred. Given the cuts in domestic public funding for RTDI since June 2010, already mentioned, several small companies and bridging organisations, for which revenues from government support schemes are crucial sources, already face severe financial difficulties, and major decision-preparatory projects, e.g. the one to underpin the national RI development strategy, have also been put on halt. More generally, these abrupt measures undermine the shaky relationship between the research community, firms active in RTDI, and politicians. Highly effective new measures would be needed to start building trust again, and re-energise the shocked, demoralised researches What can be destroyed overnight, might take years to rebuild. Experienced, highly skilled scientists and engineers may leave for other countries where they can continue their research activities. Hampering RTDI activities when those would be crucial to be prepared for a new, post-crisis era is particularly harmful, no doubt.[37]

As for *instability*, frequent reorganisations of the STI policy governance sub-system have become a major feature of the Hungarian NIS. Several studies have noted that organisational instability affects negatively policy formation and implementation as it hampers organisational learning and imposes unnecessary burdens on RTDI performers, too. (Ernst & Young and GKI, 2010a, Havas, 2009, Havas and Nyiri (eds), 2007, OECD, 2008) This instability "has arguably had detrimental effects on the ability of agencies to implement measures consistently, thus blurring signals and creating a good deal of uncertainty among beneficiaries of the policy measures. Moreover, excessive instability is a serious obstacle to institutional learning and to the adoption of an evidence-based approach to STI policy making in Hungary". (OECD, 2008, p. 15)

Shortfalls in implementation have also been stressed by the OECD review, confirming observations by other analysts: "The difficulties encountered for optimal implementation of STI policy are partly related to the lack of commitment and stability. If the level of policy attention is low and organisations and institutions undergo frequent changes, implementation is likely to suffer. However, additional factors also limit the efficiency of the policy system:

- Scarce capacity at both the national and regional levels to implement a rather large number of programmes.

[37] The president of the Hungarian Association for Innovation protested against the cuts in domestic public funding for RTDI in several interviews in the electronic and printed media in 2010, and leading researchers also stressed the negative consequences of this measure in several articles published in dailies and weeklies.

- Delayed decisions and tardy provision of promised public funding often make planning of projects by R&D performers, notably business enterprises, very difficult." (OECD, 2008, p.15)

Finally, *policy learning processes* were described by the OECD Review as slow and insufficiently informed. "Tools for strategic policy intelligence and policy learning, such as monitoring, evaluation, and technology foresight, are used only occasionally (...)." (OECD, 2008, p.16) This list can be extended by the lack of thorough analyses of innovation performance (combining census, R&D and innovation data) and technology assessment. The government's STI policy action plan also stipulates that it is an important task to apply relevant, up-to-date methods – notably technology foresight, technology assessment and technology watch – to identify, co-ordinate and channel demands for knowledge. However, the prevailing practice is one of fragmented support for RTDI activities, without a comprehensive understanding of knowledge dynamics (drivers for the emergence of new knowledge, and demand for knowledge).

Table 5 : Structural challenges, policy actions, and impacts, Hungary

Challenges	Policy measures/ actions	Assessment in terms of appropriateness, efficiency and effectiveness
Low level of innovation activities, especially that of the SMEs	A large number of schemes and increased public funding are in place providing incentives for companies to engage in RTDI.	These measures are appropriate, e.g. in terms of their overall objective, the identified target groups, and the tools applied (grants and tax incentives). Yet, they are not likely to be effective unless framework conditions for RTDI improve significantly.
Low occurrence of co-operation in innovation activities among key actors	Several schemes have provided incentives for strengthening industry-academia co-operation since the late 1990s.	In general, these schemes are appropriate; there is a strong rationale to use public funding for this purpose. Public funds are not spent as efficiently as it could be: (i) several of these measures have overlapped; (ii) these measures might have induced 'rent-seeking' strategies, leading to superficial and temporary collaboration, instead of facilitating knowledge circulation and exploitation in a sustained way. Evidence on impacts is mixed. The effectiveness of these measures could be significantly increased by reforming the public research sector, especially placing more emphasis on exploitability of knowledge when evaluating research performance.
Potential gaps in the quantity and quality of human resources for RTDI	The quota for publicly financed students enrolled at S&E faculties has been increased.	Financial incentives or mechanical increases in S&E enrolment themselves might not yield results without major changes in the research and education systems, and sustained, concerted public efforts and actions by businesses.

Challenges	Policy measures/ actions	Assessment in terms of appropriateness, efficiency and effectiveness
Unfavourable framework conditions for innovation	Severe austerity measures were introduced in 2008-2009 to cut budget deficit. The economic policies pursued since June 2010 have increased fiscal tensions by the end of 2011. The fundamental institution of a market economy, that is, private ownership, has been severely undermined by various laws and measures.	Given the macroeconomic tensions and the lack of meaningful dialogue among the major political parties it is uncertain if fundamental reforms, needed to create more favourable framework conditions, can be implemented. The measures applied since June 2010 have created a less transparent and predictable, highly volatile environment. Other measures amending private contracts between banks and their clients by law, so-called sectoral taxes, and in essence nationalising private pension funds' assets have undermined the trust of investors and international organisations. Two of the three major international credit rating organisations downgraded the Hungarian government bonds into the "junk" category in December 2011, and the EC pulled the plug on preparatory talks with the Hungarian government on a joint loan agreement with the IMF.
Shortcomings in STI policy	The STI policy governance sub-system was once again reorganised in 2010. Domestic funding for RTDI was cut severely in 2010-2011.	No measures have been taken to rectify the shortcomings identified by the OECD Review. The reorganisation of the policy governance sub-system has further aggravated the problems stemming from instability: (i) lack of possibility for organisational learning and thus weakened policy formation and implementation capabilities; (ii) unnecessary burdens on RTDI performers.

