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National Research and Development and Innovation Strategy (2013-2020)

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content

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preface

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Every Hungarian forint invested in research & development & innovation is an investment in the future of enterprise and in the country as a whole. The business sector is well aware that behind every advantage in the market place, there is additional knowledge which the competition does not have. In fact, only those enterprises which invest now in knowledge creation and innovation will succeed in the longer term.

In a similar way, nations will thrive and prosper only if there is the on-going flow of new knowledge into the economy. Effectively, there are two main approaches to fostering economic growth and enhancing prosperity: increasing resources such as capital and labour; and using resources in more efficient ways, for example through technological development. Experience and history have shown us that it is the second approach, that of technological development and at times radical technological breakthroughs, which contribute to fostering economic growth in more significant and permanent ways than simply increasing resources.

Investment in research & development, and particularly in basic research, has the greatest economic impact when the outcomes and benefits reach consumers as market innovations. In the Hungarian language, the concept of innovation is often used quite loosely: in everyday conversation anything that is new, novel or original is also innovative. However, something that is new or original is not innovative until it meets consumer expectations. Only those novelties are innovations which respond to and meet consumer needs in new ways. More than that, innovation itself is the road to creating new consumer needs. And who else could be closer to understanding and anticipating consumer needs than the entrepreneur? The true meaning of enterprise is the development of new products, the introduction of new solutions and the creation of new markets – this is key to the growth of business and also that of the national economy. This is why the research & development& innovation strategy, adopted after extensive consultation, focuses on enterprise.

While the centrality of enterprise to innovation may seem self- evident, the answer to how innovation should be supported by government is far more complex. Some would question whether innovation should be supported by the government at all, and would advise that healthy competition and a good education system are enough, and that enterprises themselves would take care of the rest. Most people, however, believe that government can and should do more to support research & development & innovation, and that this is in fact essential to the success of developing countries. But this immediately give rise to a number of paradoxes.

One paradox is that the contributions of both small enterprises and large corporations to research and innovation are essential within almost all sectors of the economy. In practice, it is possible to compile a long list of those inventions and developments which have been created by small enterprises or individual inventors, but the name of a specific product is more likely to be associated with a large company. As such, the really great and radical technological breakthroughs can almost without exception be linked to small enterprises. Nevertheless, large companies are still

essential, especially when it comes to transforming those inventions and developments into mass consumer products and distributing them through their extensive networks. Therefore, the innovation process requires both the inventiveness of the small company or individual, and the ability of the large company to invest into reaching into and opening up consumer markets. In terms of the research & development & innovation strategy, it must provide benefits to the whole business sector, meaning small enterprises, medium-sized businesses and large companies.

A second paradox for government is the need to support new enterprises, enterprises which do not yet exist and which are the most likely to bring about radical innovation, at the same time as ensuring the strength of the incremental and systematic research programmes of large companies looking to improve their own market position. In both cases, government cannot play an effective role by providing direct support, especially given the sizeable resources and extensive market knowledge of larger corporations.

It is, nevertheless, necessary for government to increase expenditure on research and development; in fact, in Hungary, it is particularly important at this moment in time to increase research and development spending. Although research and development expenditure by business and government increased in 2011 and 2012, reaching 1.3% of GDP in 2012, the highest value in the last two decades, Hungary remains far behind the 2% average of the European Union. Therefore, the innovation strategy sets out the ambitious but realistic target of 1.8% of GDP, to be achieved by the end of the decade.

However, a strategy is more than the sum of objectives, programmes and budgets. Although the volume of resources is of the utmost importance, also important are the system of tax benefits, the rules on competition law, the institutional environment of innovation, the forms of higher education, and the presence of academic research networks. The strategy must encompass all components of the research & development & innovation system. If the government can nurture such an environment – or eco-system, using the technical jargon – for public institutions and enterprises engaged in research & development, as well as innovative enterprises, this will in turn contribute to providing the opportunities necessary for economic development and growth. Therefore the research & development & innovation strategy is built upon three components: the production of knowledge, the use of knowledge, and the flow of knowledge.

The most important factor in producing knowledge, and especially new knowledge, is excellence. On the one hand, competition is already globalised in the field of knowledge production, on the other hand, the resources are limited and must therefore be focused on those areas where outstanding results can be expected at the global level. All stakeholders are needed in the production and and commercialisation of knowledge, including Hungarian small and medium-sized enterprises, as well as foreign-owned small and large companies which are already established in Hungary or will be in the future. Finally, it is necessary to realise more intensive co-operation and technology transfer between publicly funded academic and higher education institutions and the business sector than can be found today. This is the means through which new knowledge will be embraced by enterprise, and ultimately will reach consumers in the form of innovation.

Innovation has a paradoxical impact on markets and consumers: it simultaneously means that something new is introduced and provided for consumers, who then give up the consumption of something old. The essence of innovation is the process of 'creative destruction', which involves the elaboration and adoption of new products, methods and processes alongside the creation of new industries and employment, at the same time as old products fade from the market and those enterprises and workplaces are diminished or even cease to exist.

Policy-makers often forget about this duality when developing innovation strategies, and generally emphasise only one side – the creation of new jobs. They would like to have innovative enterprises and new jobs, while also retaining the old ones. It is, therefore, very risky for government to determine where innovation will take place and which sectors will be key to the future. As such, the innovation strategy does not specify any sectoral orientation.

Equally, it is clear that there are several research & development-intensive industries with comparative advantages in Hungary, in particular pharmaceutical manufacturing, the health industry in its broader sense, the IT sector, biotechnology, green technologies, and car manufacturing. Nevertheless, it is not the task of

government to bet on the future, using 'taxpayers' money, in terms of of research & development & innovation at the level of industry or sector. The task of the government is to ensure spontaneous specialisation in the market by introducing direct and indirect instruments and tax benefits, setting out the framework for capital market solutions, operating funding programmes, and providing innovation services. Businesses know exactly which research & development-intensive sectors they can succeed in, especially given that they are risking their money and livelihoods. In this regard, the task of government is creating the necessary favourable environment rather than contributing to sectoral investments.

A further paradox can be found in the regional distribution of research & development & innovation. In effect, a competitive advantage is provided to certain regions and enterprises where research & development is especially strong and where technological breakthroughs have taken place. And yet, the overall competitiveness of a country and its ability to catch-up with the best performing economies is often significantly more dependent on the widespread distribution of existing technologies.

The spread of information technologies may be the best example of this: the development of these technologies has been limited to only a few small regions in the world, but those countries that were able to quickly take up and spread information technologies have also been able to achieve rapid economic growth. Consequently, the research & development & innovation strategy does not only have to advance the creation and practical exploitation of new knowledge but also support the wider dissemination of existing technologies.

The position of research & development & innovation is also controversial in the European Union more broadly, where there are at least three big gaps in this field. First, there is a significant global gap in research & development expenditure since, on average, 2% of GDP is spent on this field in the European Union, while 2.7% of GDP is spent by the US and 3.4% of GDP is spent by Japan. Second, there is a gap between the objectives, the endeavours and the reality. At the turn of the millennium, the European Union set the objective of increasing research & development expenditure to 3% of GDP by 2010. However, in reality expenditure is only 2% of GDP today, and the European Union has extended the deadline for reaching the target of 3% to 2020. And third, there is a significant gap between the core countries of the European Union and Central and Eastern Europe and Southern Europe, both in the terms of research & development capacities and in innovation performance.

The European Union intends to spend significantly more resources on the upcoming Community-funded research & development programme which will operate between 2014 and 2020, known as Horizon 2020, than on the current 7th framework programme. Hungary also intends to spend nearly one-tenth of the resources coming from the Structural Funds and the Cohesion Fund in the 2014-2020 programming period directly on research & development & innovation, which is more than a twofold increase compared to the current 2007-2013 period.

The time has come to make the national research & development & innovation system internationally competitive, embedded as it is now in a longer-term strategic approach. The draft strategy was created with the involvement of a wide range of academic, higher education, and business professionals; the final version was prepared – following a series of consultations - by social and economic experts who also contributed their recommendations and comments to the work.

Budapest, September 2013

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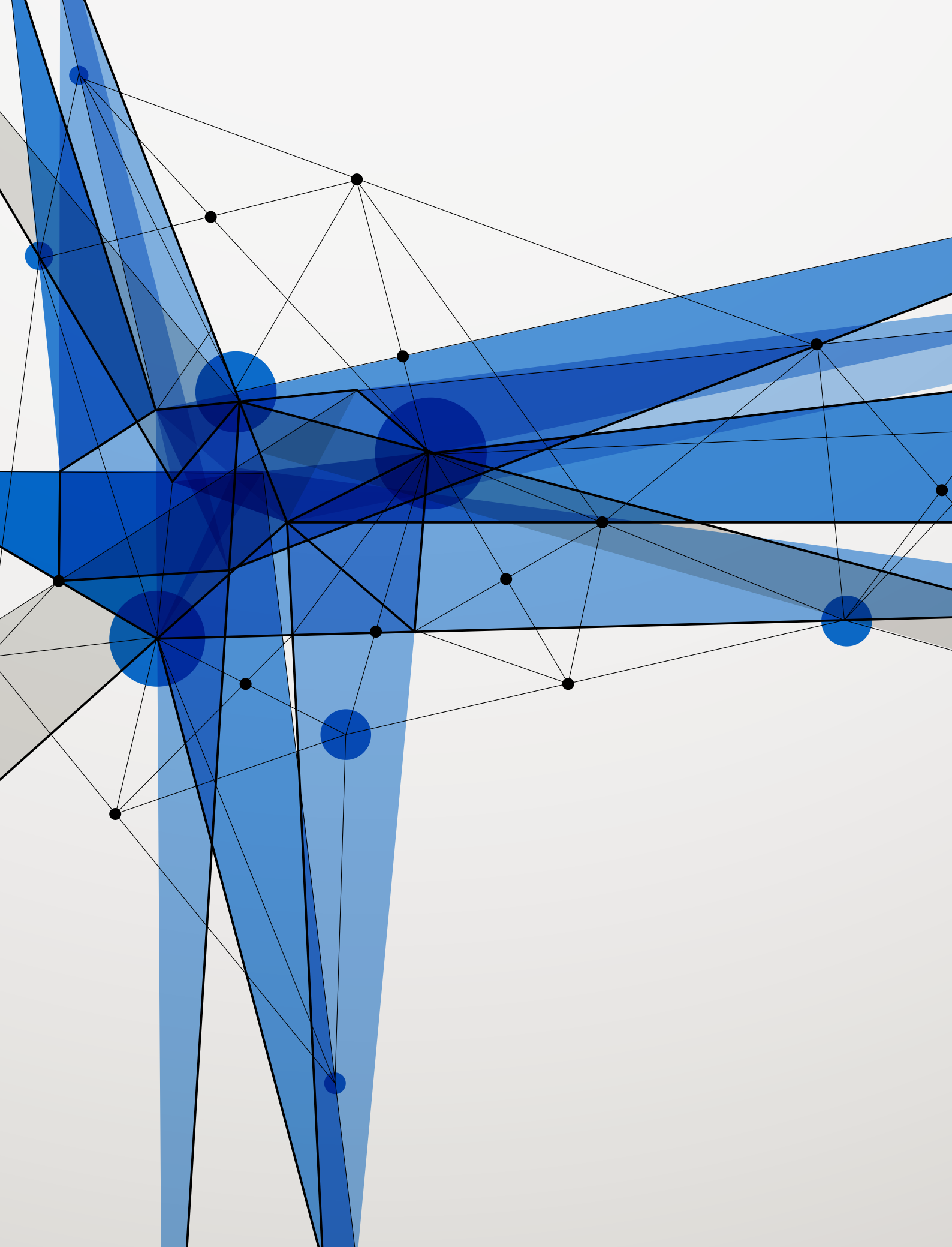
The following pages contain the updated version of the National Research and Development and Innovation Strategy (2013-2020) approved by the Government with its decision 1414/2013 (4 July).

1 overview of the situation



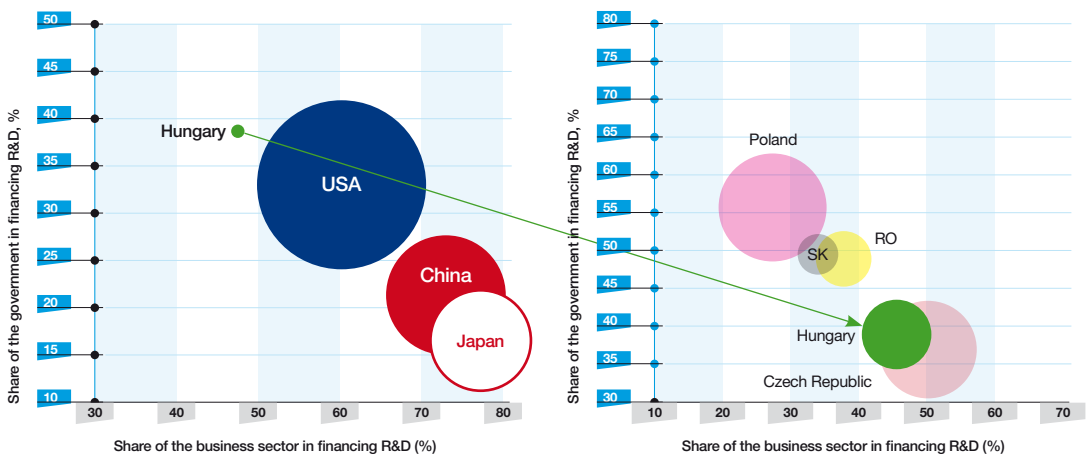
1.1. The international environment of the government RDI strategy

The competitiveness of the European Union in the field of research and development and innovation (RDI) has been deteriorating for a long time at the global level. The regional and structural differences of R&D&I – and particularly of R&D – has further increased in the last decade and the so-called European paradox – i.e. the contradiction that outstanding scientific results are achieved in Europe, while the practical results of innovation are more moderate – still remains[1]. The impacts of these can certainly be felt in Central and Eastern Europe and Hungary (see figure 1 and 2).

It is therefore striking that, in spite of the world economic crisis, **most of the developed countries in the European Union, as well as the EU itself, are endeavouring to increase theR&D support[2]**. The European Union's framework programme for R&D development between 2014 and 2020, i.e. **the Horizon 2020 strategy, set the goal of significantly increasing the R&D resources available at the Union level** (see figure 3 for budget distribution). While the budget of the current 7th Framework Programme is EUR 53 billion, this amount will increase to EUR 81 billion in the next programming period[3]. So if Hungary would like to maximise its use of these resources, then in the future **the country has to invest more seriously in research and development and innovation than the EU average.**

However, this is not just about the increase in the narrowly defined R&D subsidies. **The coordination of the instruments of Cohesion Policy and innovation policy** has been set as a specific objective by the European Commission for the 2014-2020 programming period. Similarly there may be more resources available for developing the **R&D infrastructure** at the Union level in the next programming period. Besides the coordination of and increase in development resources, new types of governmental interventions are to be expected in the next programming period both at the Community level and at national level: from the demand-side programmes to the uniform patent and standardization package, from establishing a Union-level institutional system for venture capital to supporting the Joint Programming Initiatives.

Figure 1 **The size of the research and development sector and its main funding sources (2011)**



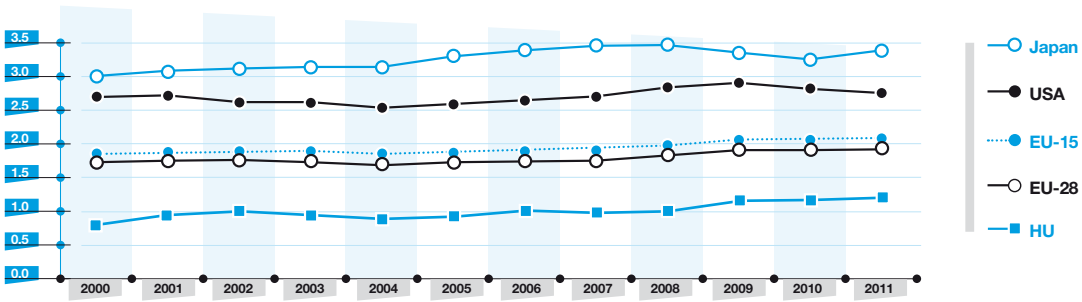
Remark: The size of the circles is proportional to the amount of R&D expenditure. The figure on the right is the enlarged part of the figure on the left showing Hungary complemented with some other countries from the region. Source: OECD-MSTI 2012/1

[1] According to some authors it is also no longer true that Europe can keep up with the United States in sciences – if not in innovation – because the European Union is already lagging behind in the key scientific fields (see Dosi et al, 2006)

[2] The developed RDI policies often have a counter-cyclical characteristics. According to this, the governments raise heavily the amounts spent on RDI in the time of depression. 25 out of 29 European countries increased their R&D expenditure in 2009 and 12 countries were able to increase their governmental R&D expenditure with more than 5%. Even though there are 10 countries where the R&D expenditure has decreased, there is only 4 examples that the fall in R&D expenditure was even more pronounced than the economic downturn.

[3] Nevertheless, the planned amount of EUR 81 billion is indicative and it can happen that a smaller amount will be adopted as principal amount of the Horizon 2020 programme's budget.

Figure 2 **Gross domestic expenditure on R&D 2000-2011 (%)**



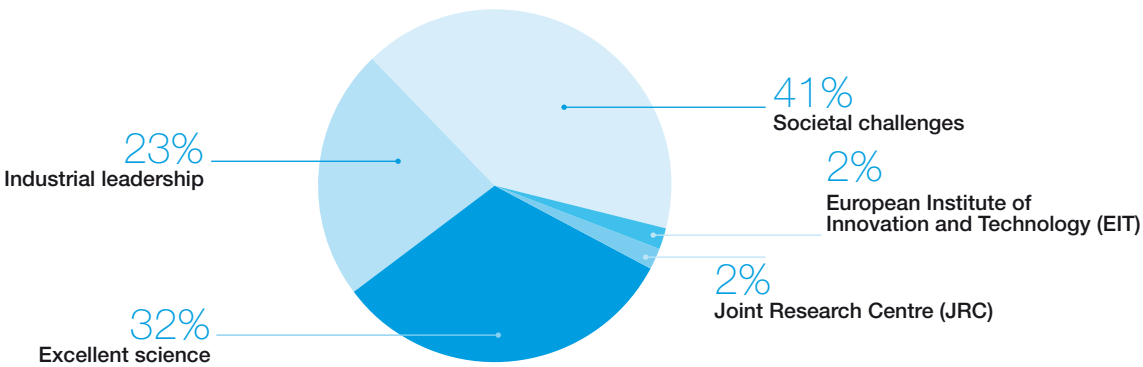
Remark: EU-28 means the old member states of the European Union, EU-15 means the new (entered into the EU in 2004 and later).
Source: OECD-MSTI 2012/1

A new approach to coordination will feature in European Union competitiveness policy in the next programming period, namely **smart specialization of the regions** ("smart specialization", see Eurada 2011/a and 2011/b) – or to describe the content more precisely: rational and efficient. During the last decade competition in the world economy has become more fierce, and not just between economic blocks and countries, but also at the level of the regions. In this case it is a competitive disadvantage that access to knowledge is territorially more limited than in the economies of the United States or Asia. Europe cannot give up the aim of creating a critical mass of research and development and innovation capabilities - based on the local characteristics and comparative advantages - in every region.

While it is obvious that **the regional smart specialization strategy** backed by RDI **can significantly strengthen the global competitive position of Europe**, it is a problem that the administrative borders of planning regions and the borders of economic areas are not the same in most cases. Moreover, research and development and innovation is one of the most internationalized economic activities so the impacts on the national innovation systems and global innovation systems are constantly changing.

The implementation of the Horizon 2020 strategy of the European Union has important consequences for Hungary. The international framework of the national RDI policy will be determined for a significant period of time, and at least for the seven years of the next programming period, So, if Hungary would like to use these funding resources in a more effective way then **the country has to pay more attention to RDI than the EU average.** On the one hand, this means more thorough competitiveness monitoring and accountability in the implementation of the national reform programmes than before; on the other hand, both of the planned measures of the Innovation Union and the extension of the European Research Area (ERA) indicate the completion of the single market of knowledge.

Figure 3 **The planned budget division of the Horizon 2020 framework programme**



1.2. National overview

The gross domestic expenditure on R&D (GERD) to GDP has increased slowly in Hungary - mainly due to the limited margins of the annual budgets (see Figure 4). **Although the gross domestic expenditure on R&D increased to 1.2%** in 2011, its highest value in the last two decades, it is still **far away from the 2% average of the European Union**.

In addition to the necessary increase in resources, enhancing coherence between government policy and RDI policy is also important. Hungary can only be successful on a global stage, and rapidly catch up to the European front runners, if **Hungarian governments prioritise investment into research and development and innovation in the future, recognising that it is profitable in the long term**, and taking concrete measures related to the sector in the spirit of this approach.[4]

Even though total expenditure on R&D has been growing only slowly, since 2008 there has been a positive trend as the proportion of **R&D expenditure from the business sector has increased rapidly and now exceeds the public resources** (See Figure 5). In those countries at the leading edge of innovation in the European Union – also in the United States and Japan – companies fund the majority of investments related to research and development and innovation because it is in their fundamental interest and enhances their competitiveness. The state can only substitute for the corporate sector in a limited way, rather its primary task is to ensure the most advantageous framework conditions.

The business sector has responded particularly well to the appearance of EU co-financed resources, and spends proportionally more and more on R&D by making good use of those resources. However, it is also a fact that there have only been eight years in the almost quarter century since the end of Communism – 1997, 1998, 1999, 2001, 2002, 2005, 2006 and 2011 – when the budgetary R&D expenditure has not decreased in real value.

The structured adaptation in higher education R&D has not been realized as investments during the previous period have at most only been able to conserve fragmented R&D capacities and capabilities. However, **the reform of the research network of the Hungarian Academy of Sciences has resulted in important developments.** The new research centres of the Academy provide public services with a more efficient institutional operating framework and a more concentrated research strategy. Between 2009 and 2012 a total number of 65 Momentum (Lendület) research groups (39 in the Academy and 26 at the universities) were created in the research institute network and at the universities, making it possible for researchers with an international track-record of significant achievement to come home or stay in Hungary. These steps are substantive components in the reform of the research network.[5]

While the proportionately growing R&D expenditure of the business sector can be considered a positive trend, the fact that **research and development funded from public sources finds it increasingly difficult to compete globally in scientific excellence** is a potential cause for concern:

- in spite of the satisfactory growth in the number of Momentum (Lendület) research groups, there is currently no solution for the growing problem of the supply of new researchers;
- the quality of the research infrastructure is lagging behind that of more developed EU countries;
- the change in perspective strengthening both individual and institutional excellence advances slowly in the sector;
- there are only a few internationally competitive research centres in the country;
- the systemic stability of the funding of basic and applied research is only partly guaranteed.

Nevertheless, the research and development sector funded by public resources has maintained and even strengthened its scientific standards in some science sub-fields. This is also reflected by the participation data of the 7th Framework Programme: among the new member states the second highest number of successful applications was submitted from Hungary, after Poland, meaning that Hungary won the second highest amount of funding. However,

[4] The analyses – by using elaborate methods – always verify that R&D makes a much higher return than for example investments into machinery (See: Hall, Mairesse, Mohnen, 2009).

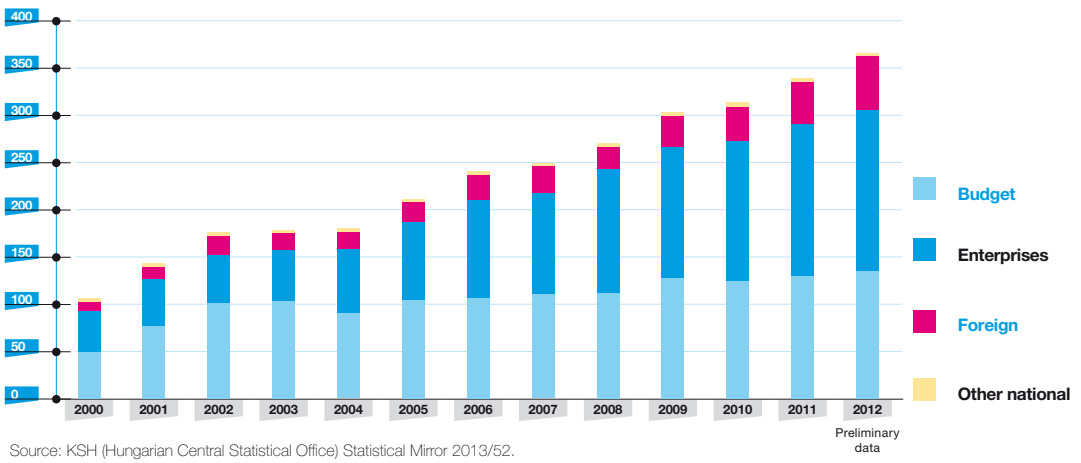
[5] In the future, research groups organized around researches with outstanding achievements and establishing their own scientific professional field will have a key role and the increase of the role of external advisory bodies and the completion of the performance requirement systems of individual researchers, research groups and research centres are to be expected.

[6] From a different point of view the same trend can be seen by the fact that the scientific institutional system is excessively fragmented according to institutional excellence and also with regard to international comparison (average project size, average size of research institution, research funding per unit etc.). For example the average project size per researcher is EUR 100,000 per researcher in the 7th Framework Programme, while the typical average project size is one-third of this amount, i.e. EUR 33,000 per researcher in the countries of Central and Eastern Europe. See Fraunhofer, 2012.

if the whole European Union is taken as the benchmark, then **these results are more modest in proportion to the population and with regard to the success rate of participants**[6] (See Figure 6). This can be seen by the fact that there are 245 researches in average in the new member states and 560 researchers in the more developed EU countries, indicating research communities of twice the size. As such, successful performance depends on whether such a **critical mass** of research and development capacities can be created in Hungary, enabling the country to receive further significant EU funding by maintaining or increasing its participation rate. The decreasing popularity of careers in engineering and the natural sciences along with the decreasing prestige of careers in education and teaching hinder the talent management and supply of researchers and add to the problem. At the same time the planned decrease in the volume of university courses in economic-, legal- and social sciences may influence the innovation absorption capacity of the economy.

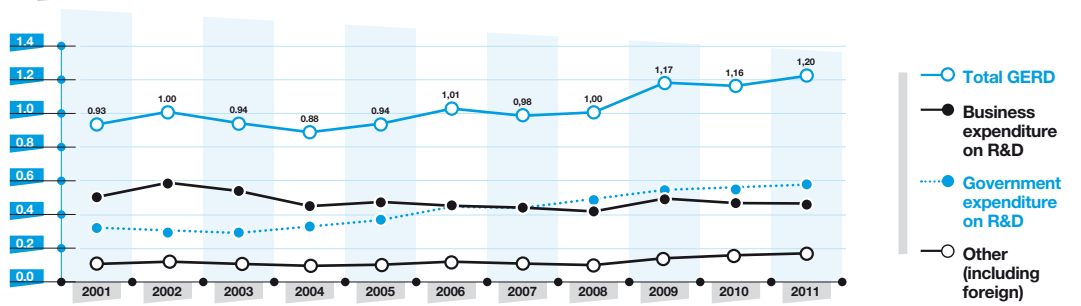
Currently the R&D activity of the business sector is simultaneously fragmented and concentrated. It is fragmented because the number of employees does not reach 20 in more than half of the business research organizations active in the field of R&D. At the same time it is concentrated because the number of employees is more than 250 only in one-tenth of the business research organizations pursuing R&D activities. The R&D expenditures of large companies are proportionately much higher than those of small and medium sized enterprises (see Figures 7 and 8).

Figure 4 **R&D expenditure in Hungary, 2000-2012, based on the distribution of resources (billion HUF)**



Source: KSH (Hungarian Central Statistical Office) Statistical Mirror 2013/52.

Figure 5 **Development of R&D expenditure in Hungary, 2001-2012 (as % of GDP, by financial source)**



Source: KSH (Hungarian Central Statistical Office) Statistical Mirror 2013/52.

[7] Fraunhofer, 2012.