4 National policy and the European perspective

An intriguing puzzle can be observed in Hungary: whereas there are a large number of apparently relevant policy schemes to foster RTDI activities, innovation performance is 'moderate'. Two main reasons have been identified by independent analysts. The first one points outside the narrowly defined STI policy domain: the framework conditions for innovations influence firms' behaviour with such a power that STI policy schemes cannot offer strong enough incentives to overrule those unfavourable effects. Thus, major policy efforts are needed to create favourable framework conditions, notably a stable macroeconomic environment; endurable administrative and tax burdens on firms; strong demand for new products; a sufficient supply of skilled people for RTDI projects; appropriate regulations and standards; effective IPR policies; etc. Further, policies affecting these conditions need to be aligned with STI policy efforts to make a difference.

The second set of factors can be grouped together as shortcomings in STI policy-making, including lack of political commitment. R&D and innovation needs to be perceived by politicians as a major contributor to socio-economic development, as opposed to the current – although implicit – understanding, when it is taken as a burden on the budget, and thus becoming the first 'victim' when budget problems must be solved.

Frequent changes in the structure of the STI policy governance sub-system has lead to organisational instability, which, in turn, affects negatively policy formation and implementation as it hampers organisational learning and imposes unnecessary burdens on RTDI performers, too. Hence, this sub-system needs to be stabilised.

Combining these explanatory factors, there seems to be no 'panacea' or a simple 'quick fix' to improve RTDI performance. Substantial efforts are needed, both at the level of the overall strategy formation and the design and implementation of STI policies. At a strategic level, conscious co-ordination of major economic and STI policies should is needed, guided by an overarching socio-economic development strategy. Foresight processes would be useful to underpin these strategies. These systematic, strategic dialogues among major stakeholders, supported by thorough, transparent background analyses, could also contribute to orchestrating the main objectives at different policy domains and levels (macro, mezzo and micro).These dialogues can also highlight how RTDI processes – advanced by appropriate STI policies – can contribute to overall socio-economic development. Policies affecting RTDI processes and performance need also to be orchestrated. Up-to-date decision-preparatory methods – most notably thorough analyses of innovation performance, combining census, R&D and innovation data; evaluation of individual policy measures, as well as that of the policy mix as a whole; and technology assessment – should be relied upon when devising and implementing STI policy measures, also assisted by recurring consultations with the major actors of the national innovation system.

Taking a somewhat mechanistic approach, the European Research Area does not feature prominently in Hungarian STI policy documents. It is only mentioned in the government's mid-term STI policy strategy (2007-2013) in a footnote, when referring to important EU policy documents. Further, ERA is mentioned in the National Lisbon Action Plan (2008-10) in connection with the National Research Infrastructure Survey and Roadmap (NEKIFUT, Nemzeti Kutatási Infrastruktúra Felmérés és Útiterv) project, as well as when listing other ERA-related activities, concerning joint programming, mobility schemes and international co-operation.

Taking a broader approach, the government's mid-term STI policy strategy (2007-2013) stresses the need to align the national and EU STI policy goals: "It is Hungary's primary interest that taking into account its own situation, financial opportunities and endeavours, it should contribute to the realization of the common European goals, besides defining its own national interests and strategic goals" (p. 5). Thus, while the national STI policy mix is not aligned with the specific ERA pillars and objectives in an explicit, purposeful way, there is no major tension between the national policy goals and the ERA initiatives, either. As already indicated, severe cuts in government funding for RTDI since mid-2010 have prevented the launch of new schemes. Hence, only recent measures can be mentioned in Table 6 (not new ones in a strict sense, i.e. introduced in 2001).

Table 6: Assessment of the national policies/ measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA dimension	Main challenges at national level	Recent policy changes
1	**Labour market for researchers**	The share of S&E graduates is half of the EU average Potential gap in the supply of human resources for RTDI Working conditions for researchers are not attractive enough	Higher quota of publicly financed students enrolled at S&E faculties Worsening working conditions due to the severe cuts in government funding for RTDI since June 2010

	ERA dimension	Main challenges at national level	Recent policy changes
2	**Cross-border co-operation**	Given the low level of public funding for R&D, Hungary can only fund cross-border co-operation to a rather limited extent	Schemes to support participation in EUREKA, COST, FP7, and ERA-Net projects, Joint Technology Initiatives (JTIs), and joint programming have already been introduced since the early or mid-2000s Some of them have been affected by the cuts applied since June 2010: no new calls were published
3	**World class research infrastructures**	An uneven technical level of RIs: a mix of up-to-date and outdated facilities Lack of a comprehensive RI investment strategy, suboptimal use of public funds	A strategy-building process to underpin RI policies was launched in 2008, on hold since mid-2010. Participation in devising the ESFRI Roadmap, commitment to host one of the ELI sites
4	**Research organisations**	Uneven teaching and research performance of HEIs	Several schemes to modernise education and research facilities at universities were introduced in 2007*
5	**Public-private partnerships**	Low occurrence of co-operation in innovation activities among key actors Low level of inter-sectoral mobility	Several STI policy measures to foster industry-academia collaboration are in place since the early or mid-2000s
6	**Knowledge circulation across Europe**	Fairly limited means to contribute to the development of a sustainable, efficient, and effective European scientific information system	There are no specific Hungarian policy measures aimed at enhancing open circulation of knowledge across national borders and open access to research outputs
7	**International co-operation**	In most cases grants offered by bilateral agreements between Hungary and other countries cover only travel and subsistence costs (not costs of conducting research)	Hungarian STI support schemes are open to non-nationals, but funding is limited for them: foreign organisations are not entitled for Hungarian grants, foreign citizens obtaining a Hungarian mobility grant should carry out the supported research project at a Hungarian research unit, and the grant holder should be employed by that organisation

* Ten calls were published in 2010-2011 under the priority axis of "Developing the content and organisation of higher education to create a knowledge-based economy" of the Social Renewal Operational Programme of the New Hungary Development Plan (2007-2013). This priority axis has two

major interventions: "Improving the quality of tertiary education in accordance with lifelong learning"; and "Expansion of the capacities of R&D&I&E [Research, Development, Innovation and Education] of tertiary education, thus supporting the enhancement of institutional cooperation with businesses". All these schemes are co-financed by the EU Structural Funds, and thus have not been affected by the cuts in government funding for RTDI activities.

Annex: Alignment of national policies with ERA pillars/ objectives

1. Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers

1.1 Supply of human resources for research

Despite the detrimental effects of the global economic crisis on the Hungarian economy in general, the number of researchers kept steadily increasing in 2008-2010 the total number of FTE researchers in Hungary grew from 17,391 in 2007 to 21,342 by 2010. (KSH) Thus, the share of researchers in total employment also grew from 0.44% in 2007 to 0.59% in 2010. As already mentioned in section 1, the business enterprise sector became the largest employer of (FTE) researchers in 2006 (6,248 researchers, 35.5% of national total), and has kept that position since then (10,274 researchers, 48.1% of national total in 2010). In spite of the increased share of researchers in total employment, Hungary still lags behind the EU-27 average (0.72%).
University enrolment data show that science and engineering are still not among the most popular career paths, and this has been identified as one of the key challenges of the Hungarian innovation system. (For data, see section 2.)
Researcher mobility has been permanently at a low level, with regards to both inter-sectoral and cross-border mobility. Hungary has one of the lowest shares of inward researcher mobility among the surveyed EU countries. (MORE, 2010, p. 35)
International mobility of researchers has stagnated since 2006. The number of foreign researchers employed in Hungary was 630 in 2010, and accounted for only 3% of the total number of researchers. The vast majority (68%) of foreign researchers were EU citizens, and 16%-16% came from other European countries and other continents. An additional 196 foreign researchers stayed in Hungary for shorter periods as grant holders (as opposed to staff members), just over half of them from other EU countries. Outward mobility has also been relatively stable. In 2010, 398 Hungarian researchers stayed abroad for more than six months (of which 299 with employment contracts, the rest as grant holders). (KSH) Four hundred and fifty one foreign citizens were registered as PhD and DLA students at Hungarian HEIs in 2009/2010 (corresponding to 6.6% of all doctoral students), though the vast majority of them were Hungarians from neighbouring countries. (NEFMI, 2010, p. 148)
Several STI policy measures promote inward and outward mobility, some of them directly, as their main objective. The Mobility scheme provides support to three target groups: (i) Hungarian researchers carrying out research at outstanding foreign research institutes or universities; (ii) foreign researchers coming to Hungary, (iii) Hungarian researchers currently working outside Europe returning to Hungary.

1.2 Ensure that researchers across the EU benefit from open recruitment, adequate training, attractive career prospects and working conditions and barriers to cross-border mobility are removed

The yearly wages of researchers in Hungary were below the EU25 average both in absolute (€15,812 vs. €37,948) and in PPS terms (€27,692 vs. €40,126) in 2006. (EC,

2007) Hungarian researchers' ranking in terms of remuneration decreases along the career path among the 33 countries covered: Hungary ranks 20th in the group of researchers with 0-4 years of experience, and fall back to the 26th position for those with more than 15 years experience. Researchers in the private sector earn roughly 20-25% more than their colleagues working for PROs.

The average net wage for employees performing "professional, scientific and engineering activities" was ~€698 (HUF192,061) a month in 2010. (KSH)

The salaries of academic staff in the public research sector are determined by law, based on scientific seniority. On the basis of scientific performance, however, employers may provide supplementary salaries. Researchers' additional income stems from various projects, or scholarship schemes. There are no readily available figures to assess the relative weight of these sources of income. In general, however, researchers employed in the public sector are modestly paid, and therefore (i) salaries are not the key motivating factor for pursuing a scientific career; (ii) it is a must to earn additional income from research and/or consultancy projects or even other (non-research) activities.