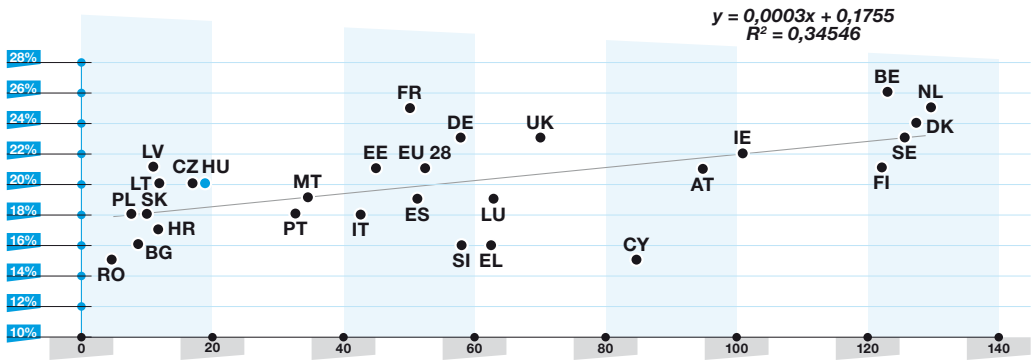
[8] At the time of writing this strategy there are several measures in progress with regard to the reconstruction of higher education. It is required to enhance the absorption of the EU funding and strengthen the scientific excellence, which evidently requires measures to be taken over the strategic time horizon (see for instance the plans for elaborating the career model for researchers).

Moreover, this concentration is linked to strong regional factors, largely because Budapest and its agglomeration excel in the field of business R&D. Similarly, business R&D activities are concentrated by sector[9]: **currently the pharmaceutical industry, the automotive industry and IT are key sectors** which provide the vast majority of business expenditure (see Figure 9).

Large global corporations play an ever greater role in Hungarian research and development and innovation; however, currently Hungarian subsidiaries have relatively little influence on the strategic decisions of their parent companies in relation to their R&D activities[10]. Foreign direct investment which is integrated with the local economy and based on R&D is also relatively scarce. Nevertheless, it is a positive trend that in more and more cases small IT and engineering-electronics companies have successfully tackled the first challenges in accessing international markets.

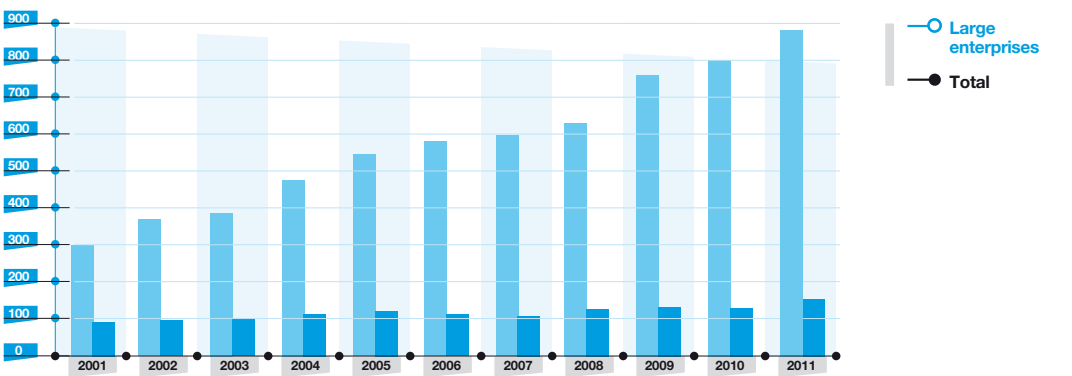
Hungary is classified as a moderate innovator at the level of the European Union (see Innovation Union Scoreboard, Figure 10). Industries operating within global value chains, such as the pharmaceutical industry, the IT sector and the automotive industry, along with researchers with international ties, significantly strengthen the performance of the national innovation system. Meanwhile, the research and development and innovation performance of most Hungarian enterprises lags far behind that of the enterprises in the more developed EU member states.

Figure 6 **The success rates of the 7th Framework Programme and funding per capita, July 2013 (€)**



Source: National Innovation Office, CORDA database

Figure 7 **R&D expenditure per company in Hungary between 2001 and 2011, by size classes (large enterprises and the average of all enterprises, HUF million)**

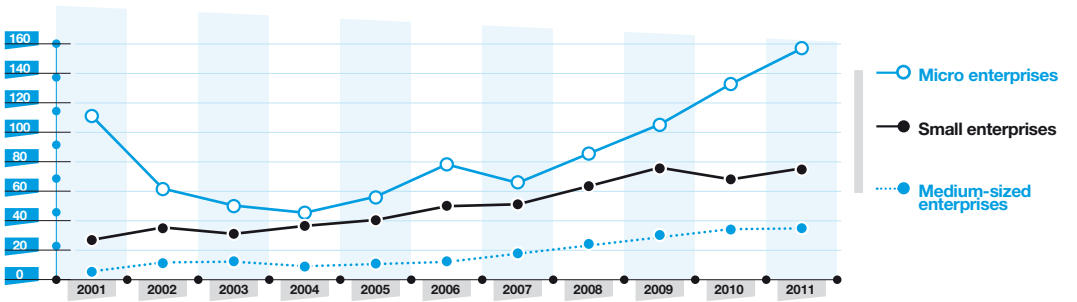


Source: KSH (Hungarian Central Statistical Office)

[9] If our study is not narrowed down to R&D then the food industry is also among the significant innovative key sectors of Hungary.

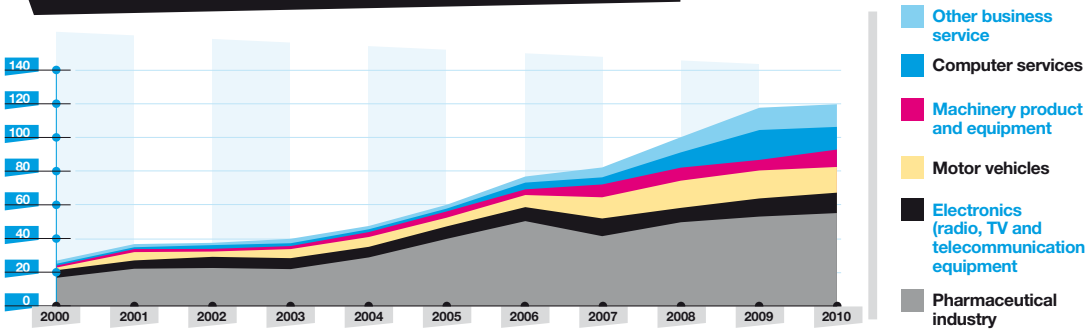
[10] The statement is relevant in terms of the total foreign direct investment. Certainly those prestigious international large enterprises are present in Hungary whose Hungarian R&D centres play an important role in making strategic decisions of the parent companies.

Figure 8 **R&D expenditure per company in Hungary between 2001 and 2011, by size classes (micro, small and medium enterprises, HUF million)**



Source: KSH (Hungarian Central Statistical Office)

Figure 9 **R&D expenditure of enterprises in Hungary, 2000-2010, by main sectors, HUF billion**



Source: KSH (Hungarian Central Statistical Office)

It is a positive trend that **Budapest and its outskirts can already be considered a knowledge-producing region on a European scale from a regional perspective** (Borsi and Viszt, 2010); its RDI performance is significant even at the level of the European Research Area (ERA) (see Lengyel and Leydesdorff, 2008).

The strategy submitted for public consultation specifies the national framework. Assessing the regional variations in innovation from a global perspective, and elaborating guidelines that can be formulated at a regional level, are independent and diverse tasks. The elaboration of the reading related to the regional specializations and the so-called smart specialization strategies[11] is planned by the government in consultation with local stakeholders during 2013.

Compared with other member states of the European Union, the innovation performance of Hungary differs in terms of innovation co-operations, particularly linkages between research organizations and enterprises. A particular weak point is the co-operation of small and medium-sized enterprises with large national and international companies and knowledge bases. In the last 5 years most progress has been made in the fields of indicators demonstrating economic impact and protection of intellectual property, particularly sales of new to market and new to firm innovations (25%), community trademarks (15%), and knowledge-intensive services exports (12%) according to additional data from the Innovation Scoreboard. Indicators in the fields of finance and support of innovation (especially due to the 32% decrease in venture capital) and of enterprises introducing innovation show a deteriorating situation.

By contrast, the international linkages, primarily for research purposes, of publicly funded research organizations are relatively strong, This is partly due to the fact that the pure science aspects of R&D are stronger in Hungary than the more practical, industrial deployment of research results. There are also opportunities for environmental

[11] The smart specialization means – in terms of the content of the concept – the rational and efficient specialization taking into account regional, sector, scientific and technological aspects.

knowledge- and technology-intensive start-ups (e.g. incubation) which are currently very weak.

In comparison with other member states of the European Union, it is problematic that spin-off processes often come to a halt in the early stages, due to the lack of seed capital supporting start-up and spin-off companies. Similarly mechanisms encouraging technology transfer are not effective (see Havas, 2011). Nevertheless, according to the estimates of the European Commission (based on data of the European Venture capital Association) a significant change has occurred in the field of venture capital investments due to JEREMIE funds: in 2011, Hungary was ranked 5th among EU member states regarding the value of invested venture capital proportional to GDP. There is relatively little market-driven research and development among medium-sized Hungarian enterprises, and the demand for R&D is also small. An organisational base through which the innovation development strategy is consistently implemented is missing among the few innovative small enterprises, where usually the required corporate culture and the financial and human preparedness are also not present.

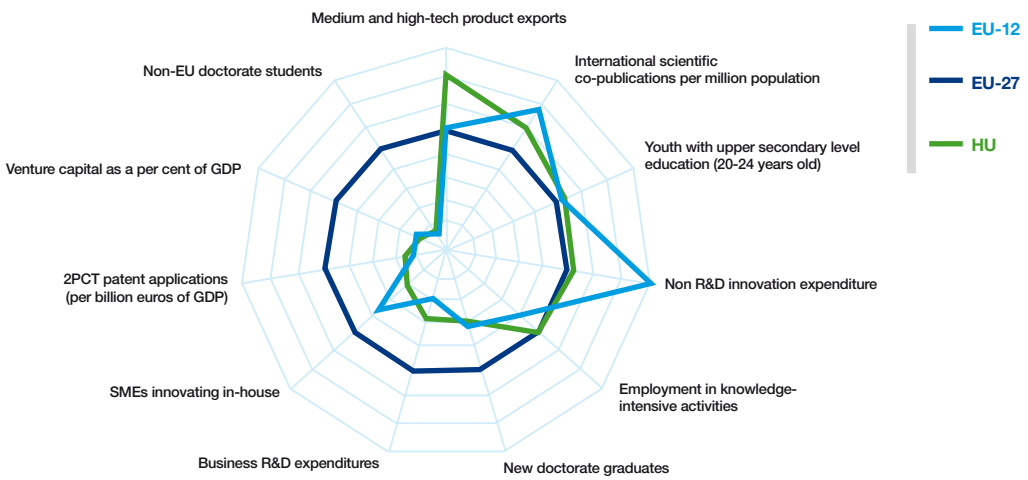
Although, in international comparison, the national R&D tax system has a significant incentive effect, the instruments are often directed to strengthening the R&D activities of large companies (see Figure 11). One problem of the current arrangement is that it seldom reaches the knowledge-intensive but less profitable young and innovative micro and small enterprises.

The moderate innovation performance of Hungary, evident at the level of the European Union, has its origins in a wide range of factors, but obviously it cannot be separated from the overarching problems of national RDI policy and practice.

- the strategic approach is still partly not present in state involvement (unlike for instance in Estonia, where a strategy focused on the strengthening of human capacities was elaborated and implemented in the 1990s)[12];
- the management system, regulations and institutional structure have changed frequently in the last decade and the consistent implementation, monitoring and systematic evaluation of measures related to RDI have often been missing;
- coordination of different RDI subsidies is not effective, particularly between Cohesion Policy with significant EU funding and RDI policy relying on national instruments;
- components of low cost-efficiency have been built into the public RDI funding system (e.g. anomalies in using the R&D tax benefits);
- the rationales for innovation in the public sector and its socio-economic impact have just begun to be examined;

It is an additional problem that the innovation management approach and competences are generally absent from the RDI institutional system (including awareness related to protection of intellectual property and deficiencies in law enforcement). This is partly why the efficiency of R&D fund-

Figure 10 **Data of the Innovation Union Scoreboard, 2011 – Hungary**



Source: Innovation Union Scoreboard

[12] Török (2006) also draws attention to the fact that Hungarian RDI tries to play a strategic role in the national economy without a strategy.

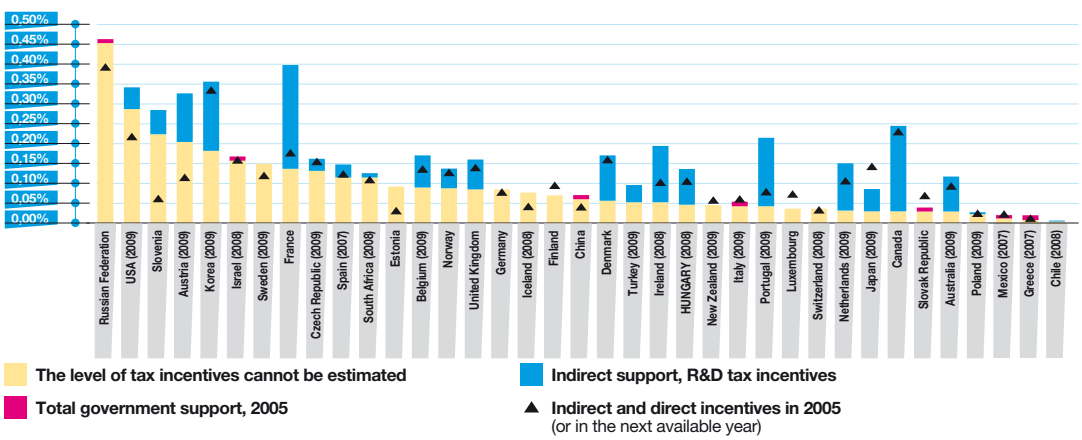
ing instruments is relatively low, in spite of the periodically abundant funding. The growing regional disparities and the eligibility rules of the EU resources in the Central Hungarian Region (hereinafter referred to as KMR) complicate the support of the region with the most significant R&D bases, while the rural areas often struggle to make reasonable use of R&D resources.

1.3. Framework conditions

The state cannot take over the primary role of enterprise in the field of research and development and innovation but **it is an important task of the government in power to establish such framework conditions that encourage enterprise to invest in research and development and innovation.** The most important components of framework conditions encouraging enterprises are the following:

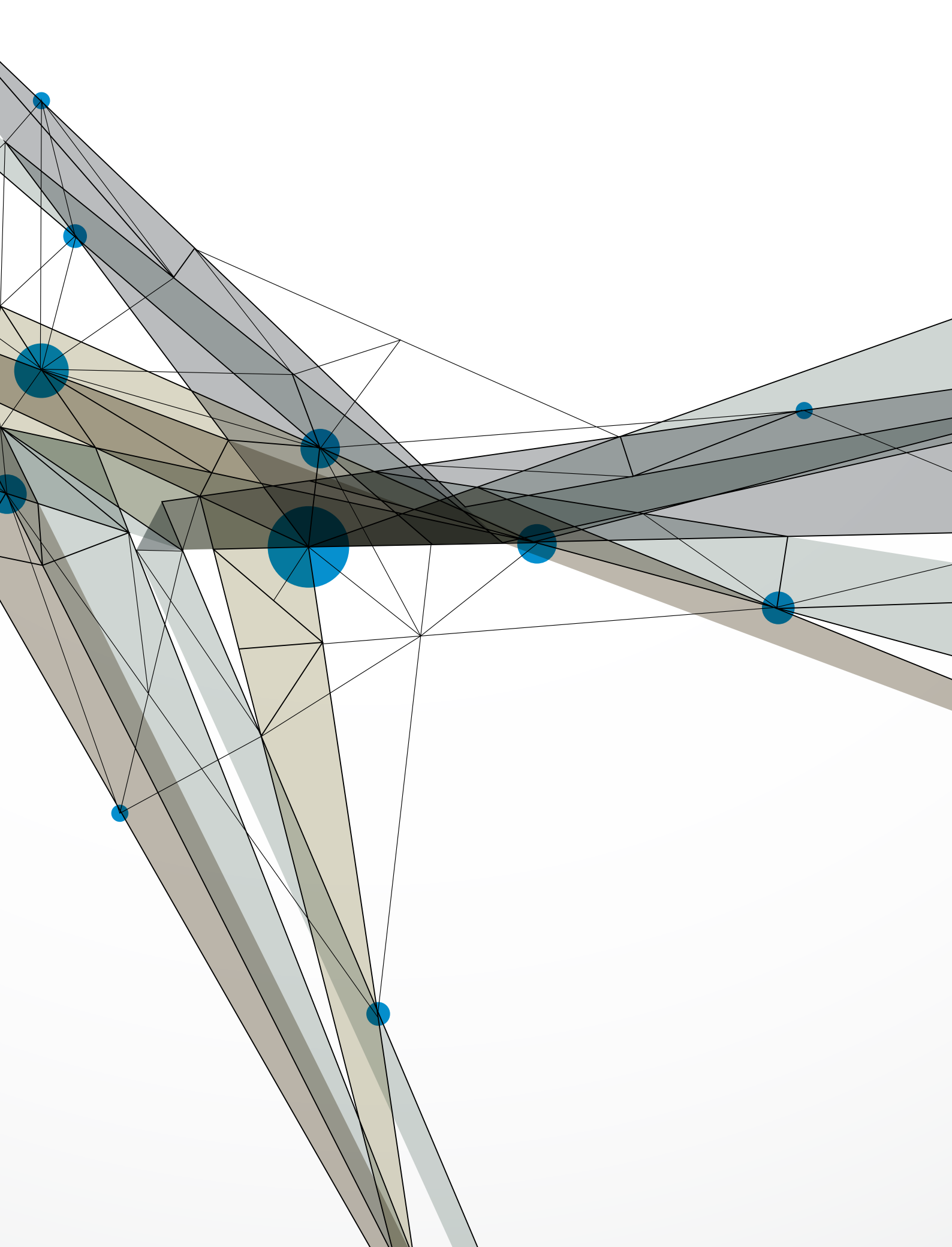
- *The international economic processes and the macroeconomic environment:* this includes foreign working capital financing, advances in the structure of the economy, participation in global processes even amid economic-financial turbulence.
- *Stability of the institutional system and coordination between related policies:* the institutional system of RDI management has been changed significantly with each government since the end of Communism. It is important that this issue is dealt with in a more rigorous manner, and a fully elaborated and appropriately managed strategy is created to provide a comprehensive and coherent framework.
- *The predictable and supportive functioning of the legal environment:* the legal system is an essential prerequisite for innovation, and economic growth based on RDI cannot be expected without it.
- *The stability of public funding of R&D:* practice shows that the sustainable funding of R&D can only be ensured with difficulty by the state, due to limited budgetary resources, so the RDI strategy has to place a strong emphasis on this aspect.
- *Satisfaction of conditions for strong competition:* an important framework condition can be established by applying competition law and by improving the business environment (e.g. by further reducing administrative burden, particularly in case of start-ups and innovative enterprises)
- *Improvement of entrepreneurial skills and spirit:* essential for the success of the strategy are displaying the technological entrepreneur as a positive role model and improving the entrepreneurial skills of young adults with potential for business management who have just come out of the education system.
- *The effectiveness and standards of education policy* (primarily higher education policy due to the fact that the time frame of the strategy ends in 2020): the success of the RDI strategy depends fundamentally on the training of professionals qualified for carrying out research and development and the development of education in the fields of mathematics, natural sciences and digital literacy.
- *Increasing mobility in a more favourable direction:* the strengthening of both horizontal (cross-border, interregional, intra-sectoral) mobility and vertical (between different sectors and different stages of the value creation process) mobility and improving the balance in a more favourable direction to advance the development of a knowledge-driven economy.

Figure 11 **The direct and indirect governmental support of the R&D activities of enterprises, as % of GDP, in the OECD countries, 2010**



Source: OECD Science, Technology and Industry Outlook 2012

2 identification of the problem and strategic alternatives



2.1. SWOT-analysis

Based on a detailed analysis, the strengths, weaknesses, opportunities and threats of the national innovation system can be summarized as follows (see Table 1).

Table 1 **SWOT analysis of the national RDI system**

Strengths

- Certain (narrow) disciplines are at the global leading edge (e.g. Hungarian mathematical research and education is world-renowned).
- University-business co-operation is getting stronger in some segments.
- Leading researchers use international sources, infrastructure and databases.
- Cutting-edge researchers capable of qualified and outstanding scientific performance; internationally significant achievements in certain research sub-fields.
- First-class work culture by several large companies, appearance of R&D and knowledge centres, concentrated R&D.
- The appearance of start-ups with high growth potential that have found their niche market and carry out their own high-tech developments (born global model).
- Capital and modern infrastructure by large companies, promising co-operation with universities.
- The development of (company law, competition law, consumer protection, accounting rules, intellectual property protection etc.) legislation relevant to the economic and innovation environment is consistent with the national legislation of developed countries.

Weaknesses

- The market and social needs/expectations do not receive the necessary emphasis in research; the economic-social utilization of R&D is weak, including also public sector innovation.
- Fragmented research capacities and performances that are not focused enough.
- Generally weak demand towards the services of the Hungarian research organizations (in addition: the research readiness of the university and academic sector and the research needs of the industry are not the same, the responsiveness of the university and academic sector is slow).
- Out-dated and scattered infrastructure and often missing new supply of researchers; weak management in the institutions of knowledge base; slow institutional learning.
- The research funding is unsatisfactory and varies over time, the (normative) funding level of R&D institutions is low.
- Out-dated science and technology education, the practical and multidisciplinary education is underdeveloped. The loss of popularity of careers in natural sciences and engineering - in line with the European trends.
- The innovation policy instruments are not sufficiently harmonized („policy mix").
- Lack of capital by the SMEs, weak innovation and growth ambitions and abilities in global comparison.
- Shortcomings in RDI management by the majority of SMEs, low awareness level of innovation and intellectual property protection. Demand for IPR protection is weak. Sometimes the lack of entrepreneurial spirit and failure tolerance.
- There is no established form and practice of communication between SMEs and research organizations (e.g. purchase of service, use of infrastructure etc.)
- There are weak linkages between the actors of the R&D value chain, the co-operation is not efficient enough.
- The level of seed capital is low and the technological incubation processes are inadequate.
- The processes of technology transfer are not efficient enough and the national adaptive innovation processes operate with a low efficiency.
- The spin-off processes are hindered by several attitudinal and institutional factors.
- The public innovation management services are insufficient.
- The evaluation culture taking aspects of RDI into account is underdeveloped.
- The uncertainties in education environment and the decreasing prestige of the teaching career hinder talent management and new supply of researchers.
- The regulatory-supportive environment and institutional structure defining RDI are not efficient enough, the policy objective cannot be realized by the institutional system.
- The low number of new doctorate graduates and persons completed tertiary education in human resources; in funding: the low quality of venture capital (where seed capital is only component), the innovation weaknesses of the SME sector, the low patent activity and the shortcomings in the co-operation networks within the innovation system.

Opportunities

- The strengthening of RDI-friendly economic and regulatory environment.
- The strengthening of university knowledge centres, more pronounced „transfer" of the research results into education.
- The strengthening of the economic role of (industrial) clusters.
- The development of „entrepreneurial universities" satisfying social and economic needs better.
- The utilization of the optimization process of global resource allocation, attracting R&D-enhancing FDI.
- The strengthening of new R&D-intensive industries and the foreign market penetration of Hungarian medium-sized and large enterprises.
- More practice-oriented education (dual studies), the strengthening of entrepreneurial, innovation management etc. education, improvement in „digital literacy".
- The strengthening of the background industry of suppliers, take-off of R&D demand.
- The further development of the R&D tax benefit system (introduction of normative R&D tax benefits).
- Support to the co-operation between enterprises and development institutions or institutions possessing the required infrastructure.
- The introduction of the qualification of RDI service providers for the purpose of providing a uniform „quality service".
- Spread of instruments given priority by the EU (innovative procurements, smart specialization, pre-commercial procurement etc.).
- Joining the large EU co-operation programmes.
- More pronounced R&D diplomacy.
- The development of new instruments for efficient incubation (e.g. open laboratories, technology workshops).
- The development of education in the fields of natural sciences and engineering.
- The strengthening of talent management.
- The strengthening of dialogue between universities and large companies.
- The more pronounced participation of cultural institutions in disseminating the most recent RDI results.
- The catching-up of RDI performance of the Convergence regions, primarily with the support of the Structural Funds.
- The indirect social results enhancing the competitiveness of Hungary that are to be expected from the utilization of innovation results (e.g. by public sector innovation).

Threats

- Lagging behind the global leading edge, the new supply of researchers are insufficient to maintain the internationally competitive level.
- The shortcomings in education will still prevail, growing decline in the number of qualified professionals.
- The deepening of the global financial and economic crisis.
- The lack of needs and interests of economy and society towards R&D will still prevail.
- Brain drain, which is weakening public research.
- There will not be enough professionals with appropriate qualification in order to connect to the global networks.
- The digital divide existing at an international, interregional level and between different types of enterprises will still prevail.
- The SME sector will remain weak and cannot create serious demand for RDI or build capacities.
- The synergies of international RDI co-operations cannot be utilized.
- No (or not enough) FDI based on RDI will be adequately integrated into the Hungarian economy.
- There will not be (enough) enterprises strengthened on the basis of national RDI.
- The resources at the service of the desired RDI developments can be overwritten by short-term budgetary aspects.
- The lack of stability of the RDI institutional system, regulation and support system makes the long-term planning essential for the professional field impossible.
- The growing regional disparities and the eligibility rules of the EU resources in the KMR complicate the support of the region.
- The EU resources cannot be utilized in an efficient way.
- The RDI funding is generally ailing.

Based on the SWOT analysis - building on the strengths, using the opportunities, mitigating/eliminating the weaknesses, taking care of/avoiding the threats - the strategic-level problems can be solved and strategic objectives and assignments can be set.

2.2. The main problems of the national RDI system

Three main problem areas are outlined in the national RDI system based on the literature review and the SWOT analysis (see Figure 12):

- **The weaknesses of knowledge bases and knowledge production:** knowledge-intensive economic processes with higher added value will be slow to emerge if the supply of researchers is weak, scientific and technological education faces difficulties, and internationally competitive research centres are missing. Knowledge production will be alienated from society if it fails to reflect society's needs.
- **The shortcomings in knowledge flow, knowledge and technology transfer:** if the institutions and organisations of knowledge transfer are weak or are unable to transfer the knowledge created by research and development in an economically usable way, this can create a bottleneck which complicates the production of higher added value or, in a broader sense, the economic catching-up of the country.
- **Obstacles to the (innovative) functioning of the business and community sectors involved in knowledge utilization:** one consequence of the dual structure typical of Hungary is that while large foreign companies introduce mainly modern technology and management knowledge, small and medium-sized enterprises can only reduce their disadvantages in innovation slowly. The potential of public sector innovation has been absent from government policy.