Hungarian university-level graduates have the highest earnings advantage among OECD countries: those with below upper secondary qualifications earn 73% of national average, while those with tertiary education 217% of that.[38] (OECD, 2007)

Unemployment figures also show a much more favourable position compared to lower qualifications: 2.6% among ISCED 5-6 vs. 16% for ISCED 0-2 level. (KSH)[39] This difference is smaller in many other countries.

The demand for PhD degree holders is strongest in the HE sector.[40] (Felvi, 2007) In general, the activities of doctoral schools are still not sufficiently aligned with the needs of businesses, given the lack of mutual understanding of each other's activities. More than two-thirds of those holding a doctoral degree work in the public research sector. These findings, especially the need to improve dialogue between HEIs and the industry regarding the economic relevance of curricula, have also been stressed by the OECD's *Review of Innovation Policy in Hungary* (OECD, 2008).

Inward mobility is of almost negligible importance. As already mentioned, foreign researchers employed in Hungary accounted for only 3% of the total number of researchers. Most of them are likely to be of Hungarian origin from the neighbouring countries where overall working conditions and earnings are roughly at the same level or slightly less favourable. Regulation does not allow flexibility in wages paid by PROs, and hence researchers from countries with better working conditions and significantly higher salaries are not attracted to take up positions in Hungary. As for the private sector and private non-profit research organisations there are no such restrictions, it is up to their budget if they can pay higher wages for foreign researchers coming from more affluent countries.

As of December 2011, 12 organisations have signed the Charter for Researchers: 9 HEIs, 1 research centre at the Budapest University of Technology and Economics, and 2 private non-profit research centres. The National Office for Research and Technology promotes the uptake of the Charter.

In general, research positions at public research institutes are open to non-nationals. In most cases, however, command of the Hungarian language is among the prerequisites.

[38] These data refer to the 25-64 years old age group of the population in 2004.

[39] One also has to bear in mind that Hungarian employment rates are significantly below the EU average in all qualification groups.

[40] The study was conducted by the National Higher Education Information Centre in 2002 and 2007, based on in-depth interviews and surveys, using a representative sample of degree holders.

That basically prevents foreign nationals from applying for these positions (except the ethnic Hungarians coming from neighbouring countries).
The equivalence/ validation of foreign academic degrees, i.e. the recognition of foreign certificates and degrees are carried out by the Hungarian Equivalence and Information Centre (Hungarian ENIC, a member of the European Network of Information Centres) within the Educational Authority, while the nostrification of scientific degrees is done by the Hungarian higher education organisations. The only exception is the recognition of the foreign Candidate of Science and Doctor of Science degrees under international agreements.
Just as in other new EU Member States, Hungarian research institutes advertise very few (a mere 6 in December 2011) vacancies (for researcher positions) on the EURAXESS website.
Grants awarded by the various Hungarian research funding schemes are generally not transferable to other (national and foreign) research institutes.
In sum, relatively low salaries, 'patchy' research infrastructures, and unsatisfactory overall working conditions generate brain-drain to foreign countries and professional shift to other, more attractive sectors in Hungary.

1.3 Improve young people's scientific education and increase interest in research careers

To pursue a research career is less attractive for young talents than becoming a professional (medical doctor, lawyer, manager in large public or private organisations, etc.), which can be achieved in many cases without a PhD degree, i.e. better paid jobs can be taken up even earlier, and thus life-time earnings would be definitely higher. Further, general working conditions for a researcher, e.g. access to funding, journals, books, and modern equipment – especially in the public sector – are not satisfactory, either.
The impact of these unfavourable factors is reflected in the fact that while the number of graduates (ISCED 5-6) in mathematics, science and technology (per 1,000 people, aged 20-29) has increased from 5.1 in 2004 to 7.5 by 2009, it was still well below the EU-27 average (14.3 in 2009). (Eurostat) Brain-drain seems to be an important threat. Some 125 thousand of Hungarians with tertiary education were living in OECD countries (outside Hungary) in the early 2000s, that is, a 14% migration rate among degree holders. One out of four S&E degree holders graduated in 1990-2000 left Hungary. (Csanády *et al.*, 2008)
Heated debates started again in 2010 if education curricula put too much emphasis on creativity, critical thinking, problem solving, teamwork, and communication skills at the expense of learning facts and memorisers, or on the contrary, more time and efforts should be devoted to develop these skills. The new Bill on Education, passed by the Parliament in December 2011, takes a conservative stance.
Entrepreneurship and innovation management courses are widely available from private training companies, and also included in the curricula of some universities.

1.4 Promote equal treatment for women and men in research

The restoration of the same position after maternity leave is safeguarded by the general provisions of the Labour Code. However, the employer is not obliged to extend the employment period of a fixed-term contract.
There are no specific provisions for female researchers. Gender quotas have been discussed in various areas in order to reduce the gap between the representation of men and women in various professions and bodies, but have not been introduced.

2. *Facilitate cross-border cooperation, enhance merit-based competition and increase European coordination and integration of research funding*

Hungarian STI policies are designed through joint initiatives to a limited extent, and there has been no co-operation with other countries explicitly aimed at joint policy design. Hungarian partners are involved in several *Joint Technology Initiatives* (JTIs), such as ARTEMIS, ENIAC, and IMI, as well as in *joint programmes*: Eurostars and AAL. There has been an intention to participate in *Joint Programming Initiatives*, supported by preparatory activities via various ERA-NET projects. Further, Hungarian National Technology Platforms have co-operated with *24 European Technology Platforms* in identifying their strategic research agendas, which – in principle – are to be considered when devising new STI policy measures.

As to the delivery of these policies, most Hungarian support schemes are open to *non-nationals*, and some of them, e.g. the second sub-programme of the "Mobility" scheme, explicitly identify foreign researchers as one of their target groups. In most cases, however, the supported research project should be carried out at a Hungarian facility (and the grant holder should be employed by that organisation).

Foreign legal entities can join RTDI consortia co-financed by Hungarian STI policy schemes, but are not eligible for funding from Hungarian public money. As a general rule, Hungarian funding can be used abroad only by Hungarian researchers who are supported by a mobility scheme.

Hungary holds the EUREKA chairmanship in July 2011 – June 2012; and the main priorities for this period are outlined in a 10-page work programme. *Seventy-four EUREKA projects* with Hungarian participants have been completed by June 2010, and as of early 2011 there were 24 on-going projects involving Hungarian participants, altogether 43 of them. Besides, Hungarian partners contribute to 5 strategic cluster projects.

Hungarian researchers have been involved in *160 COST actions* (as of February 2011),[41] and *51 ERA-NET projects* by October 2011.[42]

3. *Develop world-class research infrastructures (including e-infrastructures) and ensure access to them*

A strategy-building process was launched in 2008 to underpin policy proposals aimed at developing the R&D infrastructure, also emphasised by the National Lisbon Action Plan (2008-10). Its Hungarian acronym is NEKIFUT ("Take-off"), derived from **Ne**mzeti **K**utatási **I**nfrastruktúra **F**elmérés és **Út**iterv (National Research Infrastructure Survey and Roadmap). It would suggest a roadmap for building new RIs and upgrading existing ones in Hungary, as well as those areas of specialisation where participation in new transnational infrastructures is favourable.

The project – devising and following a very detailed assessment method, relying on a two-round on-line survey to collect data from individual RIs – has identified some 80 Hungarian RIs of strategic relevance (strategic RI, in short). Given the strict assessment criteria, altogether hundreds of RIs have formed networks to be qualified as strategic RIs. Hence, the ~80 strategic RIs are actually composed of over 400 individual RIs.

[41] The complete list, the distribution of actions by fields, and data on Hungarian participation in previous years can be accessed at the NIH website.

[42] A full list can be accessed at the netwach website.

These strategic RIs have been selected from all fields of sciences: physical and engineering sciences, life sciences, as well as social sciences and humanities. A web-based, bi-lingual register presents all the relevant data of these RIs for potential users and co-operation partners, while other types of data pertinent to STI policy-makers are available only for them.

NEKIFUT had been mainly financed from the Research and Technological Innovation Fund until June 2010. As already mentioned, unused funds were frozen by the incoming government in June 2010, and thus a new decision is needed if the project is to be completed, i.e. to update the register – updating would be crucial in 2012 as most of the formerly independent institutes of the Hungarian Academy of Sciences are going to be merged into research centres in January 2012 –, and devise the RI development roadmap (covering both national and transnational RIs). As of December 2011, there was no decision on the completion of the NEKIFUT project, although it was presented to the EU Competitiveness Council in April of 2011.

So far Hungary has chosen to participate in two RIs listed on the ESFRI roadmap: XFEL with 1% of the total budget, around €1.0-1.5m in the construction phase; ELI with around €3.5m allocated for the preparatory phase to host one ELI site in Hungary. Besides, several Hungarian research units have expressed their interest to participate in over a dozen ESFRI projects, in which cases RIs are (or would be) located in other EU countries.

Hungary has joined several inter-governmental agreements, organisations and large RIs, including EMBO, European Molecular Biology Organization; GMES, Global Monitoring for Environment and Security; EFDA, The European Fusion Development Agreement; ESA, European Space Agency (as an observer); CERN, European Organization of Nuclear Research; ITER, International Fusion Energy Organisation; ECMWF, European Centre for Medium-Range Weather Forecasts (as observer); EUMETSAT, European Organisation for the Exploitation of Meteorological Satellites; ESRF, European Synchroton Radiation Facility; ILL- Institut Laue-Langevin: Neutrons for Science.

Given the size and level of economic development of the country, not much funding is available to invest in expensive research infrastructure (RI), roughly €100m a year. Only a small fraction of the Hungarian RIs can be regarded as large RIs, mainly in physics. The best known example is the research reactor operated by the Atomic Energy Research Institute (MTA), open to the international research community.