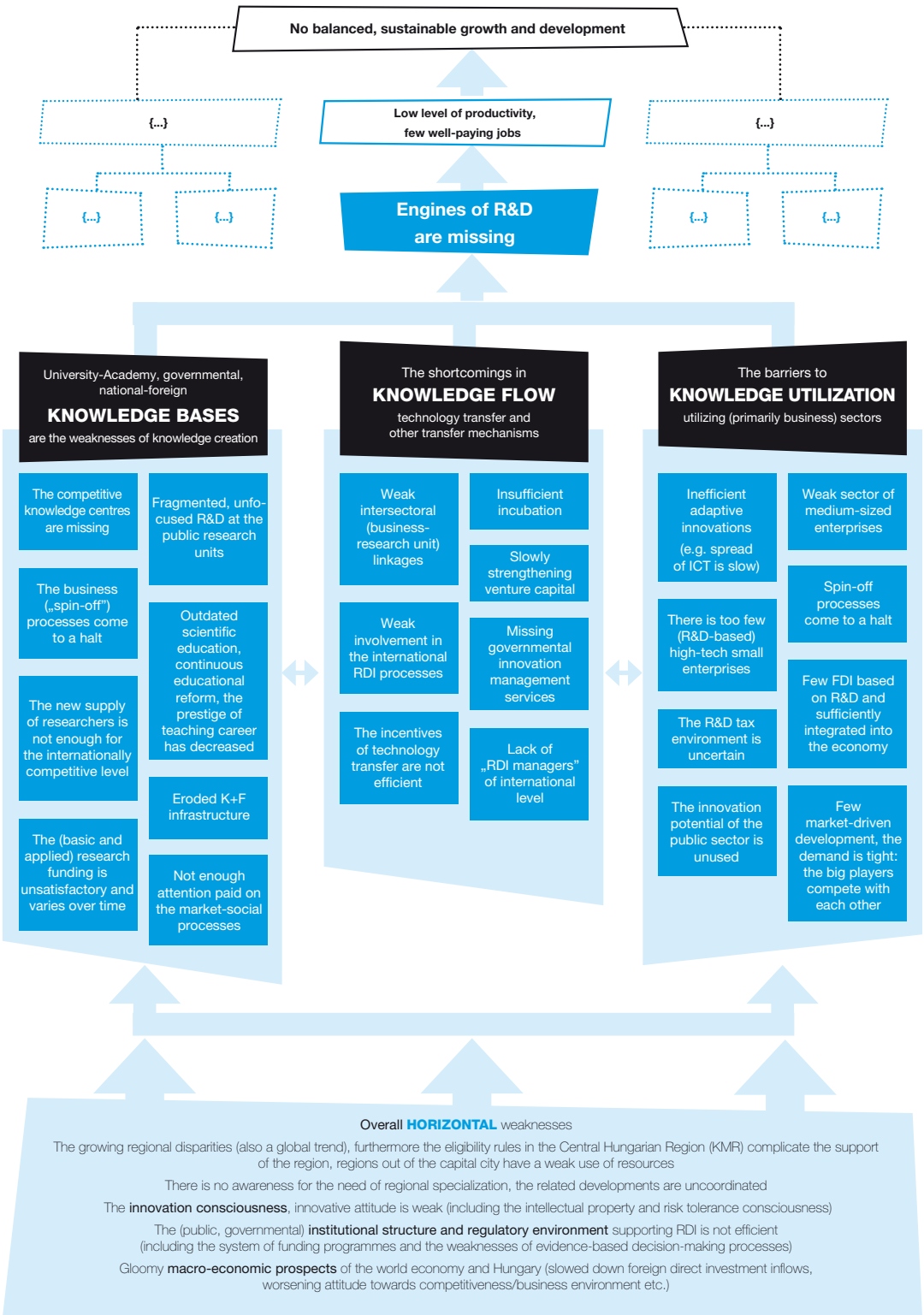
The problems require a clear division of labour in the RDI strategy:

- **the knowledge bases** (all the knowledge bases of the universities and the Academy, the private sector and the non-profit and community sectors) **form the basis of the national innovation system,**
- social and economic actors **in the knowledge economy,** particularly private enterprise and the public sector, are primarily interested in the processes of knowledge utilization and creation of added value,
- in terms of competitiveness, the actors involved in knowledge utilization are strongly dependent not only on the quantity and quality of supply of knowledge bases but also on **the efficiency of the transfer system** (For more detail see Chapter 1.3.).

The concept of **„industrial commons"** is used in the international literature to describe how an industry of a country can only be competitive in global terms if it is built on strong and widely available R&D foundations[13]. Furthermore, it is also highlighted in the international literature that these industrial commons can only be utilized by the industry in an efficient way if strategically considered innovation transfer mechanisms, the required management capacities and diverse forms of network co-operation are present in the given country. Hence **such a RDI strategy is required, which can also handle the problems of knowledge flow** indicated in the large middle block of the problem map, **knowledge and technology transfer and co-operation mechanisms.**

[13] This is a reference to the medieval village communities. The common pastures were available to be used by every farmer in the village communities (see Pisano and Shih, 2009).

Figure 12 The main problem areas of RDI in Hungary



2.3. Strategic alternatives and smart specialization based on RDI

The support of research and development and the development of the innovation system is primarily **a long-term investment in the future.** It is relevant for the future whether Hungary **regards research and development and innovation as a pulling force and a resource to be made more robust** - or merely as an area on which the country must spend because every developed and developing country „must" deal with RDI. Thus the strategy envisages the primary objectives of strengthening the investments in research and development and innovation in Hungary, modernizing the related institutional solutions and achieving a real breakthrough over a strategic time horizon as a result (see Figure 13).

Based on international experience, public funding of research and development creates a major multiplier effect and generates significant additional expenditure from the business sector (Streicher, Schibany, Gretzmacher, 2004). This additional expenditure from the business side will not only create the basis for long-term growth but also enable a real catching-up process in the countries lagging behind in terms of economic development.

There is a very strong positive correlation between the volume of public expenditure on R&D and GDP growth. In addition, the return on R&D investments many times exceeds the return on other investment forms (see Table 2, Enterplan, 2005). Nevertheless, the social return on R&D activities - i.e. the impact of increasing R&D investments on the output of other companies - is significantly higher than the business return (Griffith 2000: Corderié.n.). This exceeds the rate of return of 13-14% estimated in OECD countries (Enterplan, 2005), although the level of education is also a take-off point for developing countries.

The business rate of return is estimated between 20-30% in most cases by the international literature (Hall, Mairesse, Mohnen 2009). The social rate of return is generally higher than that and in some cases it can reach 80-100%, although the variation is quite high (AmirPiric, NevilleReeveé.n.). Parallel to the rise in development of the innovation system, the micro-economic return on investments can be better demonstrated.

It is recommended to build the RDI strategy around three priority axes in order to ensure that the public and business resources spent on the RDI sector in Hungary are a worthwhile investment in the future:

1. **internationally competitive knowledge bases** which can underpin economic and social progress,
2. promoting **co-operation in knowledge and technology transfer which is efficient** both at the national and international levels, and
3. **innovative enterprises intensively utilizing** the results of modern science and technology, **and in the public sector.**

These three priority axes also mean that there is a **need for** a methodical **system building** in the field of RDI in Hungary. Such development can arise from drivers within the innovation system, particularly these four factors:

- investment on R&D and invigorating the demand for research and development,
- introduction of innovations improving productivity,
- establishment of an efficient support and funding system,
- completion of the start-up ecosystem.

The regional-technological-sectoral aspects of the RDI strategy will be determined by the National S3 Strategy 2020 document to be prepared during 2013. The National S3 strategy fits into the RDI strategy as follows:

- The RDI strategy provides the national frameworks and the research and development and innovation objectives of the economy and society.
- In the seven NUTS-2 regions regional strategic plans will be compiled on the basis of the RDI strategy and by adaptation of the EU S3 planning methodology.

Figure 13 **Hungary at strategic crossroads: the challenges created by RDI**

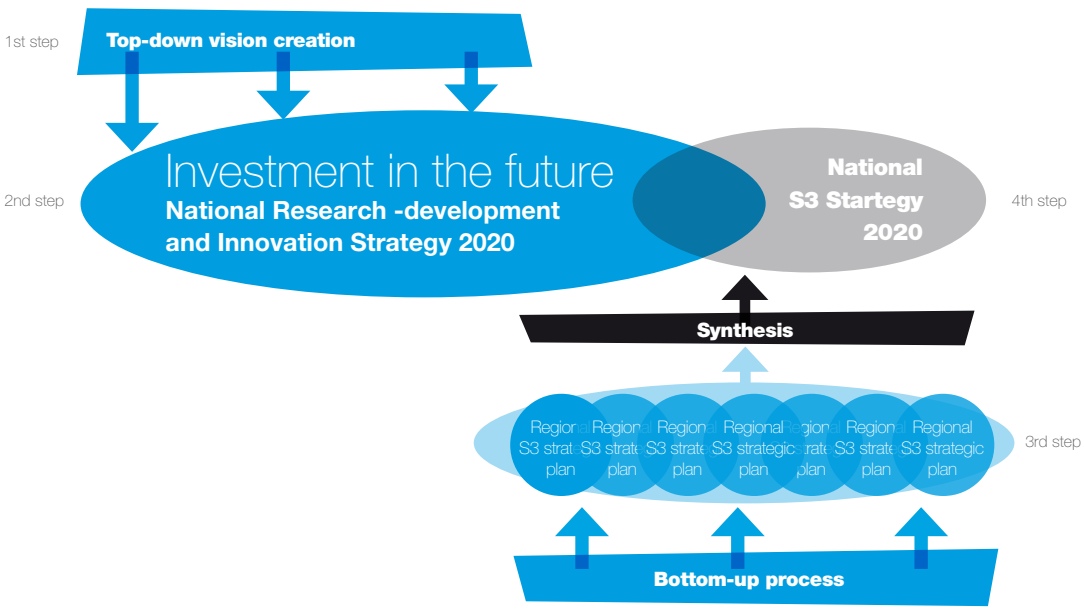
Table 2 **R&D as a highly profitable investment**

Country	Return on R&D	Reference
United Kingdom	business rate of return: 7-14%, social rate of return: at least 30%	Griffith, 2000
Canada	the rate of return on R&D investments exceeds 2.5-4 times the return on physical investments	Hall, Mairesse, Mohnen 2009
The 17 most developed OECD countries	0.1% increase in BERD can cause a 0.3–0.4% increase in the output of the national economy	Bassanini – Scarpetta 2001
USA	between 1959 and 2004 5% of the GDP growth could be attributed to R&D activities; between 1995 and 2004 already 7% of the GDP growth could be attributed to R&D activities	National Science Foundation 2007
EU	Doubling of the R&D expenditure of a company can increase the employment of given company by 2-3%. Doubling of the R&D expenditure can increase the demand for labour of a given company by 15-20% in sectors with high R&D intensity; and by 8-10% in sectors with lower R&D intensity.	EC-IPTS 2011, EC 2011

- The seven strategic planning documents will be summarized in one synthesis document for the purpose of identifying the technological and sector synergies between regions.
- The synthesis plans shall be fully brought into line with the RDI strategy. The national S3 strategy 2020 will be adopted by the government after consultation with relevant parties in the region, and a long-term planning framework establishing the specialization efforts on RDI bases will be drawn up.

Continuous periodical and overall evaluation - and if needed, amendment - of the strategy is the other important instrument for the purpose of systematically strengthening the RDI components. In this way it can be established whether there is an essential system component which will be invigorated; on the other hand, the RDI strategic management – which the above mentioned S3 planning constitutes a part of – at the national level can also be amended[14]. So the evaluation is not only a significant component of the rolling planning and implementation, but it enables advanced measurements of research and development and innovation to be elaborated and implemented.

Figure 14 **Setting of the planning of smart specialization**



[14] As a starting point – see the intended management roles – the establishment of such management structures are required that take the systemic determinations into account and considers the whole area of research and development and innovation in context. Since there is little related experience about the institutional system in Hungary, a more significant learning effect is to be expected from the first evaluations.

3 vision and objectives

3.1. Overall vision

The RDI strategy lasting until 2020 sets the goal of renewing and strengthening the innovation system as a whole; its vision can be summarized in the following statement:

By 2020 the key participants of the national innovation system will be significantly reinforced through the active support of RDI policy and will become equal partners in global innovation processes in Hungary. They will then be able to invigorate the national innovation system as a whole, due to the follow-through effects, and thus contribute significantly to enhancing the competitiveness of the Hungarian economy together with transforming it to a sustainable knowledge economy.

Every aspect of this statement determining the vision is of the utmost importance. According to the vision, **the participants of the national innovation system** are the following: research and development organisations, enterprises, government institutions, organisations funding innovation developments, universities, high schools and vocational training establishments, research hospitals, libraries, historical archives, museums, public education institutions and other information centres and organisations providing legal, management, incubation, IT, commercial (marketing) and other services required for the successful innovation processes. **The key participants** among them **which can bring about** a significant **follow-through effect:**

- „world class" research groups,
- R&D centres of the global large companies integrated into the national innovation system,
- R&D-intensive Hungarian medium-sized enterprises expanding in international markets[15],
- small enterprises building on RDI and capable of fast growth (by the technical jargon and in David Birch's phrase: the „gazelles"[16]),
- innovative supplier SMEs,
- innovative start-ups,
- early-phase and venture capital investors integrated into the international markets, and
- public sector institutions engaged in R&D activities and utilizing innovation results[17].

These organisations can become **equal partners in the global innovation processes** only if their innovation and economic performance approaches the average level of more developed countries[18]. The vision for invigorating the innovation system **as a whole** aims at enhancing the performance of all participants in the innovation system – through direct and indirect effects[19]. Finally the **sustainable knowledge economy** means such a knowledge-driven organizational system of economic processes that is sustainable from an environmental, social and economic perspective, while the number of workplaces with higher intellectual added value increases[20]. The expansion of the 'green' economy plays an essential role regarding **environmental sustainability** longside economic growth. **Social sustainability** refers to the responsibilities related to human and social capital (see KRPIH (2008)), while **economic sustainability** refers primarily to the requirement of maintaining macroeconomic balance. It is essential from the viewpoint of social and economic sustainability that the related public sector institutions should improve their innovation potential while establishing coherence with their public services (e.g. provision of services regarding human resources shall be uninterrupted).

[15] The policy considers it important that the companies with a Hungarian ownership background should get stronger but these efforts should be implemented in line with the international competition rules at the same time.

[16] David Birch, 1979.

[17] The social impacts (e.g. for providing more cost-efficient public services of a higher quality by contributing to increasing the health status and work skills of the population) are aimed at achieving the goals in the public sector.

[18] This justifies detailed measurements and evaluations. It shall be mentioned that the performance of the national innovation system is dependent on the international embeddedness and performance of the sectoral, regional and technological innovation systems (Vas and Bajmócy (2012)). These shall also be addressed as priority issues in the future evaluations of the strategy.

[19] Systematic evaluation has already been done in Hungary in the 1990s (See Inzelt, 1996, Papanek, 1999) but the RDI policy from a standard systematic viewpoint has not been recognized yet.

[20] The objectives of smart, sustainable and inclusive growth of the European Union are taken into account by some parts of the strategy.

The science, technology and innovation policy as a whole is constituted by the RDI strategy and the strategy of science policy to be drawn up. As such, the relevant frameworks from a public policy viewpoint required for the RDI system and for promoting research and cultivating science are specified together by the RDI strategy and the strategy of science policy together with the smart specialization strategy (S3), which is regarded as an ex-ante conditionality for drawing development funds from the European Union.

The above vision is also expressed by **quantified objectives** complying with the undertakings of the National Reform Programme submitted to the European Commission in 2011 and elaborated in relation to the Europe 2020 strategy:

Hungary will increase its gross domestic expenditure on R&D to 1.8% by 2020, and to 3% by 2030.

As a complementary objective, the business enterprise expenditure on R&D will rise to 1.2% by 2020.

3.2. Other detailed and quantified objectives

Additional quantified objectives based on the main components of the strategy complement the overall vision. These detailed and quantified indicators describe the objectives to be achieved compared with the current status. The „+" marking in the objectives listed below indicates the new, additional capacities to be introduced in the national innovation system compared with the current status. The strategy considers strengthening current capacities an important task, alongside developing additional capacities.

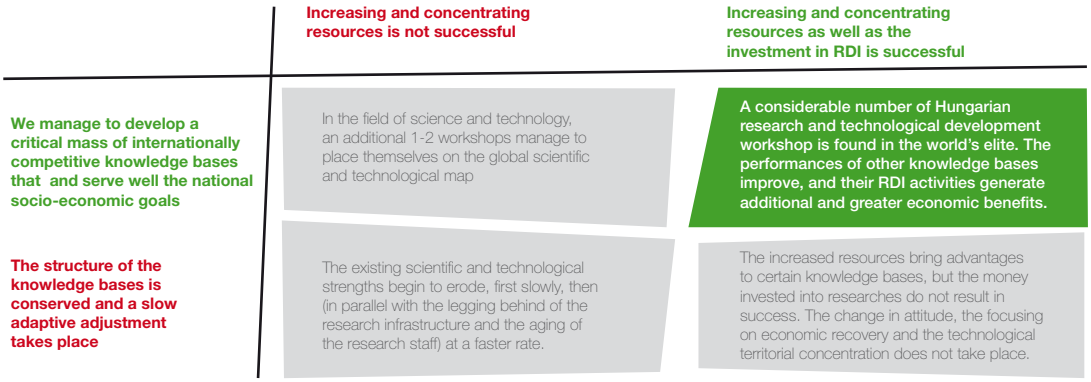
The definitions and terms related to the objectives – and used in the RDI strategy –are detailed in the Annex. The detailed professional contents of additional indicators proposed for the further monitoring of the strategy will be elaborated over the strategic time horizon.

During the seven years of the strategy in Hungary, by 2020:

+30	**larger research and technological development group will join the „world's elite"**
+30	**R&D research centres of large global companies will be established / strengthened**
+30	**R&D-intensive macro-regional medium-sized enterprises will produce and provide services**
+300	**RDI and growth-oriented small enterprises (so-called „gazelles") will find their place in the global market**
+1000	**innovative start-ups will get the funding required for starting their activities**

many innovative supplier companies with national decision-making centres will provide services to the global large companies that have already been established or will be established in Hungary

Figure 15 **Alternatives to developing knowledge bases**



3.3. Specific goals in relation to the knowledge bases

The RDI strategy and the strategy of science policy are interlinked with each other in many respects; the issue of scientific research is the most important among them. Two kinds of scientific researches are to be distinguished:

- basic (or frontier) research generally taking place over a longer period, and
- targeted research over a shorter period (which also has a significant part of applied research).

The new supply channels of applied research and development, and the knowledge-driven economy and society can not be sustained without ensuring the framework conditions of basic research[21]. The RDI strategy considers it important that the physical and human resources of basic research are available and the financing conditions are ensured.

In addition to recognizing and encouraging scientific excellence, the RDI strategy separately supports the knowledge bases connecting to national enterprises through professional management structures. The main goal is that outstanding knowledge centres – by entering their professional fields into international processes – would be able to provide a new supply of high quality researchers and also strengthen the position of national enterprises in international competition. For the purpose of enabling research centres to compete internationally, the research infrastructures will be developed[22] and research laboratories will be established to attract both foreign researchers and Hungarian researchers from abroad. The strategy will also to support, to a lesser extent, knowledge bases contributing to public sector innovations.

It is recommended that the development of high quality knowledge bases which achieve cutting-edge results, are founded on the national knowledge base. The demand for new knowledge among the foreign and national business sector can be satisfied in a direct way by developing these knowledge bases; furthermore the innovation-based development of the public sectors can begin. The linkages of internationally competitive knowledge centres to other sectors and organisations can cause significant follow-through effects and also support modernisation beyond their organisational boundaries in such sub-fields where the impacts of the RDI centres of multinational companies could only be felt in a more indirect way (see Figure 15).

Based on the strategy, the currently known future technologies[23], e.g. the so-called „converging technologies" such as info-communication, biotechnology, cognitive technologies, nanotechnologies and mathematics, play a privileged role in developing knowledge bases. The elaboration of the smart specialization strategies shall partly decide how the development of these technologies can be useful for Hungarian economic and social development.

[21] This consideration was particularly emphasized by the 2011 report of HAS.

[22] The outstanding international importance of the research infrastructures is detailed separately in Annex 4.

[23] In the IT field e.g. the Future and Emerging Technologies (FET) initiative by the European Commission can be mentioned.

Specific objectives
for developing knowledge bases:

A1. Education and talent management

A2. Strengthening of research organisations (especially at the HAS and in higher education)

A3. Internationally competitive R&D infrastructure

A4. Modern research management

Table 3 **The professional contents of instruments aimed at strengthening knowledge bases**

Education and talent management

1) The strengthening of the higher education required for enhancing the number of research and development workplaces.
2) The development of the vocational training for creative, innovative professionals.
3) The strengthening the interdisciplinary approach in higher education.
4) The generalization and strengthening of the education of business management, project management, intellectual property protection, proposal writing, innovation management etc. in economic, engineering, natural science, research and public service courses alike.
5) The talent identification and development in the formal and non-formal, informal education; thematic talent management, elite education.
6) The development of scholarship programmes.
7) The strengthening of creativity and entrepreneurial attitude in the whole education sector – and the training of pedagogues in support of the aim.

The strengthening the research organisations

1) The development of the outstanding research organisations focusing on international standard, including EU funds.
2) The support of international mobility of researchers and encouragement of their national reintegration.
3) The attraction of PhD students and postdoctoral researchers from the BRIC+ countries.
4) The training of researchers, the strengthening and further development of doctoral schools by using the opportunities of the EIT knowledge triangle.
5) The elaboration and enforcement of a career model for researchers.
6) The predictable and sound public funding of basic research (particularly at the HAS and in higher education).
7) Coherent strategy for university research – reply to the global challenges in researches.
8) The support for the institutional technology transfer infrastructure and processes.
9) The set-up of a linkage between enterprises and researchers at the academic and university sectors (partly also a task for strengthening the knowledge flow).

Internationally competitive R&D infrastructure

1) The strengthening of the competitiveness of research infrastructures, with particular attention to strategic priority areas and the European research focuses.
2) The encouragement of networking of national R&D infrastructures.
3) The support for joining the large international infrastructures and networks (including particularly: ESFRI and ELI, see the Annex).
4) The increase of utilization of infrastructures in the framework of co-operations.
5) Making the register of infrastructures public and ensure the access to the free capacities.

Modern research management

1) The enforcement of a new research management approach in the management of research organisations and institutions (joint management of excellence and relevance, entrepreneurial and project vision).
2) The support for establishing enterprises and spin-off in research bases.
3) The enhancement of synergy between the research and business sectors.
4) The inclusion of research, education and business into joint projects; the strengthening of the knowledge triangle by using the resources and infrastructure of EIT.
5) The strengthening of practice-oriented research and development training, organized together with the business sector.

3.4. The strengthening of knowledge flow

The goal of enhancing knowledge flows is to strengthen linkages between participants of the innovation system, to develop the innovation management skills and abilities, to strengthen the integrated innovation services, all of which can together improve the efficiency of both the private and community-public sectors (see Figure 16). It is the privileged task of the state to promote the favourable ratio of competition and co-operation („competition+co-operation=co-opetition") in the field of RDI.

Specific objectives related to knowledge flow:

B1. Efficient central public innovation services

B2. Introduction of decentralized innovation services

B3. Strong traditional innovation co-operations

B4. Support for open, pre-competitive and social innovation co-operations

B5. Efficient participation in EU and international calls for proposals and initiatives

Figure 16 Alternatives to the strengthening of knowledge flow

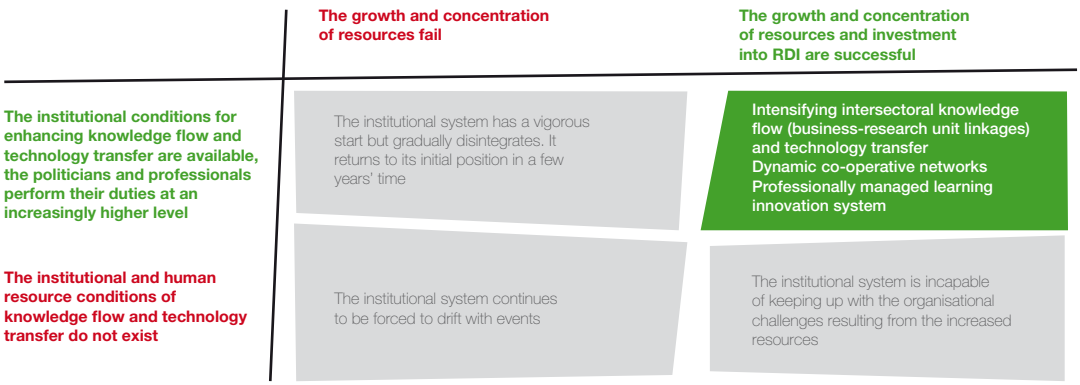


Table 4 **The professional content of instruments strengthening more intensive knowledge flow**

Central public innovation services

1) The establishment of an integrated, client-oriented, IT-based national innovation service system with regard to the international best practices.
2) The operation of a central RDI information evaluation and service database (which has already begun its operation under the name of RDI Observatory in the National Innovation Office).
3) The strengthening of innovation services with a mentoring system.
4) The transfer of the public sector's demand for RDI to the knowledge bases (pillar A)
5) The securing of the quality of RDI services (e.g. accreditation, training).

Traditional innovation co-operations

1) The support for establishing and running R&D co-operations functioning in a more efficient way than now (e.g. technological clusters).
2) The encouragement for operating science and technology transfer organisations.
3) The encouragement of co-operations in a bidding consortium and cross-sectoral (science and industry) and business co-operations both at a national and international level.[24]

Decentralized innovation services

1) The utilization of regional features; better compliance with the local special needs.
2) The establishment of an integrated (one-stop shop) innovation service base per every region.
3) The set-up of information points on intellectual property protection.
4) Services that can be provided quickly and are available in quantities (e.g. modelled on the national example of the innovation voucher prevalent at an international level, called Innocsekk)[25].
5) The strengthening of regional information bases and ensuring of the compatibility with the centralized national system.

Support for open, pre-competitive and social innovation co-operations

1) The involvement of the users, social participants into the innovation development processes (open innovation).
2) The strengthening of the platform-like business and horizontal co-operation.
3) The exploration of and support for opportunities of social innovation.
4) Pre-competitive instruments strengthening the demand-side (e.g. pre-commercial procurement (PCP) which favours in a limited scope the innovative SMEs by public tenders)[26].
5) The provision of incentives for spreading new, web-based social innovation solutions (crowd-funding and crowd-sourcing).

Efficient participation in EU and international calls for proposals and initiatives

1) The representation of Hungarian interests in the RDI organisations, initiatives and fora of the European Union (e.g. national contact points, NPCs).
2) The advancement of Hungarian participation in the EIT KICs - possibly as principal investigators. The support for and encouragement of participation in the European Innovation Partnerships (EIP) and Joint Programming Initiatives (JPI) in the strong national RDI areas.
3) The securing of a more efficient access to the EU programmes and initiatives (RDI representation in Brussels, national supporting programmes, national additional funding, support in partner search).
4) The focused support for bilateral science and technology and industrial R&D co-operations in the priority relations; the further development of the network of science and technology attaches and enhancement of its activities in strategically important areas.
5) The strengthening of the R&D components of macro-regional co-operations.
6) Resource coordination for the purpose of using the RDI resources in an efficient and synergistic way in the 2014-2020 programming period.
7) The better inclusion of the Hungarian processes of the Enterprise Europe Network into the strategy.

[24] The scope of the RDI strategy does not cover the support for the physical facilities of industrial parks / technological parks / science parks because these belong to the more narrowly understood development policy. Nevertheless, the facilities can be important spatial junctions for encouraging linkages between enterprises and research organisations that are recognized and supported in an appropriate way – e.g. by providing incentives for moving into parks –by the instruments of the strategy.

[25] The functioning of the voucher is as follows: if a company needs a service related to patent, research etc., then it will order it and accept the service provider's invoice, which will be paid out by the supporting organisation directly to the account of the organisation issuing the invoice. The main definitions are summarized in the Annex.

[26] The PCP means such a procurement of research and development and related services when the new developments can potentially serve community (public) needs without the contracting authority committing itself to actually procure the product or technology resulting from the development.

3.5. Specific goals in relation to knowledge utilization

The utilization of „spontaneously created" new knowledge with prospects of profit is **expected** primarily **of the knowledge-intensive companies** engaged in relevant RDI activities **but improved productivity of the innovative public sector is also desirable**[27].

The strategy considers the strengthening and development of the so-called „gazelles", i.e. the **knowledge-intensive companies with high growth potential** engaged in significant RDI activities, among the fast-growing SMEs to be particularly important[28]. These enterprises:

– increase the added value of the economy more intensively than the average, resulting in an increasing number of well-paid workplaces.

– provide potential to enable innovative medium-sized enterprises to get stronger, and

– enhance the number of ground-breaking, original innovations appearing.