All strategic RIs identified by the NEKIFUT project are open to the entire research community: openness has been one of the selection criteria. The web-based register provides data on these RIs in English in order to promote their use by foreign researchers.

4. *Strengthen research organisations, including notably universities*

The autonomy of higher education and scientific research is one of the key principles of the Hungarian legal framework, entrenched in the Constitution,[43] as well as in the Law on Higher Education, which stipulates that “the freedom of teaching, research and artistic creation shall be maintained by means of the autonomy of higher education institutions”. This general principle applies to all three aspects of autonomy, namely “academic”, “political” and “financial/ managerial”, within certain boundaries defined by the law. In particular, HEIs have a high degree of autonomy in the selection of candidates for academic positions by the governing bodies of the HEI, in devising their curricula and

[43] This stipulation of the Constitution is taken as an absolute principle, overriding any other initiatives: see below the case of the Economic Councils, proposed by the Law on Higher Education (2005).

research agendas/ strategies, and budgeting processes (infrastructure development, tuition fees, etc.). However, a number of legal requirements, e.g. pertaining to wages of public servants, limit HEIs' autonomy. Asset management is also strictly regulated by law. Promotion of university staff is decided internally, while professorships are formally awarded by the President of the Republic. Salaries of academic staff are also determined by law, with some room for performance-based complementary payments. The Law on Higher Education (2005) introduced a number of amendments aimed at modernising university governance structures (e.g. involving businesses in HEIs' governing bodies), while keeping the autonomy of HEIs as a key principle. The Rector, as head of the HEI, has remained the academic leader. The Law stipulates that eligible candidates for rector are university professors. The majority of universities apply open tender processes, while some only allow tenured professors to apply. In any case, due to the stipulation of the Law, rectors (and deans) are exclusively academics, chosen by the universities' Senate, and finally approved by the President of the Republic. Even in the case of open tenders, most rectors tend to be chosen from within own ranks of universities.

The 2005 Law introduced two new governing bodies: the Senate and the Economic Council. The Senate oversees all aspects of the operation of a given HEI: approves a Development Plan, devises, and implements RTDI strategies. It is composed of mainly academics, but also other employees of the HEI and student representatives. The Economic Council was originally supposed to make financial decisions and to supervise their implementation. Three members of these councils (composed of 7 or 9 members in total) are delegated by the government, and thus these provisions were declared unconstitutional by the Constitutional Court. The Economic Councils, therefore, only have an advisory and monitoring role. For publicly financed HEIs it is compulsory to set up an Economic Council, while it is optional for private ones. The members nominated by the (then) Minister of Education and Culture are typically non-academics (e.g. businessmen and financial experts), as are often the ones appointed by the Senate. The role played by the Economic Councils at the different universities varies considerably: while some are rather active and have a significant influence on strategic decisions, in most cases they remain formal consultative bodies.

In sum, universities have a high degree of autonomy in determining research topics and allocating budgets. These decisions, in turn, remain in the hands of academics.

Traditionally, the main mission of the Hungary HE education sector focussed more on teaching than on research activities. Apart from a few large and prestigious universities (and especially their certain faculties and institutes), which carry out the bulk of HERD, the large majority of smaller universities and colleges (especially in the countryside) have negligible R&D activities. The mission statements of the larger universities stress the importance of both multidisciplinary education and R&D of the highest quality according to international standards.[44]

The Hungarian HE landscape is characterised by a wide gap between a number of relatively competitive and traditionally "elite" universities (which nevertheless have also undergone the effects of the transition to mass education), and a large number of lower quality, less competitive colleges, especially in smaller towns of the country.[45]

[44] This group of universities include e.g. the Budapest University of Technology and Economics [BME], University of Debrecen [DE], Eotvos Lorand University of Sciences [ELTE], Semmelweis University [SOTE], University of Szeged [SZTE].

[45] To illustrate this point – and leaving aside the pros and cons of various university ranking methods/ exercises, only two Hungarian universities appear in the top 500 ones identified by the Leiden ranking: University of Szeged [SZTE] (388), and Eotvos Lorand University of Sciences [ELTE] (406). (This

In general, the access procedures at the Hungarian HEIs are competitive. However, there are significant differences among the Hungarian HEIs in this respect, too: a few of them enjoy a high esteem among the future employers, and thus it is markedly more difficult to enter those HEIs, compared to those, which are less popular among the students, given the less promising employment prospective they offer.

As for funding research activities of HEIs, there are two main channels: core (block) funding for RTDI, and project-based competitive funding. In line with the stipulations of the Law on Higher Education (2005), the so-called “scientific appropriation” (basically grants for the purpose of scientific activities of HEIs, including post-graduate education) is based on the number of full-time professors, the number of professors holding scientific degrees, PhD students and PhD graduates. Neither publication and citation performance, nor patent applications per grants indices are used as evaluation criteria. HEIs are entitled to distribute the funds among faculties or research groups autonomously, and they occasionally apply performance criteria (such as bibliometric indicators or external funding generated by the respective unit). The use of the block funds are not followed closely, i.e. they can be used for financing education activities or covering general costs, such as heating and lighting.

An implicit general “external” assessment exercise by the government was launched in 2007. Since then, a HEI may receive additional public funding in case it enters a so-called three-year maintaining agreement with the (then) Ministry of Education and Culture. Based on the agreement, the Ministry can monitor (and assess) capabilities of a given HE organisation for setting and performing strategic targets in various fields during the contracted 3 years. A detailed list of measures for monitoring and assessment include alternative indicators regarding all three aspects of universities’ missions, namely “basic activity (Education and Research)”, “supporting activity (guiding and management and collaboration and co-operation)”, and “Social linkages (regional role and participation in performing social targets)”. The HEIs had to select relevant indicators, set targets in each of these obligatory fields, and elaborate these in their so-called “Institutional Development Plans” (i.e. strategic documents), which can be monitored during the three-year period and evaluated at the end.

There are a number of national ranking exercises, mostly carried out by prestigious weekly newspapers. These rankings of universities, their faculties, and degree programmes are based on significantly diverging methods. Therefore, their results are ambiguous and are not used as a basis for national funding. However, they are important sources of information for both employers and secondary school graduates for selection.

5. Facilitate partnerships and productive interactions between research institutes and the private sector

Several STI policy measures have been launched to foster RTDI co-operation in Hungary. As discussed in Section 3.3 in relation to the specific “policy routes”, many schemes supporting private sector RTDI activities give preference to, or require mandatory, co-operation between private and public sector organisations with the aim of facilitating knowledge circulation (including mobility of researchers) and the exploitation of research results. Furthermore, a number of schemes are in place with the primary objective of facilitating collaborative RTDI. The most important policy development in this respect has been the financing of joint university-industry research centres. There are 38 such centres, each located at a university.

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ranking has been calculated by using the mean citation score indicator, and non-English language publications have been included; http://www.leidenranking.com/ranking.aspx)

Schemes funded by EU cohesion policy, i.e. the Structural Funds have also been important vehicles for fostering knowledge transfer through the creation and development of incubators and science parks in Hungary. The Economic Development Operational Programme of the New Hungary Development Plan (2007-2013) included such measures, e.g. the “Promotion of Technology and Innovation Parks”. Furthermore, most of the seven Regional Operational Programmes include measures for supporting technology parks and/or business incubation.

As already noted, the evaluation report on the operation of the Research and Technological Innovation Fund, claims that industry-academia collaboration has improved over the period of 2004-2009 (Ernst & Young and GKI, 2010b).

Attempts have also been made to create a more favourable regulatory environment and incentives for PROs to accelerate their IPR activities and produce exploitable knowledge. The Law on Research and Technological Innovation (effective as of 2005) has introduced the notion of spin-offs into the regulatory framework. Publicly financed HEIs and PROS (henceforth, publicly financed research units) are obliged to have their own internal regulation on IPR issues (since 2006), which contains instructions on valuation, reporting, rights and obligations, as well as levels of responsibility, and devise an IPR management strategy. Furthermore, in order to be eligible for funding, beneficiaries of the Research and Technological Innovation Fund are obliged to submit the applicable IPR rules (regarding IPR utilisation and procedures, researcher motivation, licensing) to the funding agency. The National Office for Research and Technology, in co-operation with the Hungarian Patent Office and the Hungarian Academy of Sciences devised guidelines, which the individual organisations could (and in most cases did) use as a blueprint.

Technology transfer offices have been established by almost all state universities, relying on support schemes. Some of them are part of the university’s organisation (e.g. at the University of Debrecen it is supervised by the Rector), whereas in other cases these tasks are carried out by an organisation set up jointly by the university and a number of other regional players, such as PROs and regional authorities (e.g. Biopolisz in the case of the Univ. Szeged).

In order to facilitate the establishment of spin-offs, the Parliament amended the Law on Higher Education in June 2007. From September 1, 2007 higher education institutes can establish business entities for commercialising their intellectual assets without any formal consent of government authorities. The Act CVI. of 2007 (25 September) on State Property amends the Law on Research and Technological Innovation: it stipulates that, as opposed to the general regulations of the Act, publicly financed research units shall be the owners of acquired IPR and be entitled to a share of the spin-off firm emanating from it. IPR regulation has become more favourable for the exploitation of R&D results by giving property rights to the publicly financed research units and by allowing the establishment of business entities (spin-offs) for the commercialisation of HEIs’ intellectual assets.

Inter-sectoral mobility of Hungarian researchers has been identified as one of the key weaknesses of the Hungarian STI system. Only 6% of Hungarian researchers at HEIs had previously been employed in both the private and the public sector, which is roughly one third of the EU-27 average. (MORE Report, 2010, p. 71) This is probably strongly related to the structural/ institutional characteristics of the Hungarian public research sector: the overwhelming majority of Hungarian researchers (85% vs. 59% EU-27 average) at HEIs are employed under open-ended contracts, and that 70% of them have been employed by their principal employer for more than 10 years. (MORE Report, 2010, p. 55) The administrative framework is not prohibitive in this respect, but does

not provide incentives, either. Researchers in the public sector are relatively well protected by law, however, are not particularly well paid. The low level of mobility can probably be better explained by the relatively low level of interaction between the sectors in general and as a consequence of the diverging incentive structures.
As mentioned in section 4 of this Annex, businesses have been involved in the governance of universities to a limited extent. Publicly financed HEIs must set up an Economic Council, while it is optional for private ones. The members of these Councils are typically non-academics (e.g. business people and financial experts). Economic Councils have an advisory role at some universities varies are rather active and have a significant influence on strategic decisions, in most cases they remain formal consultative bodies.