Thus the strategy envisages that the number and economic activity of **R&D and growth-oriented small enterprises** („gazelles") will significantly grow by providing particular and dynamic **incentives** to them. This public investment also means that workplaces generating a higher income can appear in greater number after a few years and the profit of these companies will be higher. Thus the investment pays off and the added value of this sector grows significantly faster than average in the national economy.

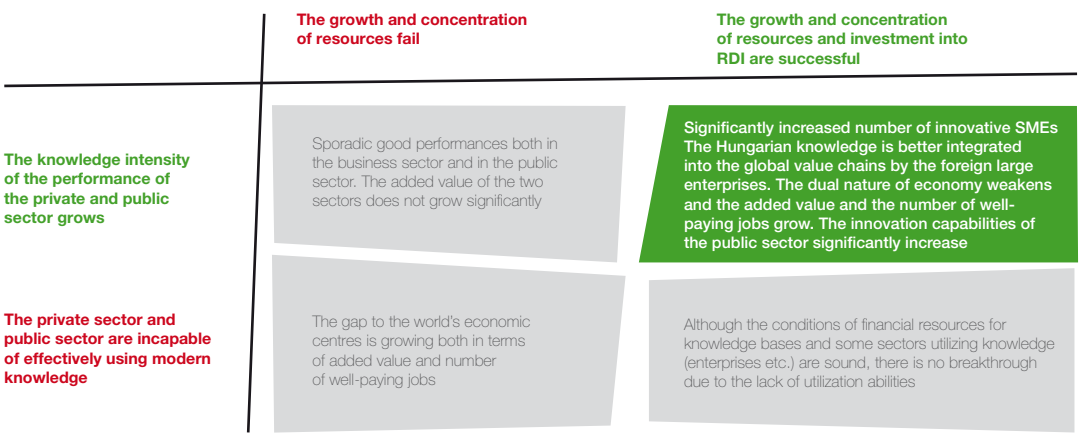
A further goal of the strategy is that innovative young companies shall not lose their determination during the early, critical phase of their life cycles. Therefore an **innovation eco-system** which is favourable for them should be created within the framework of the strategy. This eco-system not only provides incentives to the gazelles with a high growth potential, but also benefits **innovative start-ups.**

The specific objectives related to small enterprises in the field of knowledge utilization:

C1. The creation of a start-up ecosystem

C2. Awareness raising, law enforcement and relaxation of intellectual property protection

Figure 17 **Alternatives to the improvement of knowledge utilization**



[27] In addition to the direct impacts improving competitiveness, further significant positive economic and social impacts can be expected of the strengthening of RDI capacities and the provision of incentives to RDI activities.

[28] The term „gazelles" has become widespread in literature - after David Birch. The term „young innovative companies" (YIC) is also used in EU terminology.

In addition to the RDI-intensive start-ups, the (follower or adaptive) developments and innovations of medium-sized enterprises are also required for enhancing the competitiveness of the economy. The entry to foreign markets and encouragement to become high-level suppliers are particularly important among these companies.

On the one hand, the targeted support of these enterprises has a competitiveness-enhancing effect, on the other hand the support enables them to appear later in greater number as buyers and/or users of new knowledge, when adaptation is not enough to face the competition. The continuously growing knowledge centres and other modernized R&D capacities in the framework of the strategy will be in time able to satisfy this need. A further goal is that more and more national medium-sized enterprises shall be able to participate in governmental and local council public procurements with an innovative content, taking into account the significant innovation content of procurements.

Table 5 **The professional content of the instruments supporting the knowledge utilization of small enterprises**

The creation of a start-up ecosystem

1) The support for establishing and operating a technological incubation system advancing young enterprises.
2) Provision of start-ups with complex services (e.g. mentoring, voucher-like support) that improve their survival chances in the early stage of the life cycle.
3) Support for preparing young enterprises for market-based financing
4) The strengthening of the role of seed capital and venture capital funds and securing of stable, market-compatible financial and legal regulatory frameworks, elements of taxes and contributions.
5) Provision of training and accreditation services for the purpose of making enough suitably qualified project evaluators and managers and coaches available.
6) Support for investors for the purpose of finding mature RDI projects.
7) The involvement of foreign start-ups and early stage investors for the purpose of transferring knowledge and social network.
8) The funding programmes shall be suitable for supporting early stage innovation.
9) The modernization of the Act on venture capital and clarification of the incentive mechanisms.

Awareness raising, law enforcement and relaxation of intellectual property protection

1) The improvement of the efficiency of law enforcement related to intellectual property rights.
2) Support for submitting patent applications.
3) Support for maintaining the protection.
4) Support for industrial property protection other than patents and co-pyright protection (e.g. designs, database protection).
5) The implementation of the intellectual property protection strategy of the Hungarian Intellectual Property Office and its inclusion into the RDI strategy.

The specific objectives related to medium-sized enterprises:

C3. Demand creation for R&D of medium-sized enterprises

C4. Efficient support for foreign market entry

C5. Deliberate public demand for innovation

In order to reduce the duality of the national innovation system, the priority objective is strengthening the co-operation between business research centres with a multinational background, national higher education establishment, and SMEs engaged in R&D activities (not in every case for the purpose of innovation). The research centres of international companies bring advanced knowledge to the national economy and also have an incentive effect on the national knowledge base.

The goal of the strategy is:

– on the one hand, **to further strengthen the research and development centres of multinational large companies,**

– on the other hand, to help the multinational large companies establish new research and development centres in Hungary.

The global position of the centres already operating in Hungary can significantly be improved by establishing the proper business and innovation environment and ensuring a good supply of high quality professionals and researchers. A further goal is to create a culture of new, internationally cutting-edge knowledge accumulation and application by creating linkages between the research centres in Hungary and the national research and development and business sectors. This culture enables Hungarian organisations to participate more intensively in international knowledge flows; and that the specialization which can help Hungary to find its role in the global innovation space can begin. Creative researchers and engineers with an entrepreneurial spirit working in multinational companies will be able to start their own R&D-based enterprises, provided that the eco-system functions well.

Table 6 **The professional content of the instruments supporting the knowledge utilization of medium-sized enterprises**

Demand creation for R&D

1) The systemic encouragement of cross-border RDI co-operations.
2) The operation of offices providing services in support of innovation activities of Hungarian companies on focused markets and target areas.
3) The support for knowledge and technology intensive companies to enter foreign markets by consultations, training and other services.
6) The reduction of the administrative burden hindering the growth of innovative companies.

Efficient support for foreign market entry

1) Development of competencies and knowledge related to modern management, sales, production management, applications and support for trainings, advanced trainings.
2) The strengthening of IT awareness.
3) The strengthening of co-operation skills.

Deliberate public demand for innovation

1) The study of public procurement tenders from a viewpoint of suitability to the RDI policy goals and dissemination of related public procurement practices.
2) The launch of pre-commercial procurement (PCP) actions.
3) The development of technological specialization within NATO.
4) Encouragement of and support for development and application of innovative solutions in the public sector.

Specific objectives related to large enterprises:

C6. Large-company workplaces of high content of knowledge with intensive local knowledge connections

C7. Increasingly innovative and diversifying SMEs

Table 7 **The professional content of instruments enhancing the national value creation in the sector of large enterprises**

Large-company workplaces with intensive local knowledge connections

1) The multinational companies cannot be kept in Hungary for a long time only by using tax incentives, offering cheap labour and elements of the infrastructure. The stable position in the international competition is guaranteed by the high quality of human resources.
2) This requires such a high-quality training which is aligned with the future needs of these companies. The high-quality training together with research and development serving business needs provide a chance for the companies to establish their R&D activities in Hungary thus creating ten-thousands of qualified workplaces and ensuring the long-term operation of said companies in Hungary,
3) The strengthening of R&D centres of large companies in Hungary and attraction of these centres to Hungary by individual government decisions (EKD).
4) However, the structure of the Hungarian industry is not in the favour of new and original development and successful innovation. Therefore a programme is needed, in the framework of which the most excellent research bases of the Academy and higher education can participate in implementing integrated, large industrial projects.

Innovative, diversifying supplier SMEs

1) Instruments recognizing development activity (e.g. support for research and development workplaces).
2) Support for integrator programmes, cluster activities.

The role of the state is increasingly decisive in modern competitive economies[29]. Since public services are labour-intensive and their productivity growth slower than that of processing industries[30], the focused innovative development of the public sector results in economic growth and welfare effects. In countries where public sector innovation is not strong, the innovation performance of companies is also less successful (Inzelt (2013)). The RDI strategy aims at giving more attention to the public sector innovation as a part of the innovation system, particularly with regard to the largest community sectors.

[29] According to Wagner's law the state spending grows parallel with the increase in economic development.

[30] This is known by the economic literature as the Baumol effect.

With regard to the public sector innovations, a general objective has been set by the strategy:

P1. Invigoration of the innovation activities in the health care, environmental, energy, educational, transport/logistics sectors

Table 8 **The professional contents of instruments aimed at invigorating public sector innovation**

Invigoration of the innovation activities in the health care, environment, energy, education, transport/logistics sectors

1) Elaboration of reading and strategic proposals on the health care, environmental, energy and transport-logistics innovation systems, similarly to the educational field (OFI (2011))
2) Use of the innovative public procurement instruments (including pre-commercial procurement, PCP) in the professional field.
3. Order and use of applied researches based on the knowledge bases (see pillar A) in the public policy and public sector.
4. Public procurement of innovative goods and services based on such performance and functions that require development.

The business and community sectors do not modernize directly through original developments and innovation but within a framework of adaptive innovation solutions, i.e. solutions previously developed and applied in large quantities. The majority of adaptive innovation is organizational, marketing and service innovation, the information and communication technology (ICT) solutions of which significantly improve the productivity and quality of both the private and public sectors.

The objective with regard to adaptive innovation processes:

C8. The enhancement of the spread of adaptive innovation solutions primarily based on information and communication technologies

Table 9 **The professional content of instruments supporting adaptive innovation activities**

Enhancing the spread and development of ICT applications

1) The continuous development of the IT basic infrastructure satisfying the advanced RDI needs and providing benefits (network modernization, network connection, fit software houses to task and size).
2) The development and use of innovative ICT applications and knowledge in the fields of RDI and corporate management, and advancement of their co-operation.
3) The development of content service.
4) The promotion of digital literacy supporting innovation and creativity and the increase in private computer and mobile penetration.

Research and development support can be made more efficient through indirect incentives targeting specific parts of the business sector. Hence, the strategy outlines the following objective as a goal for the whole business sector:

C9. The most competitive R&D tax incentive system in Europe

Table 10 **The possibilities of tax-side incentives**

Competitive R&D tax incentive system

1. It is worth considering that some parts of the proportion of the Structural Funds that can be spent on R&D support shall be available for the companies in form of tax benefits in the next budgetary period from 2014 (The practical application of the solution is heavily dependent on the EU procedures that are taking shape).
2. It is worth considering that the R&D tax benefit encouraging linkages between enterprises and research organisations shall be financed from national sources - taking into account the limits of the budget. It is justified to involve all related market participants into developing the arrangement[32].

During the elaboration of instruments supporting the objectives of the RDI strategy – according to the previously presented problem tree evaluated in detail – some horizontal priorities shall apply. These are the following:

- H1 Smart specialization in the regions (S3)
- H2 Sustainability, equal opportunities
- H3 The ensuring of sound financing of the priority axes
- H4 The familiarization of knowledge and technology in society and strengthening of its recognition.
- H5 Compliance with global social challenges
- H6 Sound and innovation-friendly economic and regulatory environment

The satisfaction and implementation of the horizontal priorities are detailed in Annex 6.

[32] It shall be noted that development tax benefit is available under 3 titles at time of writing of this strategy, which can be relevant from an R&D viewpoint. Standard regulation of the whole tax-side R&D incentives is particularly important.

3.6. Quantified objectives (indicators)

In addition to the already described main quantified objectives, the effectiveness of the planned implementation of the 2020 RDI strategy are measured by the following **indicators**, as defined in the priority axes:

The main objectives of the priority axis **„internationally competitive knowledge bases":**

- +30 larger research and technological development group will be in the „world's elite"
- increase of the total gross domestic expenditure on RDI (GERD/GDP ratio) to 1.8%.

Other main objectives in relation to the priority axis:

- increase the total business enterprise expenditure on RDI (BERD/GDP ratio) to 1.2%,
- the actual number of researchers, developers: there is a need for approximately 56,000 research and development workplaces by 2020 in order to achieve the GERD/GDP objective.

The main priorities of **co-operation in knowledge and technology transfer, are efficient at both national and international levels:**

- success in the international and EU RDI programmes,
- innovation management services covering the whole innovation chain.
- the number of qualified innovation services based on the needs of priority business target groups (client oriented) specified in the strategy.

Other main objectives in relation to the priority axis:

- increases in revenues of residents in relation to intellectual property (with regard to the balance of payments),
- increase in the number of international scientific co-publications.

The main objectives of priority axis **„Hungarian enterprises intensively utilizing modern science and technology results":**

- +30 R&D research centres of global large companies are established / strengthened,
- +30 R&D-intensive macro-regional multinational medium-sized enterprises will produce and provide services,
- +300 high-tech gazelle companies will find their place in global markets,
- +1,000 innovative start-ups will get the funding required for starting their activities until 2020.

Other mainly indirect objectives in relation to the priority axis to be monitored:

- growth in productivity,
- growth in rate of exporting SMEs (especially the RDI-intensive medium-sized enterprises),
- growth in rate of innovative companies among active companies with more than 10 employees (the ratio to be increased to 30% by 2020).

The specific professional content of the indicators developed until now and the related target values are detailed in Annex 7.

3.7. Organization of objectives

Several separate objectives also bringing independent, substantial benefits have been defined in the detailed system of objectives (see Figure 18). The implementation of related measures strengthens the important factors of the Hungarian innovation system, thus contributing to the general improvement of society and economy. But an overall and really fundamental improvement in performance can only take place if serious steps are taken towards realizing every relevant objective and maintaining systematic strategic management in the long term.

With the help of public instruments in support of realizing objectives relating to:

- market failures,
- systemic failures, and
- government failures can be eliminated or managed in the defined intervention areas.

In the case of market failure, the government intervenes where investments into human capital, infrastructure or capital bringing maximum benefits cannot be realized through market forces. Based on the review of the system of objectives, we can refer to a whole chain of market failures, from the big pillars of knowledge production (science excellence centres, enhancing organizational excellence) to the utilization (encouraging and supporting innovative SMEs). The improvement in results and efficiency following measures taken in the RDI intervention areas can be multiplied (multiplicative effect) if **the RDI strategy has a real mission and orientation organizing the separate measures into a system.**

Based on international experience, the orientation and framework of the strategy is based on the creation of the National Innovation System (NIR) and takes into account not only the market failures of the mainstream economics

but also the already mentioned systemic failures and government failures[33]. The approach of NIR is suitable for the strategy, taking into account:

- the specific dynamics of the key sectors of the national innovation system (health sector, food and energy economies) as well as the national integrated level itself.
- such methods of task definition which ensure not only the allocation of direct subsidies solving market failures according to a system but also the use of specific structures, organisations and incentives shaping the markets and influencing the innovation behaviour of companies according to the specific system characteristics.

This engagement in defined priorities and focus areas of the RDI strategy also assumes the implementation of **top-down governmental programmes,** steps to regulate sub-markets (e.g. alternative energy consumption), the development of institutions and organisations and also classic pro-competitive regulatory steps.

The strategy regards the establishment of larger industry and knowledge bases based on the co-operation of concentrated, large RDI projects of international quality as a separate priority task, which also follows the principle of **top-down** integrated innovation system building. These bases can have a double positive effect on innovation system building: on the one hand, they cover the dynamic sectors of the innovation system, on the other hand the establishment of them supports the realization of cluster processes of knowledge flow by deepening and strengthening the network connections.

Finally, in exceptional cases such programmes can be initiated by the government in internationally defined world-class scientific and research areas within the national RDI system which go beyond the framework of innovation system building with regard to RDI risk-taking and proactivity. In such a case the programme is not only about supporting frontier research but - because of the technological interconnections - to explore the utilization space and manage the system risks resulting from interdisciplinarity, including the modelling and elaboration of profitable commercialization.

The smart specialization programme is developed and implemented on the basis of the systematic approach and priorities of the RDI strategy by the partner networks of regional stakeholders and local professionals. According to the goals and requirements of the EU 2020 strategy, this comprehensive regional development concept at the EU level (originally defined for the sectoral innovation systems and their co-operation logic) shall optimize the knowledge and learning processes of all European regions. The smart regional and local policies support key sectors and companies which have play a key role in developing this forward-looking, coordinated programme based on regions and RDI specialization organizing many partners and innovation stakeholders. The basis of regional policy is formed by the industry and service sectors which are competitive at an international level, embedded into the regional economic system and the diversified spatial structure. However, there are extreme regional differences in respect of the industry and service platforms with global innovation and technological connection systems. So **the regional innovation strategy will also ensure that the specialization process drawing upon the horizontal approach of the RDI strategy and the dynamics of the more developed regions generates growth in underdeveloped areas.**

The diversified, technology-intensive industrial and service structures to be developed in the central region, the only region of the country that can be regarded as knowledge-intensive, and in the newly strengthened areas of Hungary are clearly positive (due to the effects of economy of scale) in relation to the process dynamics of growth based on R&D, human (training and learning) and networking programmes. In the less-favoured areas this process is assisted by the efficient knowledge and innovation transfer adjusted to the technological platforms of the developed regions in appropriate fields of specialization where local training and learning programmes can successfully be realized with the most efficient economies of scale. The development of primary infrastructure, particularly in the field of ICT, in relation to the development of network connections has an important role in this regard. Furthermore, programmes which implement certain systemic community-public service functions enhancing the innovativeness of the public

[33] The innovation and technology policy strategies of leading-edge countries are defined within the framework of major societal-economic challenges and / or often large-scale international partnership development programmes and co-operations solving elaborate scientific-technological complex development problems and scientifically preparing the future technologies. In countries with a developed innovation culture where the RDI policy has already been emancipated (i.e. operating in the context of culturally determined traditions, public policy ,administration management frameworks and organizational patterns) such mature national and regional innovation systems have already been developed that are consistent with regard to their determinants.

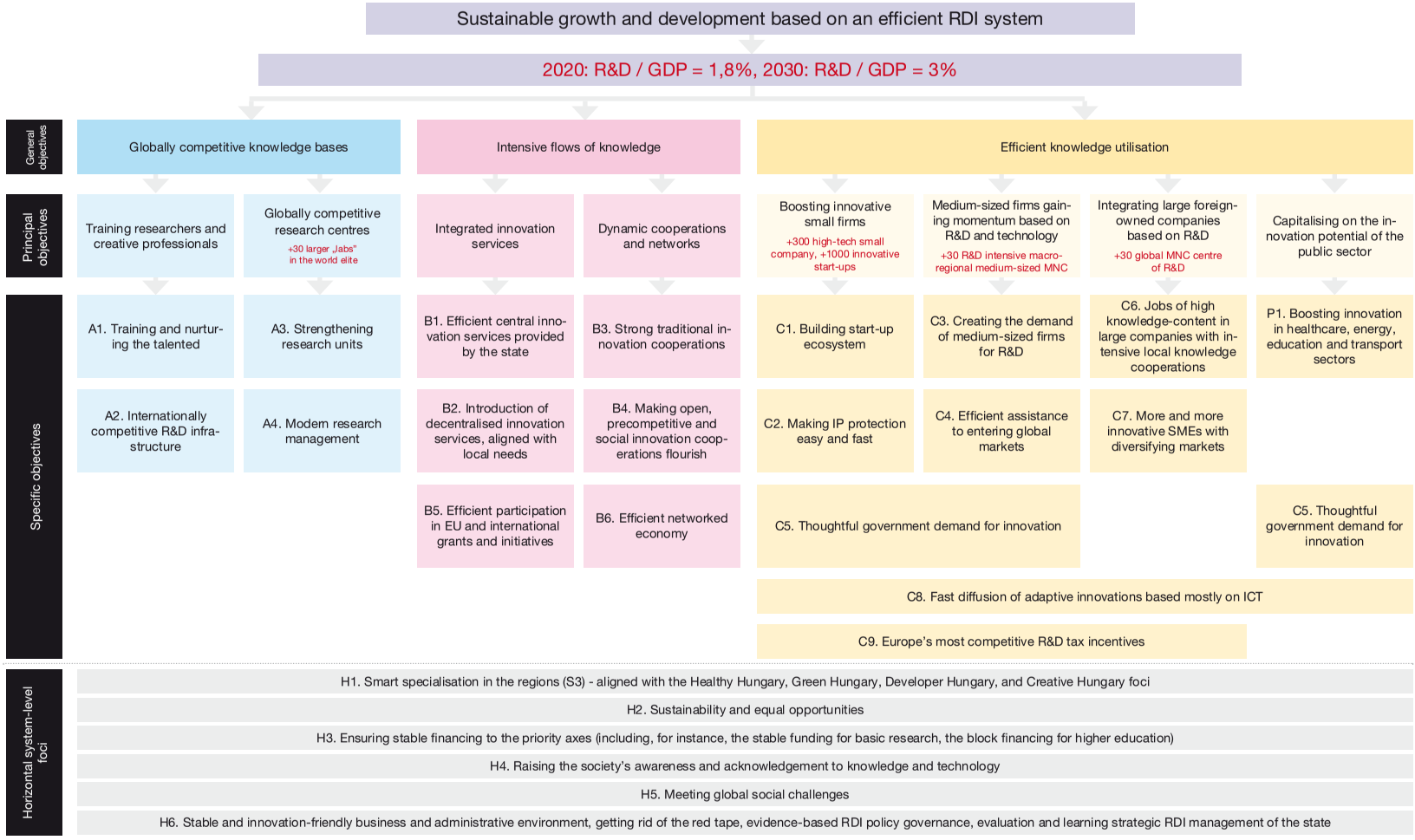
sector - which is an objective of the RDI strategy - have an important role in regional catch-up based on innovation[34].

For the purpose of realizing specialization programmes, utilizing RDI results and implementing technology adaptation, it is practical also to make a difference in relation to the applied instruments between the usually early stage RDI programmes required for implementing complex regional programmes and the business funding representing the utilization side. The meaning of this distinction is that the RDI project parts would not necessarily be tied regionally and would therefore be available with the same conditions and access requirements in every region, while the funding preferences of the innovation enterprise programme should appropriately be in line with the programme conditions defined in every region and industry.

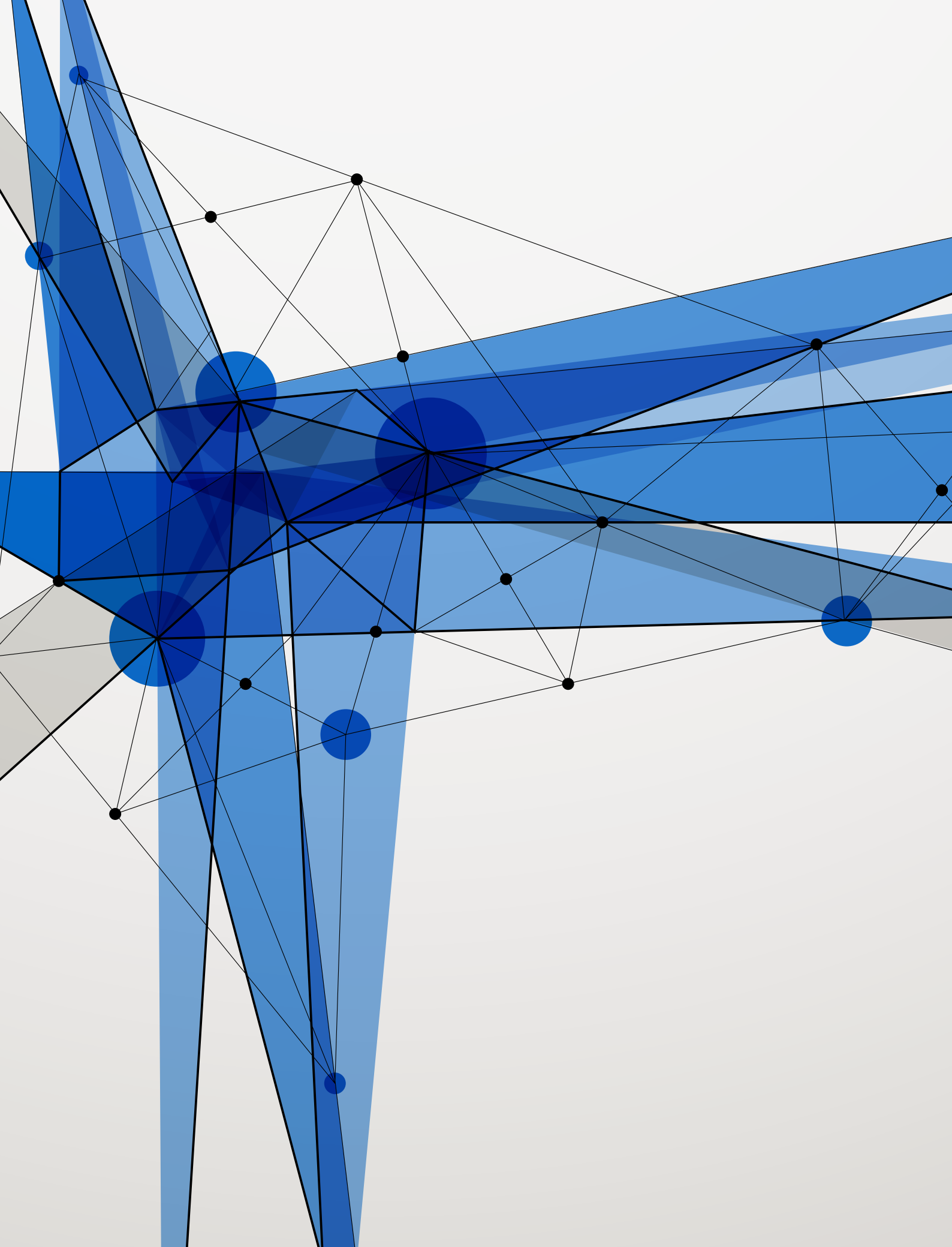
The institution-building and organisation development priorities of the strategy are to disseminate the modern innovation management of international quality. This is about the targeted and segmented introduction and implementation of such innovation services that provide agency services for enhancing the growth and strengthening the innovation capabilities of the priority, preferential target groups of the strategy (e.g. young innovative companies). All of these tasks lay the foundation for the funding programmes (e.g. technological incubator programme) in support of the dynamic growth of SMEs with fast growth potential and technology-intensive young companies. The completion of the technological incubator programme ensures the environmental conditions - the so-called eco-system - required for the permanent growth of young innovative micro- and small enterprises (gazelles). Within this eco-system - as a target group constituting a particularly dynamic node of the innovation system - further regulations and incentives can be built like a chain, including the orientation of venture capital investments and special contributions and tax benefits.

[34] Particular attention shall be paid to the community-led local developments (CLLD) on the microlevels of systemic building. The CLLD is an instrument that can be used under the regional level for the purpose of supplementing the development assistance at a local level, and encouraging the co-operation between the stakeholders of the settlement and the members of the local community. So the community capacities can be developed and innovation, (including social innovation) entrepreneurial activity and the ability to change can be encouraged.

Figure 18 **System of objectives: invigorating the economy on the basis of RDI**



4 the main instruments of implementing the strategy



4.1. Elements of the policy instruments

The planning of the instruments available for the RDI policy („policy mix") serves the purpose of uniformly advancing the target groups of the strategy, taking into account the tax policy incentives (see Figure 19).

The use of particulate instruments of the RDI policy mix does not primarily depend on a funding decision but the effective use of the instruments creates opportunities for financially efficient policy interventions:

- *direct instruments* mean the direct financial support for RDI;
- *indirect* (fiscal – tax-side –, regulatory, standardization) instruments automatically influence the behaviour of the participants in the innovation system;
- the use of *demand-side instruments* (e.g. innovative public procurement, pre-commercial public procurement) in Hungary over the time horizon of the strategy does not primarily mean that additional resources shall be ensured for the purpose of purchasing RDI results but that the available resources shall be spent in a more innovation-conscious way;
- *systematic interventions* do not require significant resources in most cases because they are not directed to support RDI activities but to the completion of the national innovation system through encouraging intersectoral relationships and networking or developing policy management, official acts or services.