6. Enhance knowledge circulation across Europe and beyond

As detailed in Section 2 of this Annex, Hungarian researchers are involved in joint programmes, EUREKA, COST, and ERA-NET projects. The "Institutional Strategy" of the NKTH declared that joining these community initiatives is a "strategic interest", and the participation of industrial players should be promoted in order to efficiently exploit the opportunities provided by these collaborative projects. (NKTH, 2007) Several schemes support Hungarian participation in these initiatives, while conferences, information days and other similar events are also organised by the NKTH [renamed as NIH since January 2011] to raise awareness.
Hungarian researchers intend to contribute to the development of a sustainable, efficient, and effective European scientific information system via ESFRI initiatives (developing e-infrastructures in all various fields of science). Support to these efforts at this stage – until a national RI development strategy is completed – can only be obtained via one-off decisions, i.e. not in the framework of a dedicated scheme.
There are no specific Hungarian policy measures aimed at enhancing open circulation of knowledge across national borders and open access to research outputs (publications and data) by researchers and society at large.

7. Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world

There were 35 bilateral STI co-operation agreements in force in 2011. In addition to the EU members, the partners include (a) leading countries in S&T, e.g. the USA, Israel, Japan; (b) the so-called BRIC countries (Brazil, India, Russia, China), which are globally perceived as emerging S&T players; as well as (c) developing countries in various continents, e.g. Argentina, Egypt and Vietnam. The primary objective of these agreements is to promote mobility and international co-operation, and organising S&T seminars and workshops.
In most cases grants can be used to cover travel and subsistence costs. Full costs of bilateral collaborative projects are covered in the case of five countries, with which co-funding agreements have been signed. Four of these countries are non-ERA countries: China (technologies supporting competitiveness and sustainable development), India, Israel (industrial technologies) and Singapore (medical instruments, bioinformatics, life sciences, pharmaceuticals, and related chemical research).

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List of Abbreviations

BERD	Business Expenditures for Research and Development
BME	Budapest University of Technology and Economics
BRIC	Brazil, India, Russia, China
CERN	European Organisation for Nuclear Research
CIS	Community Innovation Survey
COST	European Cooperation in Science and Technology
ECMWF	European Centre for Medium-Range Weather Forecasts
EDOP	Economic Development Operational Programme
EIS	European Innovation Scoreboard
ELTE	Eotvos Lorand University of Sciences
ENIAC	European Nanoelectronics Initiative Advisory Council
ERA	European Research Area
ERA-NET	European Research Area Network
ERP Fund	European Recovery Programme Fund
ESA	European Space Agency
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EU-27	European Union including 27 Member States
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FDI	Foreign Direct Investments
FP	European Framework Programme for Research and Technology Development
FP	Framework Programme
FP7	7th Framework Programme
FTE	Full-time equivalent
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GUF	General University Funds
HERD	Higher Education Expenditure on R&D
HES	Higher education sector
HUF	Hungarian forint
IMI	Innovative Medicine Initiative
IP	Intellectual Property
ISCED	International Standard Classification of Education
ITER	International Fusion Energy Organisation
IU SAT	Innovation Union self-assessment tool
JTI	Joint Technology Initiative
KSH	Hungarian Central Statistical Office
PRO	Public Research Organisations
MISz	Hungarian Association of Innovation
MORE	Mobility of Researhers
MTA	Hungarian Academy of Sciences
NEKIFUT	National Research Infrastructure Survey and Roadmap

NEFMI	Ministry of National Resources
NIH	National Innovation Office
NIS	National Innovation System
NKITT	National Research, Innovation and Science Policy Council
NKTH	National Office for Research and Technology
NRP	National Reform Programme
NUTS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
OP	Operational Programme
OTKA	National Scientific Research Fund
PPS	Purchasing power standard
PRO	Public Research Organisation
R&D	Research and development
R&D&I	Research and Development and Innovation
RI	Research Infrastructures
RTDI	Research Technological Development and Innovation
RTIF	Research and Technological Innovation Fund
S&E	Science and engineering
S&T	Science and technology
SF	Structural Funds
SME	Small and Medium Sized Enterprise
SOTE	Semmelweis University
SF	Structural Funds
STI	Science, technology and innovation
SZTE	University of Szeged
TTPK	Science and Technology Policy Council
VC	Venture Capital

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Abstract
The main objective of the ERAWATCH Annual Country Reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. EW Country Reports 2011 identify the structural challenges faced by national innovation systems. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. The annex of the reports gives an overview of the latest national policy efforts towards the enhancement of European Research Area and further assess their efficiency to achieve the targets.

These reports were originally produced in November - December 2011, focusing on policy developments over the previous twelve months. The reports were produced by the ERAWATCH Network under contract to JRC-IPTS. The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from ERAWATCH Network Asbl.

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