The flexibility of the strategy is ensured by modern institutional system solutions and the planned feedback mechanisms in line with the principles of new public management. Because it is very important that the written and unwritten rules are in accordance with the professional set of requirements, such that there are no conflicts of interest during the funding of the beneficiaries.

4.2. Instrument supporting knowledge bases

Based on international experience, the **direct public funding arrangements** are able to contribute to the strengthening of knowledge bases in the most effective way. However, in order to get the priority funding, performance requirements shall also be established for the purpose of enhancing efficiency and beneficial economic impacts. This means, in parallel to the funding, an **excellence-based approach,** research-scientific autonomy and the use of appropriate instruments of utilization-oriented science management in the case of knowledge bases willing to establish themselves at the international level (see Figure 20).

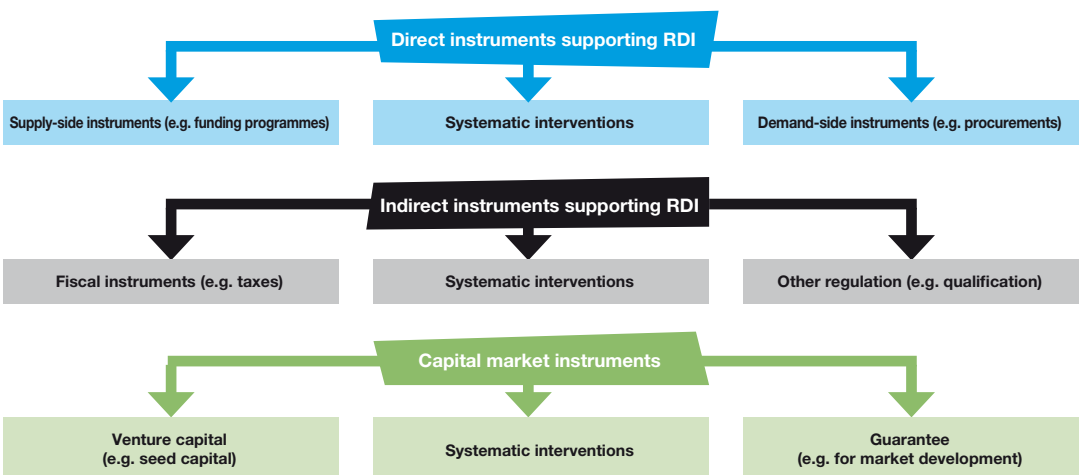
Systematically elaborated instruments also support the knowledge bases of the public sector with the help of business RDI calls for proposals requiring co-operation (in consortia) and instruments of the tax incentive system giving benefits to RDI co-operation.

4.3. Instruments supporting innovative business target groups

Innovative small and medium-sized enterprises are supported by different funding solutions which make a return on investment at the level of the national economy, and are perfectly in line with the given phase of the life cycle (see Figure 21).

The instruments targeting **large enterprises** will be elaborated on the basis of the value chain concept. In this case the central element of the instruments is the support of in-

Figure 19 Grouping of the RDI policy instruments



Source: Adaptation based on Raising EU R&D intensity, 2013 edition

novative business activities creating and maintaining high added value and well-paid workplaces. The innovative supplier businesses with a good chance of becoming independent in the future are a target for support in order to tackle the problem of the dual economy (see Table 11).

4.4. Instruments supporting the invigoration of public sector innovation

The elaboration of separate RDI strategies and action plans is required in public subsystems providing community services, e.g. in the health care, energy, education and transport sectors. In accordance with the action plans, the strategy promotes research funding and implementation of joint RDI projects with the private sector.

The support for public sector innovation and the strengthening of deliberate public demand for innovation shall not only result in direct, competitiveness-enhancing effects of strengthened RDI capacities and activities, but also in comprehensive positive spill-over economic and social impacts. Because developing and promoting the use of innovative solutions can also effectively result in higher-quality provision and more cost-efficient operation of public services and effective challenge management thus supporting the enhancement of Hungary's competitiveness[35].

Figure 20 Main instruments supporting knowledge bases

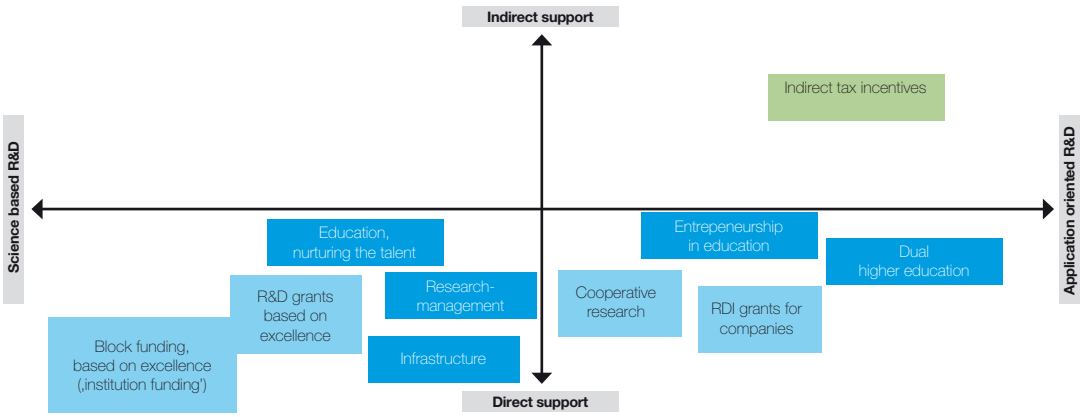
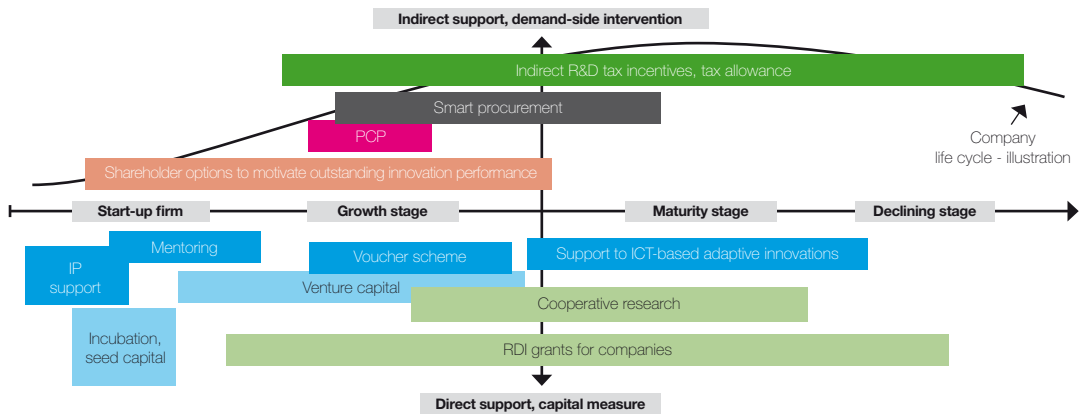


Figure 21 Instruments strengthening innovative national SMEs



[35] For example, the innovative developments in the health sector do not only provide a development opportunity for the RDI in the health sector but can also fundamentally contribute to the strengthening performance of the Hungary economy by improving the health status of the population thus improving its work skills and promoting the higher-quality and more cost-efficient operation of the social security system. Similar processes can anticipated in the education, transport, energy and environmental sectors.

4.5. Review of every instrument implementing the RDI strategy

Table 11 Instruments by target groups

Priority target group	I. DIRECT INSTRUMENTS			II. INDIRECT (FISCAL) INSTRUMENTS		III. CAPITAL MARKET INSTRUMENTS		IV. SYSTEMATIC INTERVENTIONS
	Demand-side interventions		Supply-side interventions					
	professional content	Source of funding		Tax incentive	Other regulations	Venture capital instrument	Guarantee, loan	
Knowledge bases	Support for research centres, infrastructure development, National Talent Programme, mobility programmes, research networks, ELI, bio-info-cogno-nano calls for proposals	ERDF, ESF, normative funding, KTIA	NATO procurements, procurements related to major challenges	Contribution relief in case of employment of researchers; Indirect tax incentives by enterprises	qualification, legislative rationalisation	--	--	Strengthening of research universities; technology transfer offices; assistance in international calls for proposals; representation in Brussels; transfer of research and higher education ideas to capital investors; making spin-off rules more flexible
Growth-oriented high-tech small enterprises	Research support; innovation voucher; qualified innovation services; IT calls for proposals; intellectual property protection advices	ERDF, KTIA	Pre-commercial procurement; innovative procurement	Contribution relief in case of employment of researchers; Tax incentives and tax return	qualification, legislative rationalisation	JEREMIE	export guarantee; preferential loan	Support for foreign market entry; R&D qualification
Innovative start-ups	Flexible small value calls for proposals; undertaking of costs related to intellectual property protection; incubator programme; mentoring; intellectual property protection advices	ERDF, KTIA	Pre-commercial procurement	--	Legislative relaxations	Seed capital	in relation to market entry of a product	Central and decentralized innovation services;
Medium-sized enterprises able to innovate and grow	R&D calls for proposals for medium-sized enterprises; qualified innovation services; IT calls for proposals;	ERDF, KTIA	Innovative procurement	Contribution relief in case of employment of researchers; Tax incentives and tax return;Regulation of share options[36]	qualification, legislative rationalisation	Venture capital	export guarantee; preferential loan	Support for foreign market entry
Hungarian research centres of multinational large companies	Targeted calls for proposals; Training support	ERDF, KTIA, EKD	--	Contribution relief in case of employment of researchers; Tax incentives and tax return	qualification legislative rationalisation	--	--	Support in line with smart specialization; distortion of tax benefits in the less-favoured areas
Innovative supplier SMEs	Support for developing workplaces	ERDF, KTIA	--	Contribution relief in case of employment of researchers; Tax incentives and tax return	qualification, legislative rationalisation	--	--	Support for cluster activities
Implementers of the public sector innovation activities in the health care, environment, energy, education, transport/ logistics sectors	elaboration of RDI strategies and action plans, funding for researchers, joint RDI projects with the private sector	ERDF, KTIA, sectoral budgets	Innovative procurement	Contribution relief in case of employment of researchers; tax incentives	qualification, legislative rationalisation	--	--	Consideration of the regional infrastructure aspects

[36] In this case a private person (and not a company) is the innovator.

4.6. Funding

Because RDI is a long-term investment in the future, we can calculate the growth in funding policy instruments with public financing needs, within on-going budgetary constraints, over the whole time horizon of the strategy. Primarily these instruments are:

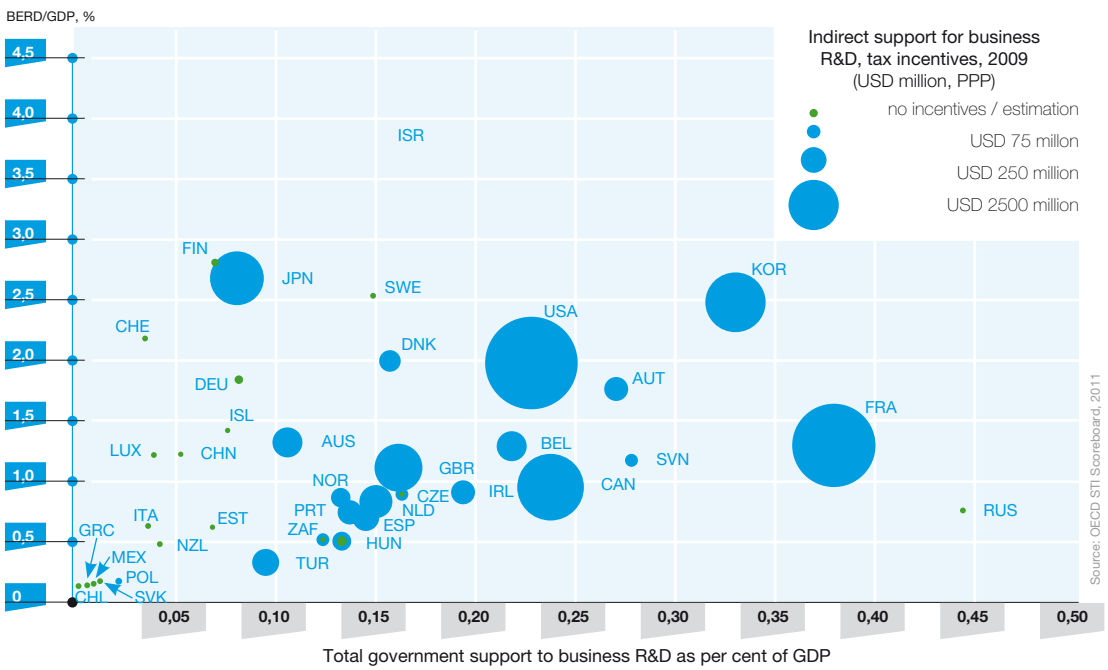
- grants[37] and normative funding of research organisations (direct supply-side instruments);
- tax incentives (indirect fiscal instruments); and
- capital-, loan- and guarantee-type financial instruments.

Without enhancing public R&D funding, it is not possible to achieve the targeted 1.8% GERD/GDP ratio commitment of Hungary set out in the framework of the Europe 2020 strategy. Nevertheless, it is also a fact that significant opportunities lie in the improvement of the efficiency and effectiveness of the Hungarian funding system given that currently in international comparisons Hungarian business RDI funding results in a lower rate of possible RDI expenditure (see Figure 22).

Primarily the opportunities lying in the more efficient utilization of the existing resources shall be used in the initial phase of the strategy in 2013-2014. For this purpose, the following resources are available:

- The resources of the **Structural Funds** guaranteed in the framework of the EU Cohesion Policy represented and will represent a significant share of public RDI funding in the previous and next seven-year EU budget period. The resources co-financed by the EU can be used in many forms, more specifically EU resources can be used in more efficient funding forms in addition to the currently dominant grant systems. However, **it is a source of serious tension that the Central Hungarian Region** (KMR) is considered a competitiveness region due to its level of economic development. As such, this region is **eligible to use EU resources only in a very limited way** in the programming perdiod 2014-2020, even though two-thirds of Hungarian R&D capacities are concentrated in the KMR region[38].
- *The Research and Technological Innovation Fund* (KTIA) is a notified national funding programme with an annual budget of almost HUF 50 billion (the main source of which is the innovation contribution paid by

Figure 22 **Public funding of business R&D and its importance in the national economy**



[37] The funding of targeted development of human resources (talent management, development of entrepreneurial skills) or any other direct funding shall be mentioned among these instruments.

[38] The Structural Funds certainly serve the catching-up of the more underdeveloped regions but the Hungarian experiences show that the mentioned problem exists.

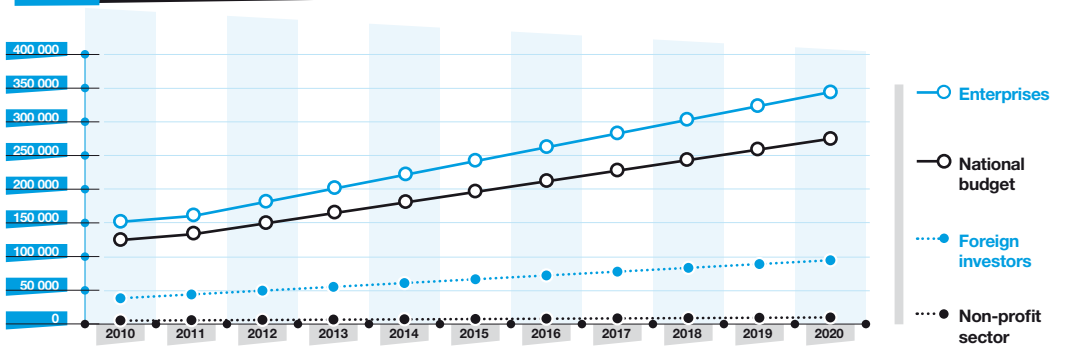
the medium-sized and large companies). The KTIA can be used as a national resource with more flexible conditions than that of the EU cohesion resources, although experiences from previous years show that the availability of KTIA resources changes over time. Since the primary goal of the Structural and Cohesion Funds in the new EU programming period is to mitigate the economic differences between regions, (research and development and innovation are intended to have a significant role in this process by developing smart specialization) the Central Hungarian Region (KMR) will be in a disadvantageous position with regard to EU resources available for RDI purposes, in spite of the fact that the R&D&I capacities of the country are focused in the KMR region. **At least maintaining the volume of development in the KMR region is a basic precondition for increasing** the gross domestic expenditure on R&D **to 1.8%. In the case of the KMR, the reduction of gross domestic expenditure on R&D may generate irreversible and damaging effects and, as a result, the EU2020 undertakings could not be fulfilled**. In view of all the above, the use of a new financing model will become necessary in the KMR region in the 2014-2020 period. The RDI strategy contributes to this new financing model in such a way that an important function of the KTIA it is to mitigate the disadvantaged position of the KMR region; nevertheless, the elaboration and use of other instruments are also needed[39].

- The funding of *the Hungarian Scientific Research Fund* (OTKA) is primarily available for publicly-funded research organisations, and as such the strategy does not deal with the OTKA programmes further. The strategy only states that budgetary support shall be ensured for these (according to the wide range of relevant parties) well-functioning programmes. The support shall at least be maintained at a constant level in the future and, if possible, shall be increased for the purpose of strengthening the knowledge bases.
- In their current form, *the R&D benefits of the corporation tax and dividend tax* are used by only a relatively small number of taxpayers. The concrete amount deducted annually from the tax base is approximately HUF 150 billion, the incentive effect of this is always dependent on the actual tax rate (higher if the tax rate is higher and smaller if the tax rate is smaller).

Overall, the vast majority of the Hungarian public R&D funding is given to the beneficiaries in the forms of grants. The advantage of this funding model is that it makes better targeting and the enforcement of the very important aspect of scientific excellence in the field of R&D possible. However, the current national proposal system consists mainly of bulk proposals – following the current methods of use of the Union resources – that do not make the fulfilment of national RDI goals possible in all cases. **Indirect support in the form of tax benefits**, and on which significantly more emphasis shall be put over the strategic time horizon, has many advantages:

- distorts the market processes less, so as a horizontal instrument it does not violate the state aid rules of the EU;
- means smaller administrative burden and is transparent;
- can be planned by the taxpayer, and

Figure 23 **The funding trends of R&D expenditure (HUF million)**



Source: NGM-IKF estimation

[39] An additional field of use is the provision of supplementary resources to the EU FP7 funding in case of Hungarian SME applicants from the KMR region – this resource will be available from the Structural Funds in the other regions.

- decreases the direct R&D costs so it plays an important role when the large companies choose their locations.

The 2014-2020 EU programming period is a good opportunity to establish an efficient tax-side incentive mechanism. According to current EU programming, companies will be able to **use a significant part** – according to preliminary analysis, it may be as high as one-third – **of the Structural Funds available for research and development and innovation purposes in the form of tax benefits**[40] in the EU budgetary period starting in 2014. In the planned model:

- tax incentives available for every enterprise engaged in R&D activities will be established that
- are supplemented by the targeted support of beneficiaries and projects complying with the aspect of excellence and other policy aspects (in the form of grants) and
- the capital- and loan-type financial instruments will have a more pronounced role than before.

One of the first steps in the implementation of the strategy is to assess the practical feasibility of transforming the funding system, including particularly **the financial viability of the tax incentive instruments of the Central Hungarian Region.**

The implementation of the RDI strategy emphasises reaching the research and development intensity targets, symbolizing investment in the future as a central, priority indicator. (Increasing the GERD / GDP ratio to 1.8%, including the BERD / GDP [business enterprise expenditure on R&D] to 1.2%.)

If we assume that the average annual growth rate of nominal GDP is 4%[41] and also accept that the current funding structure can be regarded as stable in the long term then the improving R&D performance of the national economy can be ensured by increasing the business funding to around HUF 350 billion (from appr. HUF 180 billion in 2012) and the public funding to more than HUF 270 billion (from HUF 144 billion) (Figure 23)[42].

Within this, the research and development funding plans of the public finances can be summarized as follows (Figure 24):

- The biggest share of funding comes from the Structural Funds until 2020. Since research and development is not a separate priority in the economic development plans so approximately three-quarters of the annual development resources of HUF 75 billion expected for research and development and innovation (RDI)[43] will finance R&D activities. The average current price R&D funding will increase above HUF 55 billion until 2020.
- The amount of the research and development normative funding will grow to HUF 63 billion until 2020; at least to a guaranteed 0.16% of the GDP (the ratio was below 0.1% of the GDP in 2011).
- The funding of R&D institutions (mainly the research institutions of the HAS) can be up to 20% of the public R&D funding and it can reach HUF 55 billion in current prices until 2020 (the funding ratio will be at least increased to a guaranteed 0.14% from 0.08% of the GDP)[44].
- This is the same amount as the funding available for R&D from the enhanced budget of the Research and Technology Innovation Fund.
- The funding of the OTKA is also stabilized in addition to the performance of other public R&D tasks.

According to 2011-2012 data, almost 70% of research and development expenditure was financed by the business sector and 15-15% was financed from abroad and by the public sector. Under these objectives the R&D performance of enterprise will increase from a level of HUF 210 billion in 2012 to above HUF 330 billion in nominal value by 2020, for which the long-term incentives will be guaranteed by a system of tax benefits with a planned annual budget of appr. HUF 30 billion.

[40] Or in the form of a simplified proposal resulting in a similar effect.

[41] The average annual growth rate of nominal GDP was around 4% between 2006 and 2011 (it decreased in 2009).

[42] The funding volumes shall grow by 5% in real terms for the purpose of reaching the objectives.

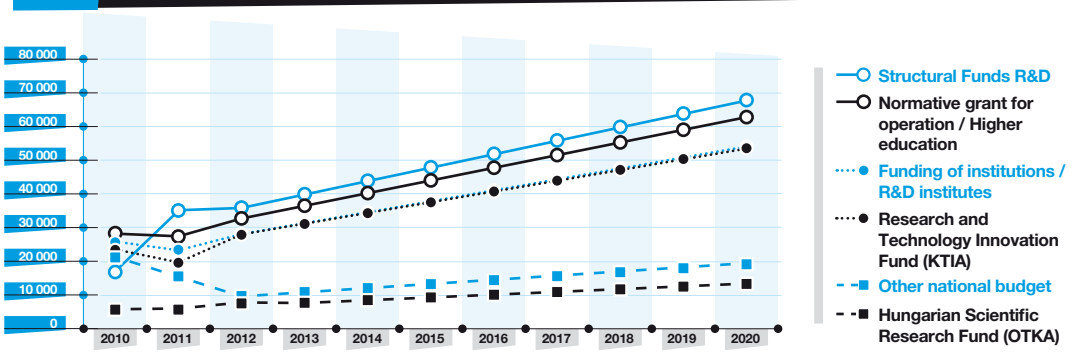
[43] This conservative calculation can be modified if an average annual funding of HUF 100 billion is available for RDI in the programming period.

[44] The gradual enforcement of competitive practices is desirable in addition to ensuring normative funding.

Overall, the RDI strategy enforces the funding principles[45] outlined below in the 2014-2020 period:

- The resources / grants guaranteed by the European Regional Development Fund within the Structural Funds available for RDI purposes on an annual average will finance the following:
  - o 38% of R&D co-operations,
  - o 18% of independent business RDI activities, product and technology development (including also adaptation of ICT technologies and support for foreign market entry of innovative products/technologies),
  - o 20% of improvements in research infrastructure and access to scientific instruments, without any large projects,
  - o 8% of purchase of innovation services by SMEs (including financing also the costs of intellectual property protection)[46],
  - o 7% of the incentives for R&D investments of large companies,
  - o 4% of the incentives for the participation and networking in international R&D programmes (including also the international and intersectoral mobility actions),
  - o 3% of development of knowledge centres,
  - o 2% of creation of start-up ecosystem (incubation etc.).
- Additional grants guaranteed by the European Social Fund within the Structural Funds intended for RDI purposes on an annual average will finance the following in the annual average amount of altogether HUF 10 billion - which is 1% of the whole seven-year budget:
  - o development of smart specialisation and facilitation of the knowledge triangle, i.e. linkages between education – research – innovation
  - o achieving a high level of participation in the Horizon2020 projects and the European research networks, programmes for the purpose of enhancing the international competitiveness of basic researches
  - o ensuring of the new supply of researchers and increasing the number of researchers, encouraging the international and intersectoral mobility of researchers
- The Research and Technology Innovation Fund available for RDI purposes will mainly fund these programmes in the Central Hungarian Region (KMR). The additional strategic objectives (public sector innovations; technology transfer; open, pre-competitive and social innovation co-operations; talent management; training and social awareness raising actions) will also be funded by the KTIA.
- The tax-side incentives of research and development are currently HUF 25-30 billion on an annual average. The renewed R&D tax incentive system can provide incentives in an annual amount of HUF 50 billion until 2020.
- The use of financial instruments for RDI purposes (e.g. seed capital and venture capital): in an annual amount of HUF 2-3 billion.
- The R&D normative funding for higher education and research and development institutions and the budget of the OTKA will grow in time according to the R&D objective.

Figure 24 **The expected trends of public funding for R&D expenditure (HUF million)**

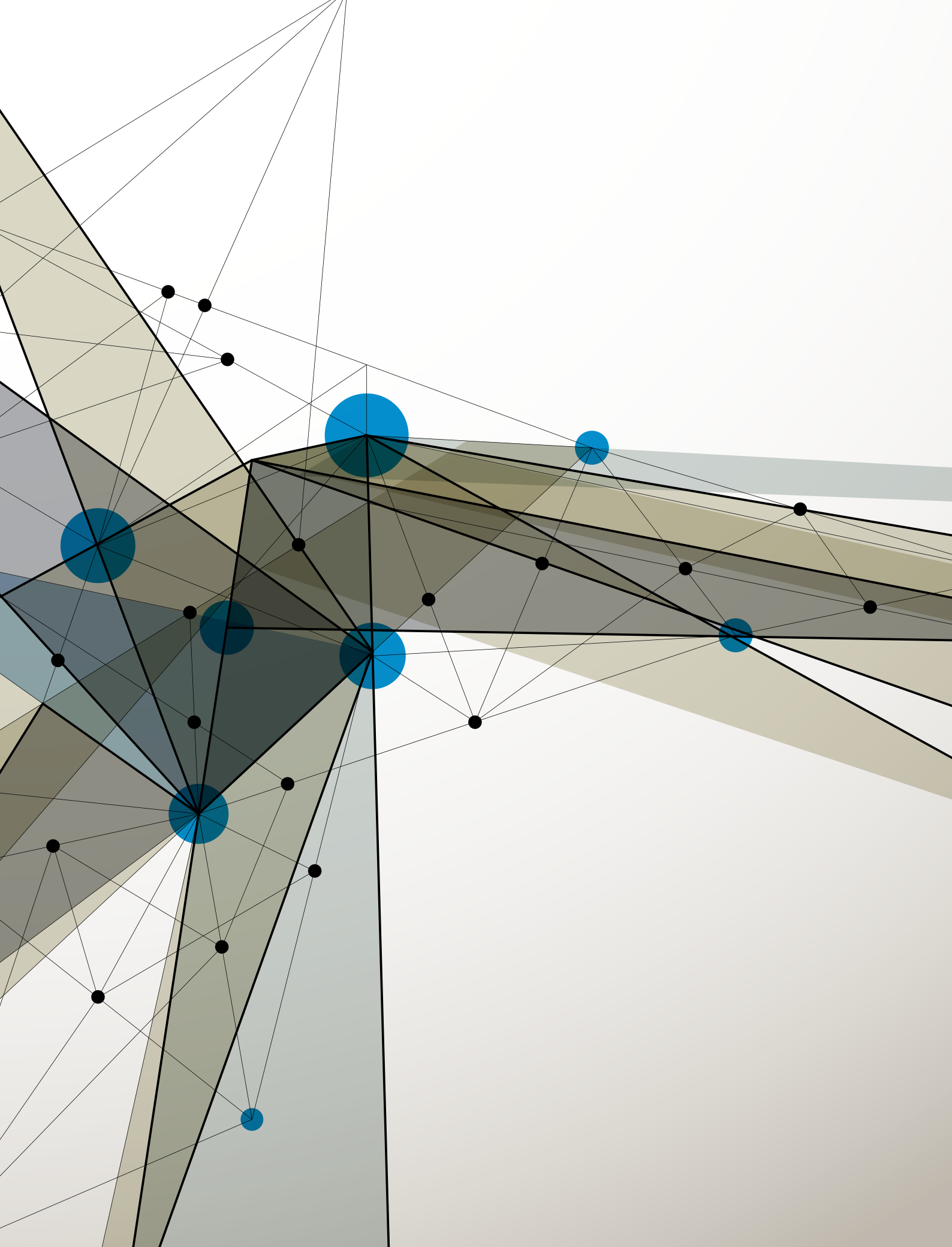


Source: NGM-IKF estimation

[45] The present plans are described by the percentage distribution. Any variation in the rolling implementation of the strategy is in the competence of the advisory body managing the strategy and the interministerial coordination body.

[46] The aspects of intellectual property protection are enforced by the strategy in every instrument.

5 the institutional system of implementing the RDI strategy



5.1. Governmental functions and responsibilities

The RDI strategy sets strategic objectives and defines instruments in such fields as science-, technology- and innovation policy (STI-policy) that are associated with economic performance and social well-being. The RDI strategy endeavours to ensure that conditions and mechanisms in organisations are established which coordinate with instruments of the STI policy and with the STI policy itself.

A condition for the successful implementation of the RDI strategy is to establish a clear scope of responsibilities and competences. The following governmental functions can be specified for the implementation:

- **Government RDI strategy management:** this includes policy and interministerial co-ordination, monitoring the implementation of the strategy (the professional data collection and data analysis background which is provided by the RDI Observatory operating in the National Innovation Office), high-level management of independent evaluations related to the advanced management of the instruments intended for implementing the strategy, observation of the science-, technology- and innovation policy and RDI policy competitive environment and observation and evaluation of the trends in public sector innovations. Based on international practice, this task is supported by an advisory body consisting of high-level independent professionals The governmental RDI strategy management tasks are managed by the ministry responsible for the economy.
- **Coordination of the innovation processes in the public sector:** every ministry is in need of a **Chief Scientific Advisor** with a professional association of a few people and a body coordinating them whose main task is to bring together the sector and vertical RDI fields of the specific ministries, government agencies, particularly with regard to the ministries more significant from an RDI viewpoint (energy research; including alternative energy research and technological development prioritized at EU level; agricultural research; and governmental use of information and communication technologies; health-related researches). The appointment of the president of the Hungarian Academy of Science (HAS) as chairman of this high-level body (the **Governmental Chief Scientist Forum**) would be highly recommended for the purpose of representing the science policy.
- **Legislation, monitoring and rationalization of legislation:** harmonizing, standardizing and making the national legislation „innovation-friendly", required for the successful implementation of the RDI strategy and the reduction of the administrative burden of national R&D organisations financed by public resources.
- **Provision of central and decentralized innovation management services, the management of the service system:** one pillar of the RDI strategy is to establish standard innovation services aimed at the bottlenecks and taking into account local needs. The establishment of an innovation service structure has an impact on organisational funding and training.
- **Reform, monitoring and evaluation of R&D tax benefits:** there is an opportunity in the next EU programming period to transfer a significant share of the funding intended for RDI to tax benefits (or to simple arrangements having similar effects), the management of which requires a governmental function.
- **Support for creating a start-up ecosystem:** A function supervising, implementing and adjusting aspects and the related instruments of special innovative small enterprises.
- **Management and monitoring of the funding programmes:** the establishment of an independent organisation for managing the funding programmes is justified by the nature of RDI and innovation projects
- **Management of RDI-centred public procurements:** significant amounts of public procurement can also mean a significant potential demand for research and development and innovation, the management of which justifies – due to the specificities of RDI – an independent function.
- **Management of priority programmes and sectors:** the ELI major investment (Extreme Light Infrastructure) in Szeged, the pharmaceutical industry, the IT sector, the automotive industry, environmental RDI, R&D in the agricultural and food sectors, energy and health RDI, justify a priority and independent management function which should be included horizontally in governmental RDI strategic management[47].
- **EKD system for attracting R&D-intensive FDI:** The elaboration of an institutionalised R&D EKD (grants approved by individual government decisions) system reflecting strategic RDI interests.
- **Intellectual property protection:** the elaboration and enforcement of the related governmental strategy; the professional supervisory role (R&D qualification) in the operation of the R&D incentive system belongs to the Hungarian

[47] The RDI strategy is sector neutral (the specialization is specified by the synthesis of the so-called smart specialization strategies); however, special attention shall be paid to these sectors due to their sizes.

Intellectual Property Office. Training (e.g. for judges and entrepreneurs) is required for effectively enforcing intellectual property rights.

- **The management and monitoring of the strengthening of knowledge bases:** the performance of knowledge bases is supervised and monitored by the ministry responsible for science policy together with the representatives of science, and taking into account the opinion of the representatives of certain related industrial sectors.
- **Public education, talent management and social awareness raising, developing innovation and creativity.**

The delineation of the scope of responsibilities and competences and the provision of functions together mean the chance for successfully implementing the RDI strategy. If any of the relevant function cannot be established or provided then the chances of success for the RDI strategy significantly decreases.

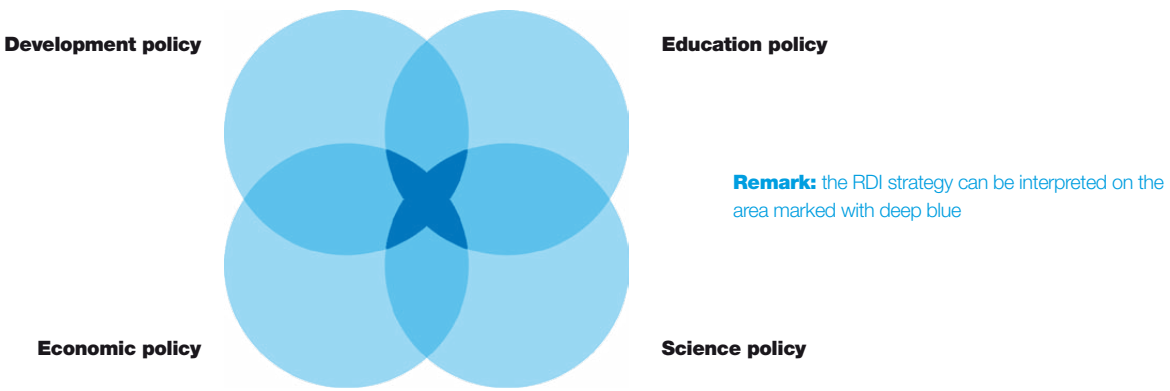
5.2. Alignment of the RDI strategy with the national policies

It is important that the RDI strategy is aligned with the national mid-term strategies above in the hierarchy of the governmental strategic planning documents (primarily with the National Concept for Development and National Concept for Regional Development (OFTK) being currently prepared and with the related policy and sector strategies[48]. It is also necessary that government authorities competent in related policy areas support the implementation of the RDI strategy in a coordinated way. The RDI strategy can be aligned with national policies in the following areas (non exhaustive list - see Figure 25):

- *In the area of development policy:* the regional development concepts and the infrastructural developments are related to the objectives of the RDI strategy concerning the development of elite research institutes and the demands of the 2014-2020 programming period to bring smart specialization into prominence.
- *In the area of education policy:* outstanding knowledge centres, research universities and higher education research and development are funded in a targeted way by the RDI strategy, It is also important to extend the scope of management to bring forth marketable talents and to develop and teach the SME sector how to be more innovation conscious.
- *In the area of economic policy:* the implementation of the RDI strategy assumes a predictable business environment, tax-side incentives and direct support such that ensuring the implementation framework is established through fiscal policy
- *In the area of science policy:* the RDI strategy encourages the creation of a critical mass of R&D capacities and more intensive co-operation with the business sector in the long term[49].
- Moreover, the alignment of sector strategies defined in the New Széchenyi Plan and in preparation shall also be ensured.

It is considered important that the implementation of the strategy is based on short-term action plans elaborated in detail. Furthermore, it is necessary to develop a monitoring and evaluation system (containing also independent evaluations) for the strategy and action plans for the purpose of continuously training and developing the institutions and instruments in support of implementation. The steps are detailed for the first time in the following section.

Figure 25 **Overlaps of the RDI strategy with the national policies**

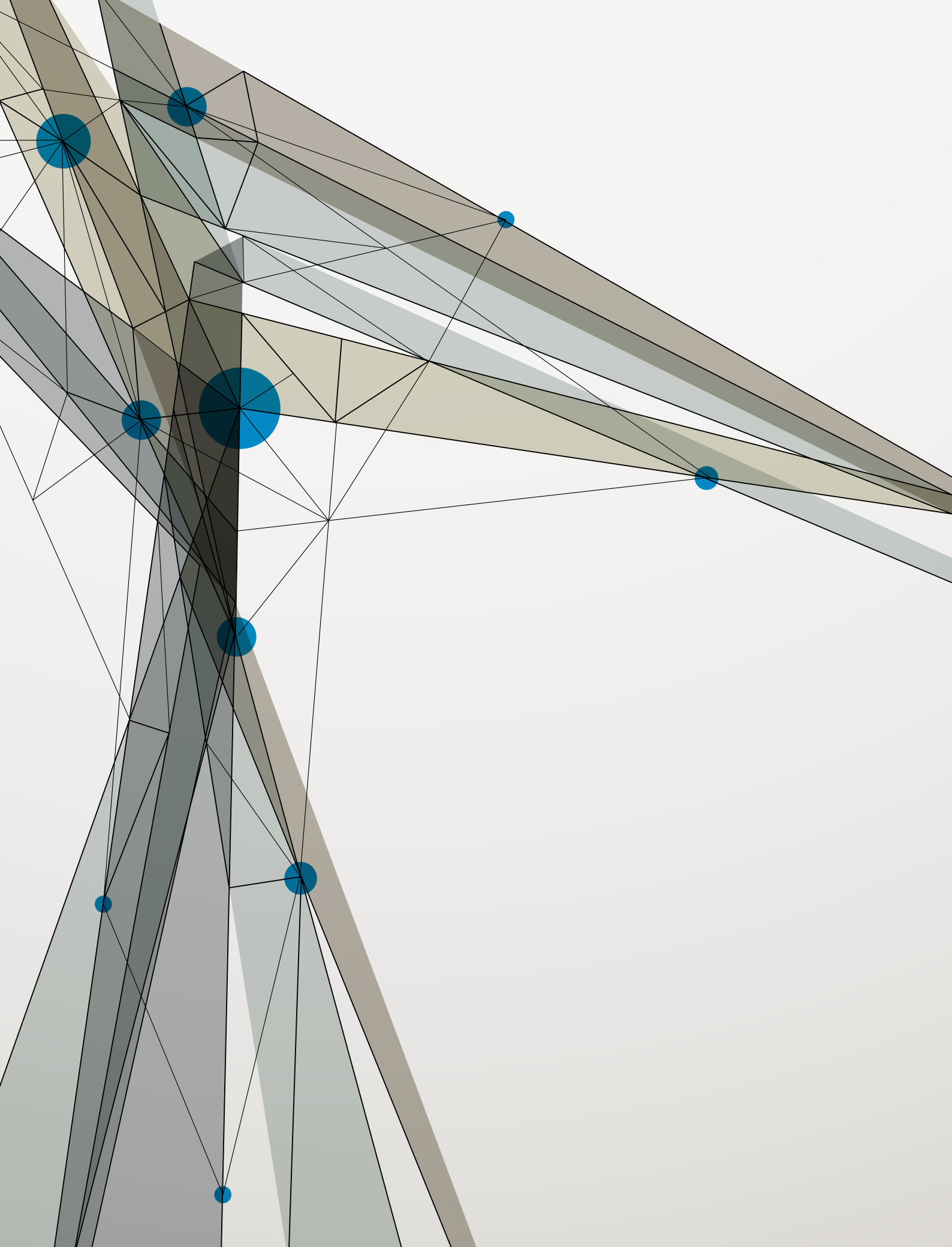


Remark: the RDI strategy can be interpreted on the area marked with deep blue

[48] See Government Decree No. 38/2012 (III. 12.) on governmental strategic management.

[49] As it has already been stressed by the strategy, the RDI strategy and the strategy of science policy being prepared constitute together the whole science and technology policy.

6 monitoring, evaluation and feedback mechanisms of the implementation of the strategy



6.1. Monitoring of the implementation of strategy

The rolling programmes of measures of the RDI strategy are prepared for two-year periods (for 2013-14, 2015-16, 2017-18, 2019-20).

The implementation of the strategy and the programme of measures is monitored according to the following:

- The forward planning of the strategy is supported by an advisory body. The advisory body reviews the planned tasks for the future at its twice yearly meetings.
- The progress of the planned tasks and programmes of measures is evaluated quarterly by the interministerial coordination body.
- The compilation of strategic-level indicators and the collection of related statistical data is a task of the RDI Observatory. The indicator system of the specific funding programmes is elaborated in advance in accordance with the objectives of the strategy. The organisation managing the RDI calls for proposals continuously collects these indicators.

6.2. The strategy and evaluation of the instruments

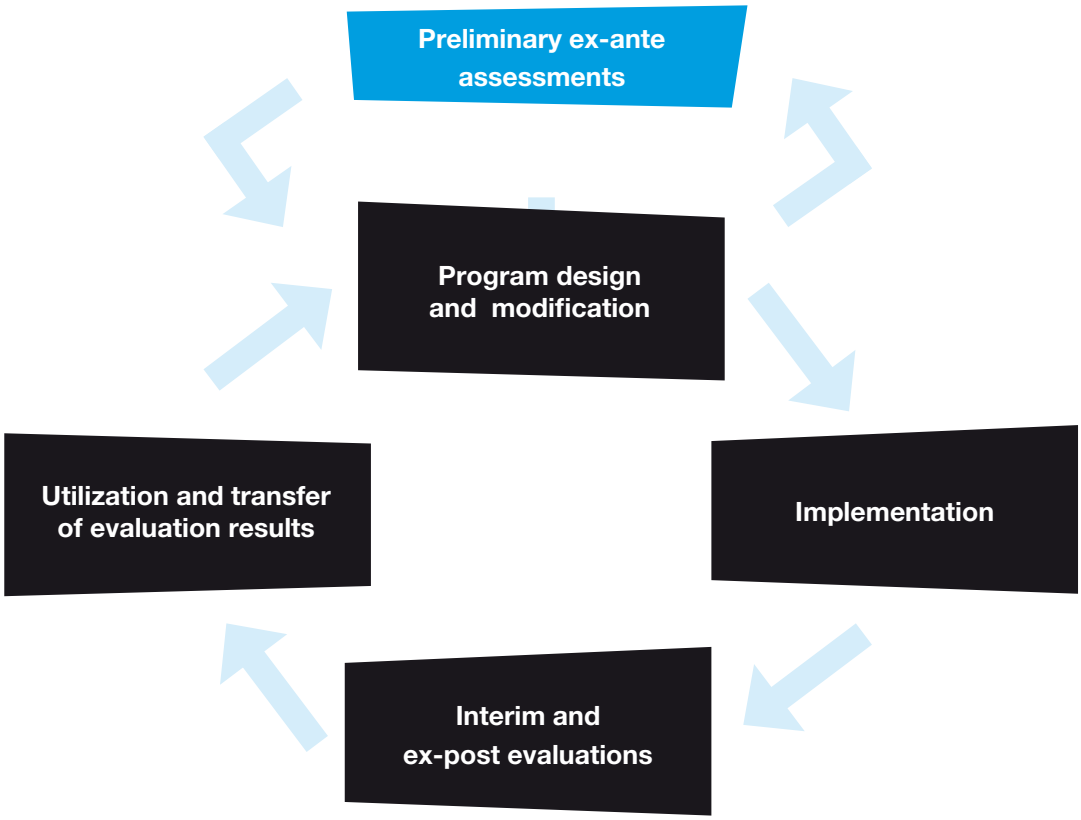
The overall evaluation of the RDI strategy will take place in autumn 2014 and spring 2017, and the independent evaluation of the R&D qualification system will take place in 2014. Moreover, regular evaluation of the instruments helps achieve the objectives (a report on the major results of the evaluation is prepared by the government). If the objectives are found to be unachievable, then the evaluations make empirically sound recommendations on the regrouping of resources in order to use the resources in the best possible way (see Figure 24). Even given the current development level of the Hungarian RDI evaluation methodologies, the evaluations can present information in such areas where the economic indicators used for identifying impacts are often not available. The economic and social impact of specific interventions in the field of RDI will be felt only years later and even if they may be somewhat predictable, the complex system connections are not easily identified.

It is necessary for the success of the RDI strategy that the monitoring and evaluation of the programmes, the programmes of measures and the action plans will be done in a separate and standard way. In order to ensure the evaluations are conducted professionally , evaluation standards will be introduced.

6.3. The feedback mechanisms

It is very important that the RDI strategy be implemented in a way which is in line with the mature strategic management practice of the end of the 20th century i.e. the strategic planning/creation and the implementation should not be sharply separated from each other, rather they should be two cooperating, complementing parts constituting a composite whole in this way. (The strategy building means the definition and evaluation of alternative routes to achieving the objectives and the selection and more detailed elaboration of the alternatives to be followed, while strategic management shall also cover the planning, management, evaluation of the implementation, taking into account changes in the environment. See: Balaton-Tari (2007).) The programmes of measures, the developing monitoring systems and the improvement of the evaluation systems have a privileged role in the strategic management of RDI and its development (see horizontal priority H6 laid down in the system of objectives).

Figure 26 **The policy cycle**



Source: FTEVAL (2003)

7 the implementation risks of the RDI strategy

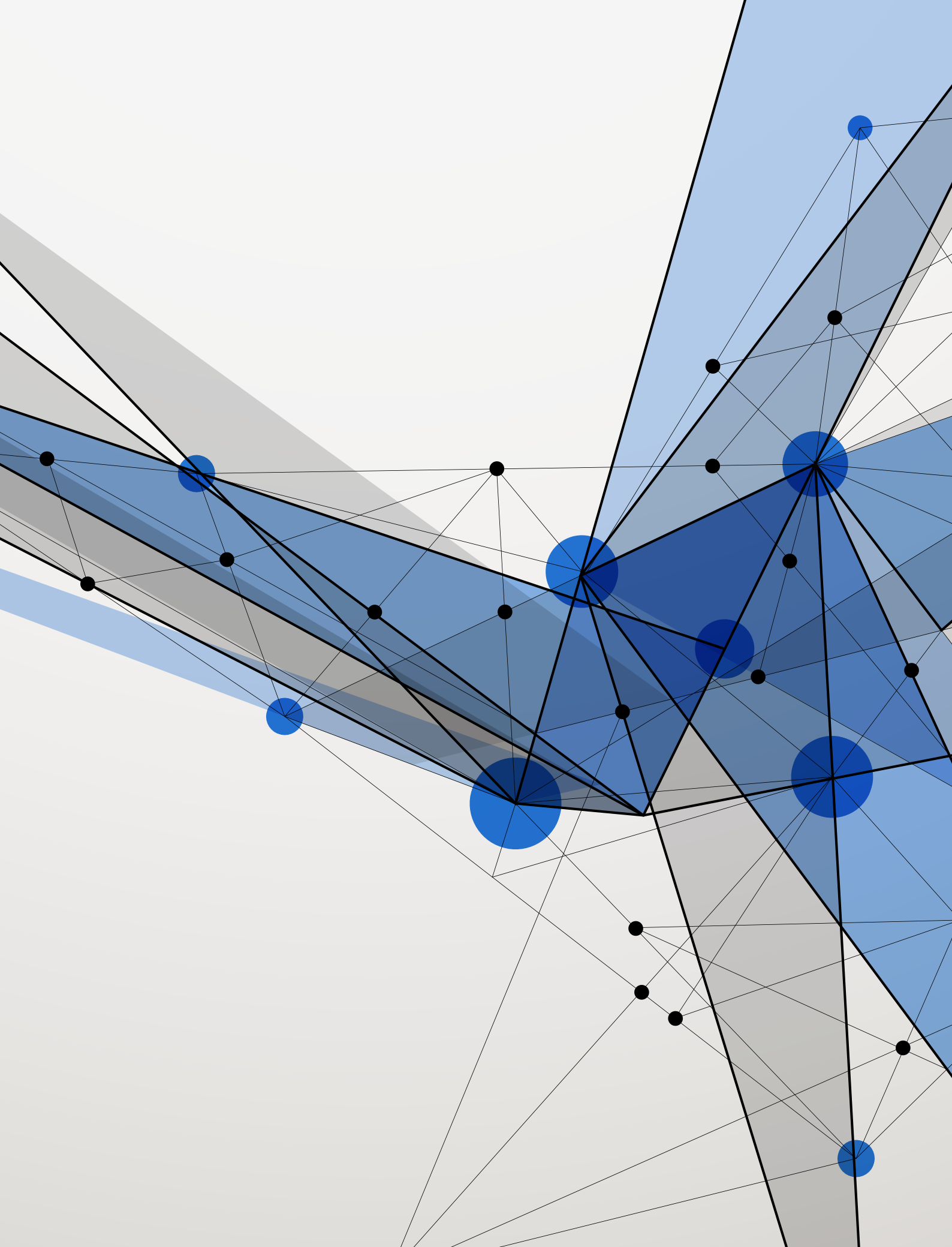
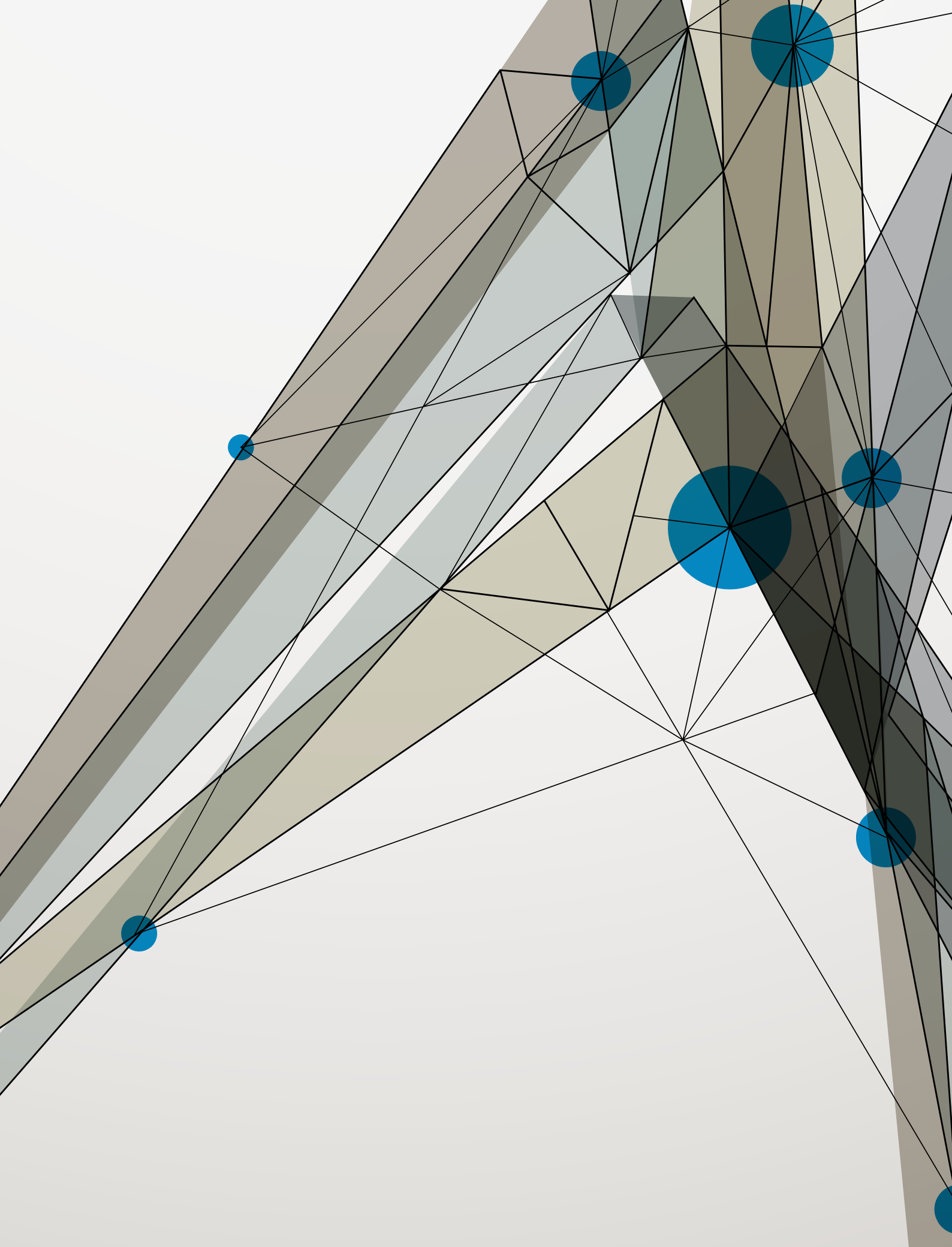


Table 12 **The implementation risks of the RDI strategy and their management**

According to our current knowledge RISK	SUGGESTED METHOD for risk management
The public R&D funding is not enough to achieve the objectives set; the funding of the professional field is part of the negotiations of the annual budget.	The strategy shall cover the level of public funding until 2020.
The necessary coordination is not ensured during the implementation of the strategy.	The management system of the RDI field shall be operated in an efficient way; the implementation of the strategy shall regularly be monitored by the governmental RDI strategic management.
The objective setting and proposed framework for measures are not consistent.	Ex-ante evaluation by experts in the first quarter of 2013.
The competences of the implementing institutional system are not aligned with the objectives.	Request for opinion from the organizations of the implementing institutional system and elaboration of specific organizational plans on the use of the instruments defined in the strategy. Elaboration of plans for competence building and periodic review of the development.
The intervention points (elements of the instruments) are not synchronized with the efforts of the major relevant parties.	Interim evaluations of the specific instruments introduced with regard to their effectiveness and compliance with the needs of the target groups; systematization of the evaluations.
The management of the implementation of strategy remains uncoordinated.	After consultations in the public administration, the detailed clarification of the management issues.
The basic researches remain underfunded and the universities/HAS still put a pressure on the government in order to be able to use RDI resources available for other activities.	Predictable R&D budget. The strategy shall cover the level of public funding until 2020.
The recommended governmental functions are not established.	The approval of the functions to be included in the programme of measures.

bibliography



Bibliography

Aerts, Kris; Thorwarth, Susanne (2008): Additionality effects of public R&D funding: „R" versus „D", Katholike Universiteit, Leuvenhttps://lirias.kuleuven.be/bitstream/123456789/216618/1/MSI_0811.pdf

Balaton K. – Tari E. (ed.) (2007): Stratégiai és üzleti tervezés – Strategic and business planning Aula, 2007

Bassanini, Andrea; Scarpetta, Stefano (2001): The driving forces of economic growth: panel data evidence for the OECD countries. OECD Economic Studies No. 33, 2001/II. http://www.oecd.org/economy/productivityandlongtermgrowth/18450995.pdf

Baumol, William (2005): Education for Innovation: Entrepreneurial Breakthroughs Versus Corporate Incremental Improvements. In: Adam B. Jaffe, JoshLerner and Scott Stern (eds.). Innovation Policy and the Economy. MIT Press, Cambridge, MA, pp. 33-56.

Baumol, William, Litan Robert and Schramm Carl (2007): Good Capitalism, Bad Capitalism, and the Economics of Growth and Prosperity. Yale University Press.

Borsi, B. – Viszt, E. (2010): A kreatív és kulturális ágazatok (CCI) szerepe és növekedési lehetőségei a Budapest Metropolisz Régió gazdaságában – the role and growth opportunities of Creative and Cultural Industries (CCI) in the economy of the Budapest Metropolis Region scientific report, December 2010 GKI Gazdaságkutató Zrt. – GKI Economic Research Co.

Borsi, B. és Lengyel B. (2011): A közszféra innovációinak kontextus-függősége – A hazai természettudományos és technológiai oktatás, valamint idegennyelv-oktatás példája – The contextual dependence of the innovation in the public sector – The Hungarian example of the education of natural sciences and technology and foreign languages; Vezetéstudomány 42. kötet 2011. szeptember pp.15-28. – Budapest Management Review vol. 42, September 2011 pp.15-28

Clausen, Tommy (1997): Do subsidies have positive impacts on R&D and innovation activities at the firm level? Centre for Technology, Innovation and Culture, University of Oslo Working Papers on Innovation Studies. http://www.sv.uio.no/tik/InnoWP/Tommy%20IPP15%20WPready.pdf

Birch, David (1979): The Job Generation Process. MIT, Cambridge, MA.

Corderi, David; Lin, C.-Y. Cynthia (é.n.): Measuring the Social Rate of Return to R&D in the Energy Industry: A Study of the OECD Countrieshttp://www.des.ucdavis.edu/faculty/Lin/RD_return_paper.pdf

David, Paul A.; Hall, Bronwyn H.; Toole, Andrew A.: Is public R&D a complement or substitute for private R&D? A review of the econometric evidence. Research Policy 29, 497-529. http://elsa.berkeley.edu/~bhhall/papers/DavidHallToole%20RP00.pdf

Dosi,G., Llerena P. és Sylos, M. (2006): Az Egyesült Államok és az Európai Unió innovációs teljesítményének értékelése és összehasonlítása – Evaluation and comparison of the innovation performance of the United States and the European Union Információs társadalom – Information Society vol. 6 No. 3

EC-IPTS (2011a): The 2011 EU Industrial R&D Investment Scoreboard. http://iri.jrc.ec.europa.eu/research/docs/2011/SB2011.pdf

EC-IPTS (2011b): Job Creation Effects of R&D Expenditures: Are High-tech Sectors the Key? IPTS WORKING PAPER on CORPORATE R&D AND INNOVATION - No. 10/2011 December 2011 http://iri.jrc.es/papers/WP%2010-2011.pdf

Einiö, Elias (2012): The Effects of Government R&D Subsidies on Company Performance: Evidence from the ERDF Population-Density Rule. May 7, 2012 http://personal.lse.ac.uk/einio/RetD_Subsidies.pdf

Enterplan Limited (2005): Rates of return to research. A literature review and a critique. http://www.dfid.gov.uk/r4d/pdf/ThematicSummaries/Returns%20to%20Research%20Final%20Report.pdf

Ernst&Young-GKI (2010): The Research and Technology Innovation Fund – overall evaluation of its operation between 01.01.2004 and 31.12.2009 Assessment report. Ernst&Young – GKI Gazdaságkutató Zrt. (GKI Economic Research Co) p.200. + p.100 annexes

Eurada (2011/a): Smart (regional) specialisation strategy. What does it mean for RDAs? http://www.eurada.org/site/files/Smart%20Regional%20specialisation-E.pdf. download on 6 June 2011

Eurada (2011/b): The S3 Platform: How to assist regions in developing smart specialisation strategies? 10-11 March 2011 in Brussels. Brief Summary of the workshop. http://www.eurada.org/site/files/Snapshot-E.pdf. download on 6 June 2011

Fraunhofer (2012): Participation of the Central and Eastern European EU Member States in the 7th Framework Programme. Analysis, Evaluation, Recommendations.

FTEVAL (2003): Evaluation Standardising Research and Technology Policy. Vienna.

Griffith, R. (2000): How important is business R&D for economic growth and should the government subsidise it? The Institute for Fiscal Studies, 2000 http://www.ifs.org.uk/bns/bn12.pdf

Guy, K and C. Nauwelaers (2003), Benchmarking STI Policies in Europe: In Search of Good practice, IPTS Report, n°71

Hall, Bronwyn H.; Mairesse, Jacques; Mohnen, Pierre (2009): Measuring the returns to R&D. NBER Working Paper 15622 http://www.nber.org/papers/w15622

Havas, A. (2011): ERAWATCH Country Reports 2010: Hungary. ERAWATCH Network – IQTANOK

Hazelkorn, E. (2005): University Research Management: Developing Research in New Institutions. OECD, Paris

Inzelt, A. (1996): Tanulmány a tudomány és a technológia legutóbbi fejlődéséről Magyarországon – Study on the latest development of science and technology in Hungary OECD-OMFB

Inzelt, A. (2013): Befektetés – hogyan is? – Investment how to do it? Élet és Irodalom – Life and Literature vol. LVII., No.1., 4 January 2013

Kay, John (2011): What is innovation. In: Simon Tilford and Philip Whyte (eds.): Innovation. How Europe can take off. Centre for European Reform, London, pp. 9-12.

KRPIH (2008): Útmutató a társadalmi fenntarthatóság érvényesítéséhez az Államreform operatív program és az Elektronikus közigazgatás operatív program projekt gazdái, pályázói és értékelői számára – Social sustainability guideline for the developers, applicants and evaluators of the social sustainability of the state reform operational programme and the electronic administration operational programme National Development Agency. April 2008, p.18.

Lengyel B. és Leydesdorff, L. (2008): A magyar gazdaság tudásalapú szerveződésének mérése: az innovációs rendszerek szinergiáinak térbelisége – Measuring the knowledge based organization of the Hungarian economy: the spatiality of the synergies in the innovation systems Közgazdasági Szemle – The Economic Review 55

León, L.R., Simmonds, P.és Roman, L. (2012): Trends and Challenges in Public Sector Innovation in Europe, Technopolis Group, funded by the European Commission http://ec.europa.eu/enterprise/policies/innovation/files/psi/psi-trend-report_en.pdf

HAS (2011): The report of the Hungarian Academy of Sciences for the Hungarian Parliament on the work of the HAS and the situation of the Hungarian science 2009-2010 HAS, Budapest, p.64.

MTAF (2011): The Maine Technology Asset Fund: Maine's R&D Program. http://www.preventharm.org/Images/475/EHSC%20publication%5B1%5D.pdf

National Science Foundation (2007): Press Release 07-129. Research and DevelopmentBolsters U.S. EconomicGrowth-http://www.nsf.gov/news/news_summ.jsp?cntn_id=110139

Nordic Lighthouse Project (2011): Innovative Public Procurement and Health Care, Nordic Council of Ministers http://www.norden.org/da/publikationer/publikationer/2011-567/at_download/publicationfile

OECD (2009): Innovációpolitikai országtanulmányok – Country studies with regard to innovation policy Hungary, National Office for Research and Technology, Budapest

OECD (2011): Regions and innovation policy. Policy brief, OECD, Paris, May 2011

OFI – Hungarian Institute for Educational Research and Development (2011): Javaslat a Nemzeti Oktatási Innovációs Rendszer fejlesztésének stratégiájára – Proposal for the development strategy of the National Education Innovation System (principal investigator: Gábor Halász) Oktatáskutató és Fejlesztő Intézet – Hungarian Institute for Educational Research and Development, Budapest, p.203

Papanek, G. (1999): The main contexts of the Hungarian innovation system OMFB

Pisano, G. P. és Shih, W.C. (2009): Restoring American Competitiveness, Global Competitiveness, Harward Business ReviewJuly-August 2009, pp. 119.

Prages Manual (2009): Kézikönyv női esélyegyenlőségi programok kialakításához a tudomány területén – Manual on elaborating equal opportunities programmes for women in the scientific field Prages project, FP7 – 2007-2013, contract no.: 217754

Piric, Amir; Reeve, Neville (é.n.): Evaluation of public investment in R&D – towards a contingency analysis. Ministry of Research, Science and Technology, Wellington, New Zealand. http://www.oecd.org/sti/innovationinsciencetechnologyandindustry/1822593.pdf

Schumpeter, Joseph A. (1975): Capitalism, Socialism and Democracy. Harper, New York

Skaringer, M. (2010): Regional policy: Sharing Innovation and knowledge with regions. Brussels, September 2010

Soete, L. (2010): The costs of a non-innovative Europe: the challenges ahead UNU-MERIT, 21st September 2010

Streicher, Gerhard; Schibany, Andreas; Gretzmacher, Nikolaus (2004): Input Additionality Effects of R&D Subsidies in Austria. Empirical Evidence from Firm-level Panel Data. Institute of Technology and Regional Policy – Joanneum Research. http://www.tip.ac.at/publications/schibany0304_RD%20Financing.pdf

Sveikauskas, Leo (2007): R&D and Productivity Growth (2007): A Review of the Literature. U.S. Department of Labor, U.S. Bureau of Labor Statistics, Office of Productivity and Technology, Bureau of Labor StatisticsWorkingPaper 408 September 2007 http://www.bls.gov/ore/pdf/ec070070.pdf

Török, Á. (2006): Stratégiai ágazat stratégia nélkül? – Strategic sector without strategy? A magyar kutatás-fejlesztés teljesítménye és versenyképessége nemzetközi összehasonlításban – The performance and competitiveness of the Hungarian research and development in international comparison Savaria University Press

Vas Zs. és Bajmócy, Z, (2012): Az innovációs rendszerek 25 éve – 25 years of innovation systems Szakirodalmi áttekintés evolúciós közgazdaságtani megközelítésben – Review of the relevant literature from an evolutionary economic point of view Közgazdasági Szemle – The Economic Review, vol. LIX, November 2012 pp.1233-1256

The most important definitions

Additionality 1: Basic principle of EU funding, according to which the amount of money spent on specific projects from the EU budget (typically from the Structural Funds) shall be provided in addition to a contribution from the national budget.

Additionality 2: The RDI policy endeavours to ensure that the interventions have the highest possible additional effects on mitigating the market and systemic failures. The following additional effects are distinguished by literature:

– Input additionality: the growth in RDI activity resulting from a governmental intervention.

– Output additionality: additional growth resulting from a governmental intervention, e.g. new publications, product sale, export, patents or the increase in technological-technical standard.

– Behavioural additionality: the extent with which the behaviour of the beneficiaries changes and so they become more competitive (in addition to - more or less - keeping their original objectives).

Benchmarking: Benchmarking means a basis for measurement (mark), i.e. something against which another thing is measured. It is suitable for qualitatively and quantitatively comparing the performance level of an intervention with such an intervention that qualifies as the best in a similar field. The method makes the analysis and correction of RDI key processes and elimination of mistakes possible and also improves the innovation performance and objective setting. One important instrument of benchmarking is the understanding of „best practices" that can lead to higher performance compliant to the objectives set.

CSR: Corporate social responsibility or social responsibility is a business term according to which the companies take account of the interests of society by having regard to effect of their activities on their business partners, suppliers, employees, shareholders and also the environment. This action seems to extend beyond the legal obligations of the companies, namely by voluntary steps made by the business partners in the interest of improving the quality of life of the surrounding society. Opinions on CSR vary.

Delphi research: The Delphi method was developed in the United States in the 1950s to forecast the possible major future trends of scientific development, the events expected to occur and their assumed date. The method consists of a survey of professionals in a given field conducted in more rounds and the analysis of the average opinion of the expert group and the differing opinions. The experts will have an information on the common position of the professional community by receiving feedback on the results of the previous rounds and in view of these facts, they have a chance to correct their opinion. It is specific to this method that the collection of expert opinions is done through an anonymous questionnaire compiled in an appropriate format.

Direct instruments: concrete financial supports or services that are addressed to the applicant or beneficiary (e.g. funding programmes, investment subsidies, consulting).

Dual economy: the co-existence of well capitalised, relatively modern, competitive, mainly foreign owned enterprises and Hungarian owned enterprises suffering from low competitiveness and a lack of capital. More than one-fourth of the GDP, half of the GDP growth, three-quarters of the export is generated by foreign enterprises while only 15% of all employees are employed by them. The growth potential of national economy providing two-thirds of the employment is weak, it is not capable of technological development by itself, it has a low degree of human resources. The connection between the two sectors is weak and incidental, the foreign enterprises operate as islands, they lean on imports instead of Hungarian suppliers. So the follow-through effects of technology transfer and technological developments are not typical at all in the Hungarian circumstances.

Dual studies: Dual studies means the university course and the parallel professional practice, the purpose of which is to enable the students to get familiarized with the practical issues of their future profession according to the instructions of experienced professionals. The students have an opportunity to develop their theoretical knowledge to practical knowledge during their stay by a company where they can have access to a much more complex knowledge (understanding of technology, creativity, responsibility, team work etc.) and can transfer their theoretical knowledge to skills. An additional aim of the training is to ensure that the graduated engineers have meaningful practice gained in business environment, which improves the usability of the graduated workforce and shortens its training period. In consultation with the university, the capacities of the student are used by the company to carry out tasks meaningful for both parties connected to certain professional fields or probably di-

rectly to given subjects of the (technical) BSc course during the practical experience. An important difference with the traditional education system is that the student spends more and more time - in an escalating system - by the company each educational semester.

European Institute of Innovation and Technology (EIT): The EIT is the (higher) education, research and innovation institution of the EU. Its primary task is to use the three components of the knowledge triangle to serve a common goal: to facilitate the knowledge-based European economy and enhance the competitiveness of the EU and its member states by strengthening their innovation capacities. The EIT functions as an excellence centre with its organization aimed at integrating the three sectors. The EIT is seated in Budapest in accordance with Decision No. 2008/634/EC.

European Research Area: means a unified structure which is a platform for the purpose of making the organisation and invigoration of research efforts at the Union level and their coordination with national and international initiatives possible. The aim of the European Research Areas is to establish the European innovation policy and the research activities carried out all over Europe and to guide them towards one direction and therefore ensure the economic future and competitiveness of the member states.

European Regional Development Fund (ERDF): The task of the EU Structural Funds is to reduce the differences in the level of development in the Union and to create an economic and social cohesion between the regions with a different level of development. There are two Structural Funds between 2007 and 2013: the European Regional Development Fund and the European Social Fund. The majority - approximately 45% - of the amount intended for the regional policy reaches the member states through the ERDF. The current rules are included in regulation (EC) No 1083/2006 determining those types of measures (convergence, regional competitiveness and employment and European Territorial Co-operation), according to which the regions are eligible to receive financial resources from the European Regional Development Fund (ERDF).

Evaluation: Activity analysing the accordance of the achieved results with the available resources and original objectives and the economic and social utilization of the results and the impacts of utilization in the interest of the efficient use of public funds. The subject of evaluation can be: strategy, institutions/organizations, programmes, according to their types it can ex-ante, mid term, ex post and on-going evaluation.

European Social Fund (ESF): The other part of the Structural Funds, next to the ERDF. Its main function is to support the development of human resources. The current rules are included in regulation (EC) No 1081/2006 effective since 1 January 2007. The aim of the European Social Fund (ESF) is to facilitate the balanced economic and social development with the support of those policies of the member states that aim at achieving full employment, improving the quality of work and productivity, advancing social inclusion and reducing national, regional and local inequalities in the employment.

FTE (full-time-equivalent): Full-time equivalent. The employees employed at research and development workplaces carry out research and development activities and participate in their promotion in one part of or during their whole - according to their working schedule - compulsory working time. The research and development statistics indicates the personal capacity by a headcount converted to full-time-equivalents. In this case, the actual number of employees employed at the research and development organisation is indicated in the ratio of the time spent on research and development to the whole working time. One unit of full-time-equivalent (1 FTE) can be regarded as one man-year. Therefore if somebody spends 30% of his or her working time on R&D and the remaining part on other activities then a value of 0.3 FTE shall be calculated.

Globalization: complex social and economic process. Integration is its key process, which connects the economy, society and culture of every country in the world through real or virtual networks together. Interdependent relations are created by globalization; its process is regulated by agreements between nations and supranational institutions.

Gazelle company: Literature knows different approaches. For instance, every company can be considered gazelle company if its annual average growth rate exceeds 20% in three consecutive years and employs ten or more employees at the beginning of the examined period. The growth can be measured by the number of employees and turnover.

Network: system of co-operation characterized by common goals, interdependence and comparative advantages. The networking co-operations have different forms; their two fundamental forms are the clusters implementing a traditional, so-called closed co-operation and the national technology platforms born in the spirit of the open innovation model.

Indirect instruments: tax remissions, tax supports, modification of the regulatory system; they are not directly addressed to somebody.

Incubation: the activity the purpose of which is to provide such resources to start-ups and small enterprises that can improve their chances of success. The business incubator (house) means such joint industrial and service facilities established like settlements that can provide the essential conditions at state-of-the-art quality and provide services at a higher quality for manufacturing advanced products and using modern technologies.

Innovation: Word of Latin origin, which refers to something novel or the renewal, modification of something. Innovation can be a new product (the production of new consumption goods), a new production process (renewed production or transport method), a new market (new markets, opening of a new placement opportunity), a new raw material (use of novel raw materials and semi-finished products, opening of their sources of supply) or establishment or elimination of a new organisation, novel corporate or industrial constitution. We can distinguish between product innovation, process innovation, marketing innovation, organizational innovation and innovative business model. The concept of innovation should not be confused with the concept of R&D (research and development). R&D is a regular creative work, the purpose of which is to enhance knowledge and the knowledge base. The first step of innovation is the birth of the idea and collection and evaluation of ideas; then the analysis of technological barriers, out of which the expected successes and failures can be forecasted. Then the practical application of the conceived idea follows.

Innovation eco-system: means a geographical concentration of entrepreneurs, investors, inventors and educational institutions where the research and commercial co-operations appear together, in support of each other, with different funding backgrounds.

Innovative start-ups: The total number of their employees is between 10 and 50 and their annual net turnover or balance sheet does not exceed EUR 10 million. They introduced an innovation significant in its industry and based on Hungarian R&D in the last 2 years. They intend to implement the average R&D expenditure of the EU industry in their mid-term business plans.

Medium-sized enterprises able to innovate and grow: Those enterprises whose total number of employees is between 50 and 250 and their annual net turnover does not exceed EUR 50 million or their balance sheet does not exceed EUR 43 million. They intend to gain a regional market share. They are capable of significant foreign market expansion with their own product in 3-5 years ~they increase the export share in their turnover by 10%.

Smart specialization (rational and effective specialization): The knowledge and innovation capacities of the regions of the EU depend on several factors: business culture, qualification of the labour force, education and training institutions, services supporting innovation, technology transfer mechanisms, R&D and ICT infrastructure, mobility of researchers, business incubators, new funding sources, local creative potential and quality of public administration. The performance of EU regions in the field of R&D highly differs from each other therefore the national and regional governments have to elaborate a so-called smart specialization strategy in co-operation with the enterprises, research centres and universities in order to define the most promising areas of regional specialization and the weaknesses hindering innovation. It takes into account the different innovation capacities of the regional economies.

IUS (Innovation Union Scoreboard): The Innovation Scoreboard of the European Union measures the innovation performance of the EU member states based on 25 indicators. Most of the indicators is based on the relevant statistics of Eurostat.

RDI and growth-oriented small enterprise: The total number of their employees is between 10 and 50 and their annual net turnover or balance sheet does not exceed EUR 10 million. They spend on R&D activities at least twice as much as the average in their sector. A significant foreign market growth up to an annual 10% is estimated by their 2-3-year business plans.

RDI management system: Every organisation responsible for establishing and operating the regulatory conditions and policy management system of research and development and innovation activities (RDI) and the related tasks.

Cluster: a bottom-up, self-organized, co-operative, non-competitive group of enterprises operating in a network along the same value chain which can permanently integrate the fragmented resources of research, development, manufacturing, distribution, service etc. companies. The members of clusters - while keeping their independence - pool their resources for a concrete task or project, for the common (further) development, technologization, manufacturing and market entry of certain products (product portfolio) and thus they can endure on the international market and fill the empty market niches.

Venture capital: Private capital provides companies not listed on the stock exchange with share capital. The private capital is provided for developing new products, introducing new technologies, increasing circulating capital, buying-ins and improving the balance sheet of the company. Strictly speaking, venture capital is only one subset of private capital investments that are used for starting companies, developing companies in their early stages or expanding their activities.

Consortium: co-operation of the parties (members) based on the division of tasks regulated by a civil-law contract for the purpose of jointly carrying out research and development and technological innovation activities or jointly implementing a research and development and technological innovation project.

Public sector innovation: There is no accepted definition. „Public sector innovation is the practical application of new or in other sectors already available ideas/knowledge in the public (general government) sector, which is a significantly novel solution without any profit targets, enhancing competitiveness, increasing well-being or having indirect positive effects." (according to Borsi and Lengyel (2011)).

Research and development (R&D): Research and development means such a creative work which aims at enhancing the already available knowledge or developing new applications. It encompasses basic research, applied research and experimental development.

a) *basic research:* experimental or theoretical work carried out primarily for acquiring new knowledge on the background of phenomena or observable facts without raising the prospect of practical application or use of them.

b) *applied research:* planned research or critical study the purpose of which is to acquire new knowledge or skills for the purpose of developing new products, processes or services or advancing the significant development of already existing products, processes or services. It comprises the creation of components parts to complex systems, which is necessary for the industrial research, particularly for generic technology validation, to the exclusion of prototypes.

c) *experimental development:* the acquiring, combining, sharing and using of existing scientific, technological, business and other relevant knowledge and skills for the purpose of establishing plans and regulations for new, altered or improved products, processes or services.

Qualification of the research and development activity: Pursuant to the Act on innovation, the Hungarian Intellectual Property Office (SZTNH) performs the qualification of the research and development activities and projects under its statutory authority since 1 February 2012. The qualification comprises two types of activities. Primarily, the preliminary qualification process initiated voluntarily and optionally by the enterprises and furthermore, the expert contribution in the ex-post tax inspection processes of the National Tax and Customs Administration of Hungary. The projects qualified as research and development activities in the final decision of the SZTNH shall be regarded as such also by other authorities. The binding qualification shall be used for proving the research and development content of proposals submitted in the framework of the research and development funding system and validating the tax and contribution benefits related to research and development activities.

Research and Technological Innovation Fund (KTIA): An autonomous public fund whose task it to ensure predictable national resources for the funding of applied researches, experimental developments and technological innovation programmes/projects.

Seed capital: Funding paid out before the starting phase of the enterprise in order to carry out research, planning or elaborate a concept.

Mentoring: Personal consulting relationship based on skills and experience. The mentors are usually persons in managerial capacities who can support their protégés with their skills, experiences and connections. Mentoring is often used by companies to prepare the prospective leaders for future management tasks and their responsibilities.

Monitoring: The monitoring means the continuous following-up of the fulfilment of objectives defined during the planning of RDI programmes/instruments. The quantification of the preliminary set objectives serve as a basis for the monitoring. A key consideration of the monitoring is that the current values of the indicators defined are continuously collected and assessed by the organisations responsible for the implementation of the programme/instrument in order to ensure the regular and clear feedback on the present state of the programme/instrument.

Hungarian research centres of multinational large companies: It increases with at least 20 FTEs the number of its Hungarian researchers. Its Hungarian research basis gets involved in strategic projects of the research network of the large company.

National Innovation System (NIR): the sum of all those institutions, enterprises and other organisations and also those resources, rules, conditions and measures in the country that influence the creation, transfer, dissemination and utilization of new knowledge and technology.

Normative funding: the normative budgetary support is a support guaranteed for the institutions from the central budget, typically proportional to the number of people, on the basis of law. The basic (statutory) types of the normative budgetary support: normative support for student allowances, support for training, support for scientific purposes, support for maintenance, support for other tasks.

NUTS 2: a coding system on geographical basis created by the European Union. The meaning of the name: Nomenclature of territorial units for statistics, in most instances it is called NUTS-system on the basis of the abbreviation of its French name (Nomenclature des UnitésTerritorialesStatistiques). The first two digits of the NUTS codes refer to the country, the third digit means the highest level administrative district, while the other digits mean the second and third highest. The parts of country comprise the NUTS 1 level: Transdanubia, Central Hungary and Great Plain and North. The planning and statistical regions correspond to the NUTS 2 level, while the NUTS 3 level comprises the counties.

OECD: Organisation for Economic Co-operation and Development (the aim of the international organisation better known by its English abbreviation OECD also in Hungary is to support the governments of the member states in developing and evaluating the best possible economic and social policies. The organisation has accumulated enormous knowledge and skills since its foundation in 1984 that are shared among the members states through professional directorates (research and development e.g. through the Directorate for Science, Technology and Industry).

Platform: The National Technology Platform is a strategic community of interests of the R&D and economic sector. Its aim is the competitiveness enhancement and professional and business development of a certain area of the national economy. It shapes the vision of the related business and technological field and determines the (world) market position intended to be achieved in the given field. It has a long-term strategic plan for achieving long-term goals, it determines the long-term needs for human resources thus providing guidelines on determining the direction of training and developing the regulatory environment supporting the implementation of the plans. Thus, the platforms provide a strategic partnership for elaborating national innovation strategies and policies and identifying their priorities. The platforms can be partners and members of the European Technology Platforms and, thereby, be also capable of asserting national interests at an international level.

S3 – Smart Specialization Strategy: see smart specialization.

Spin-off: an enterprise established for the purpose of commercializing the development results of a university or public (non-profit) research organisations. The researchers of the university or research institute and an external management usually managing the new company based on a novel product or process have an interest in the “spun off” enterprise.

Start-up: starting knowledge-intensive enterprise which can produce fast growth small with a small investment in capital or labour.

Policy: innovation can only be studied and interpreted in a wider social context due to its social-economic embeddedness. The task of policy is to review and supervise (contain and control by taking into account the ethical norms and long-term real values-interests of society) a specific field and make the decision related to this field and implement and control the measures aimed at the implementation of these decisions.

Scenario analysis: A method outlining and evaluating in detail more alternative scenarios and their advantages and disadvantages by taking into account possible future events, conditions and trends.

Technology foresight: Technology foresight is the scientific evaluation of scientific and technological development and the expected market, economic and social trends as regards their impact on the competitiveness, income capacity of a nation (or region, sector, class, enterprise) and quality of life of people. Technology foresight is very widespread in the developed countries.

Technology assessment: it studies the short-term and long-term economic, social, ethical and legal consequences of specific technologies during their application and provides information on establishing a more efficient future regulatory environment and strategic planning for the policy decision makers.

Technology transfer: in the strict sense, the placing of the technology on the market; in the broader context, transfer of new knowledge, skills. The process also covers the transfer and receipt of all the knowledge and goods, with the use of which the receiver of the technology will be able to produce new products and services. The understanding includes the knowledge, the transfer

and receipt of knowledge in the same way as tangible knowledge (machines, instruments, processes).

Knowledge flow: diffusion of the accumulated knowledge in the institutional and corporate network and in the broader economy for the purpose of maximum utilization. The knowledge can be transferred in an easier or more difficult way based on the codified or tacit nature of knowledge.

Knowledge base: all knowledge, facts and concluded rules related to a specific activity and professional field. Its fixed (either in relational database) format is the codified, explicit knowledge, the information. The other set of similarly important knowledge is the tacit knowledge linked to a place, institution or its culture, and cannot be moved. The research and development organisations, higher education departments etc. are important, organizationally separate components of the knowledge base.

Knowledge and Innovation Communities (KIC): The European Institute of Innovation and Technology (EIT) performs its activities primarily by establishing the continent-wide network of Knowledge and Innovation Communities. The co-operation is based on the Knowledge and Innovation Communities (KIC) bringing together higher education institutions, research organisations and enterprises, and the co-operating partners. The EIT shall cover 25% of this long-term R&D partnership. The remaining part is raised by the communities. KICs currently operate on the following fields: sustainable energy, ICT and climate change.

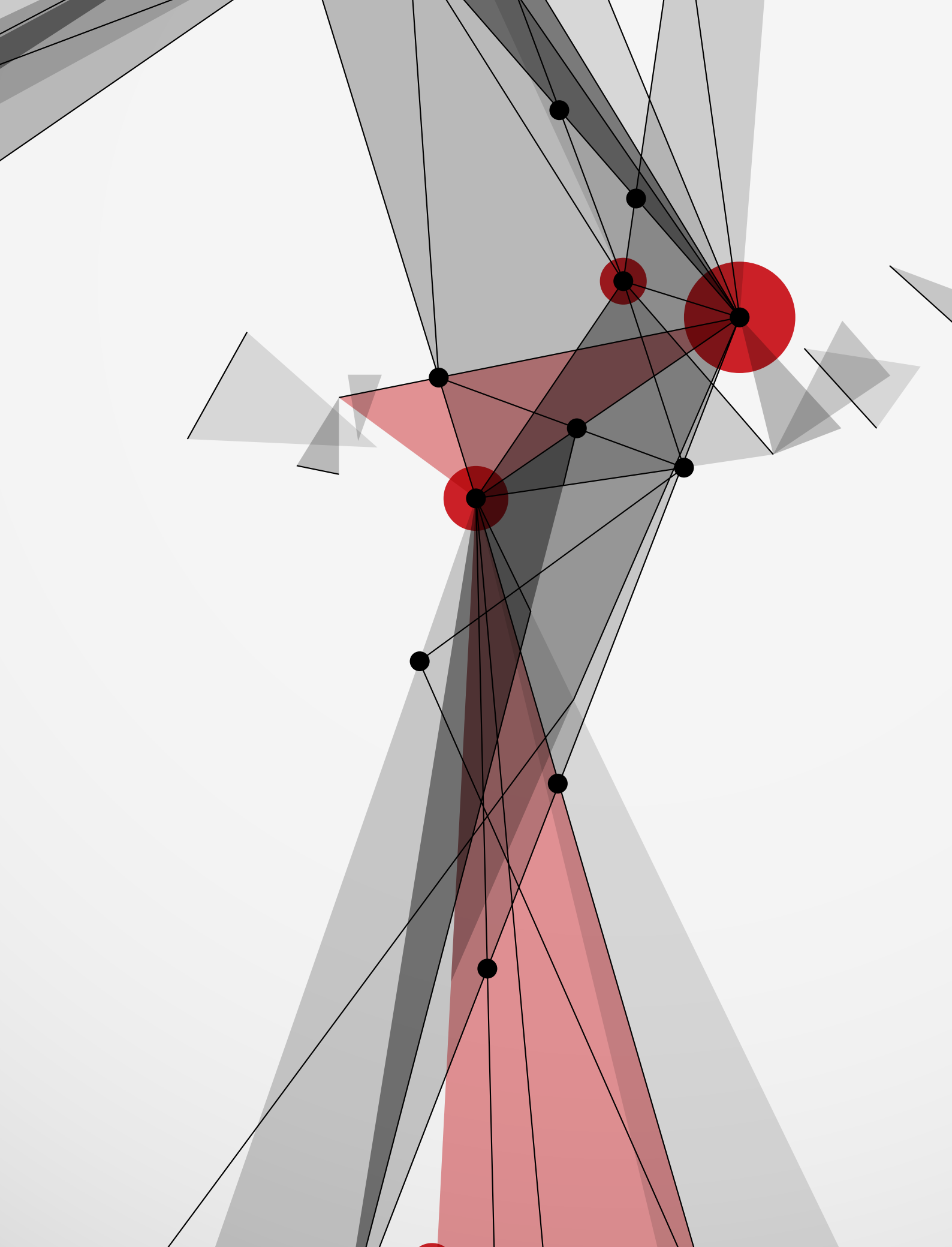
Enterprise life cycle: The enterprises undergo different, well-separated phases, similarly to the growth of a human being. This metaphor is used by the so-called enterprise life cycle models in order to make the owners realize that they have to face different problems, challenges, traps in the different growth phases that require different solutions. The phases of the enterprise life cycle: formation, growth, evolution, stagnation, decline, cancellation. Similar industrial, product and organisational life cycles exist.

Voucher: The system of innovation vouchers (introduced in the Netherlands in 2004 and in Ireland in 2006) enables the small and medium-sized enterprises to purchase the knowledge and strategic consultation services required for their current projects from the knowledge centres and so encourage the co-operation between the knowledge centres and enterprises. If a company needs a service related to patent, research etc., then it will order it and accept the service provider's invoice, which will be paid out by the supporting organisation directly to the account of the organisation issuing the invoice.

Abbreviations

EKD:	Individual government decision
ELI:	Extreme Light Infrastructure
ERDF:	European Regional Development Fund
ESFRI:	European Strategy Forum on Research Infrastructures
GINOP:	Operational Programme for Developing the Economy and Innovation
FTE:	Full-Time-Equivalent
IP:	Intellectual Property
R&D:	Research and development
RDI:	Research and development and innovation
HAS:	Hungarian Academy of Sciences
NIH:	National Innovation Office
NIR:	National Innovation System
NFÜ:	National Development Agency
NGM:	Ministry for National Economy
NFM:	Ministry of National Development
OTKA:	Hungarian Scientific Research Fund
OFTK:	National Concept for Development and National Concept for Regional Development
PCP:	Pre-commercial Procurement
SWOT:	Strengths, Weaknesses, Opportunities, Threats
SZTNH:	Hungarian Intellectual Property Office
TéT:	Science and Technology
STI:	science- technology- and innovation

annexes



Annex 1:

Comprehensive methodology of the planning

The methodology of developing the RDI policy strategy in line with the National Concept for Development and National Concept for Regional Development (OFTK) follows a simple pattern:

1. The presented stock-taking is based on an extended SWOT analysis integrating several viewpoints (see Annex 2).
2. After the stock-taking, a causation reviewing the problems and a related system of objectives are developed.
3. The strategic intervention logic is established.
4. A vision in line with the strategic intervention of RDI policy, beneficiary target groups and instruments enabling the achievement of objectives are determined.
5. The functional areas enabling the successful implementation of the strategy are determined and a proposal is made for the development of the required institutional system.
6. The main milestones of the monitoring and evaluation of the strategy are identified.

The presented methodology is in line with the ROAMEF+ RDI planning approach applied in the United Kingdom since the 2000s and the later introduced business case planning approach. On this basis, the following shall be formulated: the general objectives pursued and welcomed by the wide range of relevant parties *(rationale);* the more specific objectives detailing the rationale *(objectives);* the activities and instruments enabling the achievement of objectives *(appraisal);* the milestones suitable for monitoring the progress *(monitoring);* the evaluation concepts verifying the efficiency and effectiveness of the strategy *(evaluation);* and those intentions concerning the inclusion of evaluation results into the policy and utilization of results *(feedback).* The business case complements the ROAMEF+ methodology with the assessment of alternatives, the description of the intervention logic and the expectation that a balanced system of indicators (Balanced Scorecard, BSC) shall also support the monitoring for following up the progress. The intervention logic is specified during the planning process.

In the future, the strategy can be supplemented and clarified from time to time by applying other planning methodologies in line with the nature of research and development and innovation. Principally, the methods of technology assessment, foresight, scenario analysis, Delphi research and benchmarking can be considered.

Annex 2:

The methodology of SWOT analysis establishing the stock-taking

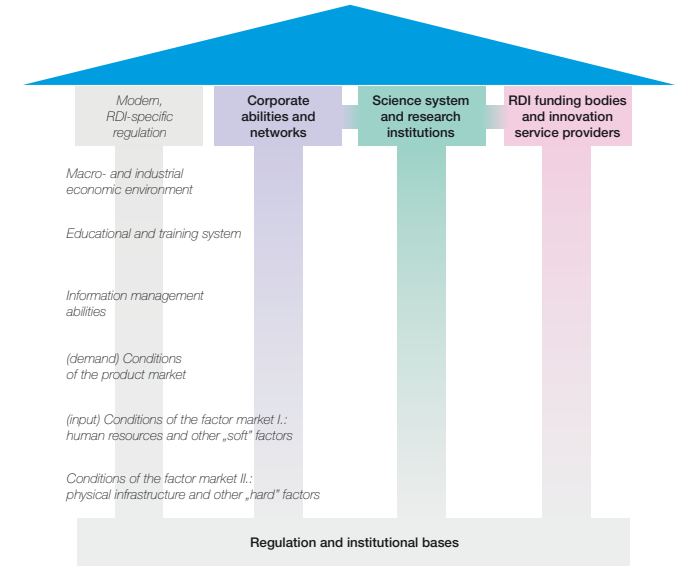
It is recommended to enforce the systematic approach by which the RDI strategy is elaborated already during the establishment of the stock-taking. In accordance with the international undertakings of the government, a SWOT analysis is used to make a stock-taking[50], which is complemented with international and regional dimensions. The SWOT analyses are made in more segments by using the concept of the National Innovation System (NIR) in a modernized way. The system approach is enforced by two ways:

- by a so-called *analytical approach* when the SWOT analysis of the main institutional sectors of the NIR (companies, funding bodies and service providers of RDI) is made on the basis of the sum of the main factors affecting the performance of the NIR (see Figure 27), and
- by a so-called *system-dynamical approach* when it is specifically concentrated on the knowledge flow (in accordance with the international emphases of the topic) and the strengths, weaknesses, opportunities and threats of the knowledge flow processes are collected (see Figure 28).

The summary of the detailed SWOT tables is included in the chapter on problem identification of the strategy.

Analytical approach

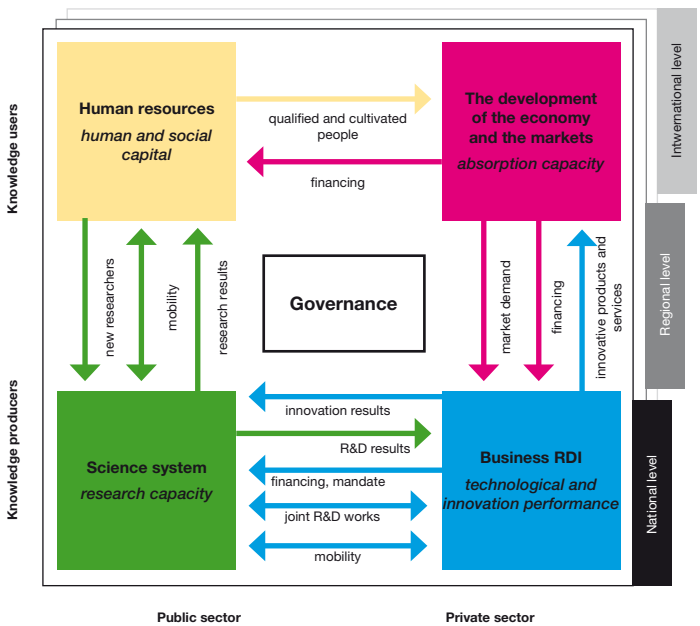
Figure 27 **The analytical structure of the stock-taking of the National Innovation System**



Source: NGM-IKF

System-dynamical approach

Figure 28 **The dynamic establishment (based on flows) of the stock-taking of the National Innovation System**



Source: Guy, K and C. Nauwelaers (2003), Benchmarking STI Policiesin Europe: In Search of Good practice, IPTS Report, n°71

[50] The shortcomings inherent in the SWOT analysis have been eliminated by expert consultations and analyses.

Annex 3:

The indicative budget of the „Horizon 2020“ Framework Programme

The table includes the amounts known at the end of 2012 that can change by the adoption of the final budget of the EU.

Table 13 **The indicative budget of the „Horizon 2020“ Framework Programme**

Priorities	Amount (EUR million)
I. Excellent science, *including:*	**27,818**
1. European Research Council	15,008
2. Future and Emerging Technologies	3,505
3. Marie Curie actions for skills development, training and career development	6,503
4. European research infrastructures (including also the electronic infrastructure)	2,802
II. Industrial leadership, *including:*	**20,280**
1. Leadership in enabling and industrial technologies*	15,580, of which 500 is for the purposes of the EIT
2. Access to risk finance	4,000
3. Innovation in SMEs	700
III. Societal challenges, *including:*	**35,888**
1. Health, demographic change and well-being	9,077, of which 292 is for the purposes of the EIT
2. Food security, sustainable agriculture, marine and maritime research and bioeconomy	4,694, of which 150 is for the purposes of the EIT
3. Secure, clean and efficient energy	6,537, of which 210 is for the purposes of the EIT
4. Smart, green and integrated transport	7,690, of which 247 is for the purposes of the EIT
5. Climate action, resource efficiency and raw materials	3,573, of which 115 is for the purposes of the EIT
6. Inclusive, innovative and secure societies	4,317, of which 138 is for the purposes of the EIT
European Institute of Innovation and Technology (EIT)	**1,542 + 1,652*****
The non-nuclear direct actions of the Joint Research Centre	**2,212**
TOTAL:	87,740

* Of which the intended budget for information and communication technologies (ICT) is EUR 8,975 million – including EUR 1,795 million for photonics and micro- and nanoelectronics –, EUR 4,293 million for nanotechnologies, advanced materials and advanced manufacturing and processes, EUR 575 million for biotechnology and 1,737 EUR for space. As a result of which, EUR 6,663 million is available for funding the most important enabling technologies.

** Out of this amount around EUR 1131 million goes towards the implementation of Strategic Energy Plan (SET Plan) projects. Around one-third of this amount goes to SMEs.

*** The total amount will be made available through allocations as foreseen in Article 6(3) of the Horizon 2020 Regulation. The second allocation of EUR 1,652 million shall be made available pro-rata from the budgets of priority „Societal Challenges“ and specific objective „Leadership in enabling and industrial technologies“, on an indicative basis and subject to review set out in Article 26(1).

Source: European Commission

Annex 4:

The importance of international research infrastructure co-operations and developments

The world-class research infrastructure available for every researcher is an essential capacity prerequisite (next to the critical mass of suitably qualified researchers) for reaching/maintaining competitiveness and fulfilling the primary criteria of scientific excellence laid down - in accordance with the above - in Horizon 2020, the next R&D framework programme of the European Union.

Beside the necessity of developing the national infrastructure, Hungary - as a member of the R&D community working on the implementation of the ERA - cannot disregard the fact that the scarcity[51] of the resources available at a national level increased the needs for international co-operation regarding the establishment and operation of research infrastructures.

The EU started to deal with the issue of coordinated development of Pan-European research infrastructures at the turn of the millennium. The European Strategy Forum on Research Infrastructures was established by the member states in 2002 (European Strategy Forum on Research Infrastructures, hereinafter referred to as ESFRI[52]).A mandate was given from the Competitiveness Council to ESFRI to elaborate the strategic roadmap of the European research infrastructures. Based on this mandate, the first so-called ESFRI Roadmap was completed in 2006 and has been updated twice since then. The most recent ESFRI Roadmap in effect is from 2010, which proposes the establishment of 48 research infrastructures of pan-European interests through shared efforts of the member states.

The Hungarian researchers can have access to the above mentioned world-class research infrastructure in case of their – professionally well-established – participation in the implementation of the projects on the ESFRI Roadmap, and the most excellent Hungarian researchers - as members of the European R&D community - can contribute to implementing the ERA and maintaining the global competitiveness of the European R&D through the results achieved by using the appropriate „instrument". Beside the scientific benefits resulting from the participation in projects, the participation in implementing pan-European research infrastructure investments and maintaining and developing large instruments to be implemented provide the national innovative companies and SMEs with an opportunity for participation (supply) - thus generating follow-through economic processes.

It means an unprecedented opportunity and also challenge for the Eastern part of Europe, strictly speaking, for the Central and Eastern European region, that one of the projects on the ESFRI Roadmap can be implemented in this region - after Hungary, together with the Czech Republic and Romania, has won the tender on the seat of project ELI.

By successfully implementing the project, Hungary and the Central and Eastern European region can be put on the „ERA" map and contribute to its implementation and to the enhancement of the global (R&D) competitiveness capacities of Europe, indicating whether Hungary and the region are capable of successfully implementing projects of similar volume (that can mean an opportunity for further large-scale developments by/beside the prestige-enhancing effect). Beside the above benefits, the successful implementation can obviously generate several („follow-through") professional outputs (innovation results; increasing R&D capacity and importance of categories of users regarding lasers, material and other sciences; knowledge transfer; education; mobility of researchers, teachers, students and between corporate developers (intersectoral); effect of reducing brain drain (effect of attracting human resources of high professional level); publications; national and international patents...). The „beneficiary" key sectors of (scientific and industrial) use can include the health sector and medical science, the environment-friendly solutions (e.g. energy efficiency), the food production, the IT sector etc.

[51] As a result of the scientific and technical development, the investment and operating costs of infrastructures required for carrying out high-level R&D activities have significantly increased in the last decade, while the individual states – even the richest ones – can only fulfil the research and development needs within scarce budgetary resources.

[52] The ESFRI supports the establishment and implementation of the EU-level research infrastructure policy, facilitates the development of an adequate legal and financial environment and makes recommendations to research infrastructure development projects important for the progress of the European Research Area (ERA).

The project of national economic importance can have an invigorating effect on the economy through innovation and follow-through economic effects and can be an engine of regional economic and social growth (factor of location: e.g. new investments in the science park in Szeged; effects generated by the construction, operation, maintenance; effects facilitating regional economic co-operations...).

An interministerial working group lead by the HAS was set up in 2012 with the aim of prioritizing the Hungarian participation in strategic R&D infrastructures of European significance and to reconcile the research and professional needs with the financial realities.

Annex 5:

Definitions related to the main objectives

- *Larger research and technological development group:* Primarily a public and non-profit research organisation, with a research personnel of at least 10 persons (the value may vary by research areas) whose scientific-technological performance is outstanding. Their strengthening is desired primarily in the fields of converging (for instance, bio-info-cogno-nano-) technological researches or researches with regard to global social challenges relevant for Hungary (for instance, researches related to water bases/water utilities, agricultural and food industry researches, energy researches, brain research, integration of Roma people, network research, diseases of public health significance and healthy ageing). If possible, the research infrastructure should also be open to other researchers and institutions.
- *R&D research centre of a global large company:* Research centre of a multinational large company, which carries out research activities with a research personnel of at least 10 persons in Hungary (or which is already present, increases its research personnel to 10 persons). The R&D centre is part of the network of parent company engaged in strategic researches; it contributes to the creation of added value of the Hungarian company by its research activities. It is desirable that the number of patent applications submitted by the company – preferably in Hungary – reflects the results of the research activity.
- *Macro-regional multinational medium-sized enterprise:* Typically a company of 50-500 persons, the seat or strategic decision-making of which is in Hungary and its owners are fully or mostly Hungarian. Its R&D expenditure, export turnover shows a rising trend. It is desirable that the company has own product, process, intellectual property, business model[53].
- *RDI and growth-oriented small enterprise* often called „gazelle" by literature: A company with less than 49 persons, which carries out R&D activities and its turnover increases by 10% for 3 years. t is desirable that the company has own product, process, intellectual property, business model. Their strengthening is desired in the fields of converging (for instance, bio-info-cogno-nano-) technological fields.
- *Innovative start-up:* The enterprise can be a potential investment area for venture capital and it is suitable for incubation. It was founded maximum 3 years ago. The enterprise has introduced novel or significantly improved goods or services in its own markets, or process, organisational or marketing innovation before its competitors.
- *Innovative supplier SMEs:* Small and medium-sized enterprise possessing innovative products and services, carrying out R&D activities, capable of increasing its added value creation by continuous developments, supplying for multinational companies and having markets to be diversified in the long term.

[53] It is important regarding this and the other definitions that they can be interpreted in the prevailing funding system and the actual funding shall implement the policy objectives in such a way that it shall not conflict with the prevailing rules on funding, competition etc.

Annex 6:

Enforcement of horizontal priorities in the strategy

H1 Smart specialisation in the regions (S3): After the completion of the national RDI strategy, individual regional RDI strategies are elaborated by the statistical planning (so-called „NUTS 2") regions, taking into account the local characteristic and the resources available at a national level, and also the evolving sciences and research directions. Then the regional strategies are summarized by a synthesis strategy. The implementation of the summarized smart specialisation strategy is included in the governmental RDI management tasks, taking into account the locally developing institutional system and instruments.

H2 Sustainability, equal opportunities: By the use if every direct funding instrument (e.g. call for proposal) the relevant aspects of financial, social and environmental sustainability shall be taken into account (all three of them; when it is not possible, separate reasons shall be given). It is a priority objective to create equal opportunities for women in the RDI professional field, for instance, when managers are appointed (the Prages Manual (2009) compiling global best practices sharply draws attention to the innovation significance of this priority).

H3 The ensuring of sound financing of the priority axes: To ensure predictable financing for the normative funding of basic research, higher education and the Academy.

H4 The familiarization of knowledge and technology in society and strengthening of its recognition:

- In case of the planned instruments for strengthening the knowledge bases:
  - o Strengthening creativity, problem solving and innovative thinking in the whole formal and non-formal, informal education sector,
  - o Strengthening the view and instruments of creative team work (workshops, competitions etc.),
  - o Continuous self-improvement, encouragement of learning,
  - o Presentation of the functioning models strengthening innovation skills in the existing methodological centres and their results in the media.
- In case of the planned instruments for intensifying knowledge flow:
  - o intersectoral (business-research organisation) co-operation,
  - o establishment of an experimental development environment („living lab") based on non-governmental initiatives,
  - o support for open innovation models (in case of proper business models),
  - o organization of educational events with the involvement of public collection and public education institutions,
  - o launch of regular programmes in the electronic media and publication of regular articles in the written media on scientific and technological novelties („Delta - scientific magazine of the Hungarian television - of the 21th century"),
  - o campaigns supporting innovation consciousness, labels on innovative products.
- In case of instruments aiming at the invigoration of knowledge use:
  - o recognition of RDI activities by awarding RDI prizes,
  - o ensuring media coverage of the corporate social responsibility activities (CSR) of innovative companies.

H5 Compliance with global social challenges: It is essential that larger scale researches with prospects of new applications and significantly influencing the national and international knowledge flow can be started in the fields representing the strengths and important challenges of the Hungarian society and economy. These fields are the following: researches related to water bases/water utilities, agricultural and food industry researches, energy researches, brain research, integration of Roma people, network research (mathematics), diseases of public health significance and healthy ageing).

H6 Sound and innovation-friendly economic and regulatory environment: Confidence-building measures towards RDI activities and less bureaucracy are essential. There is a need for organizing the diverse funding instruments, for which the evidence-based and professional RDI policy management provides a firm basis. The role of learning is essential by innovation activities so the evaluation is lifted to a strategic level and we endeavour to implement a learning public RDI strategic management. The legislation related to RDI and the monitoring and rationalization of legislation will possess large powers among the functions implementing the strategy The R&D tax benefits are intended to be stabilized taking into account both the favourable and the unfavourable experiences of the period since the end of Communism.

Annex 7:

Indicators to be monitored over the strategic time horizon

The further details of the indicators are continuously elaborated during the implementation of strategy. Since it is very important that the so-called SMART criteria are applied, i.e. the indicators shall be specific, measurable, achievable, relevant and timely. This requires deeper professional consideration (in an extreme case, an essential part of the strategy can also be revised – the probability of this revision is evidently small). In the framework of this, the consistency of intervention areas and indicators suggested for measuring shall be controlled.

The characteristics of a good indicator:

- Specific: it applies primarily to that characteristics/objective to which we assign it; and provides information in appropriate depth and details on this characteristics/objective.
- Measurable: it can be expressed in real values and its measurement does not require unrealistically large effort.
- Achievable: the objective is not unrealistic and the target value can really be reached.
- Relevant: the indicator has an important and useful information regarding the use, therefore the measurement and collection are not unnecessary.
- Reliable: the indicator is based on certified data (e.g. it is measured by an independent and trustworthy organisation or it is carried out administratively with a minimum chance for errors etc.).
- Timely: the decision-makers can make their decisions on the basis of such analytics and evaluations that can be carried out in a realistically short lead time.

Objectives related to knowledge bases until 2020

➢ GERD/GDP ratio

Macro-economic indicator based on international statistical standards The numerator is the own research and development expenditure aggregated at the level of the national economy (Gross Domestic Expenditure on Research and Development, GERD) the denominator is the gross domestic product (Gross Domestic Product, GDP) (see Figure 29).

➢ BERD/GDP ratio

Macro-economic indicator based on international statistical standards The numerator is the own research and development expenditure of the business sector, aggregated at the level of the national economy (Business Expenditure on Research and Development, BERD) the denominator is the gross domestic product (Gross Domestic Product, GDP) (see Figure 30).

➢ The number of workplaces engaged in research and development

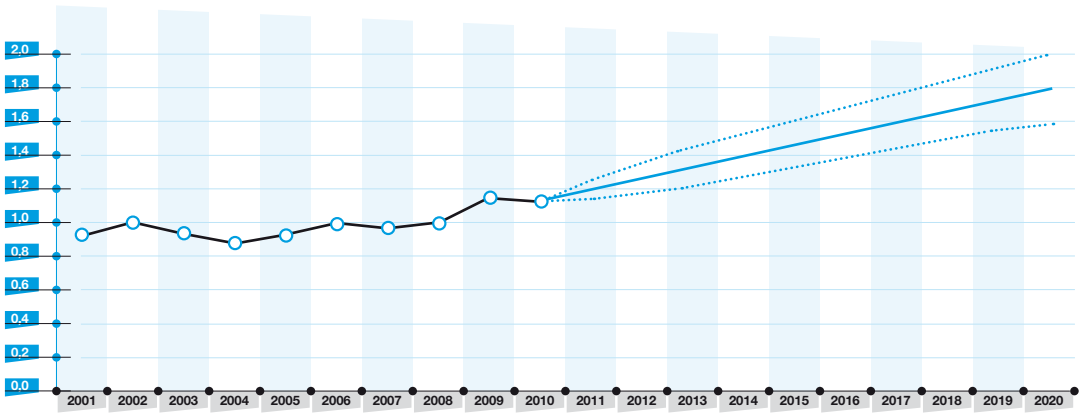
Macro-economic indicator based on international statistical standards The actual number of researchers and developers is the statistical personnel headcount of such natural persons who carry out R&D activities as researchers and developers in the research organisation in different sectors, irrespective of the time spent on research and development (see Figure 31).

➢ The number of world-class groups active in international co-operations and concentrating a critical mass of knowledge

The definition of world-class groups active in international co-operations and concentrating a critical mass of knowledge is the following:

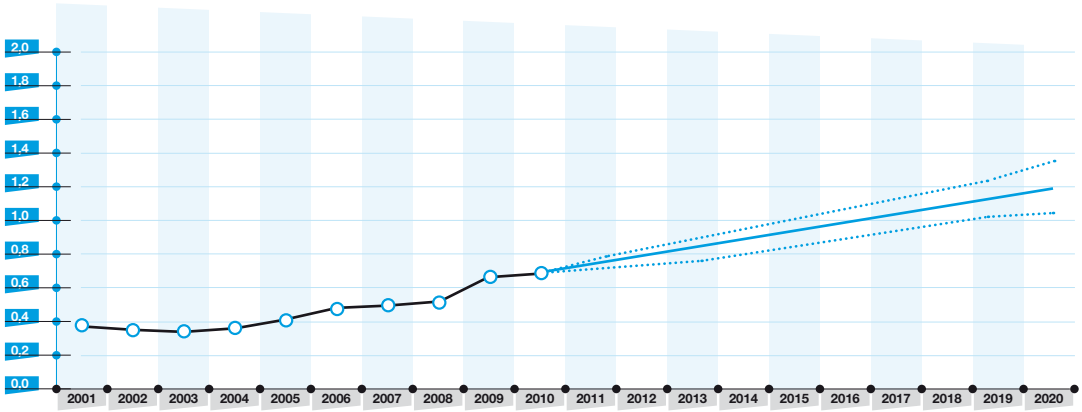
- Public or private research and development organisation which employs at least 2 outstanding researchers. A researcher is outstanding if:
  - o his or her international publication activity, measured by impact factors, significantly exceeds the national average in the given disciplinary field and/or,
  - o he or she has participated as an inventor in such patents that have generated a significant income for the owners of the exploitation rights by the sale of the patent rights.
- It has at least 10 researchers who work according to standard research plans (schedule) and as part of a clearly identifiable organisation.
- It can produce such research results and innovations (in case of technical areas) that have a significant European/international value and contribute to the Hungarian (and thus European) added value, well-being and quality of life:
  - o it provided new knowledge to at least 1 radical innovation in the last 10 years;
  - o it provides new knowledge to at least 1-2 modifying innovations annually.

Figure 29 GERD/GDP target value: 1,8%



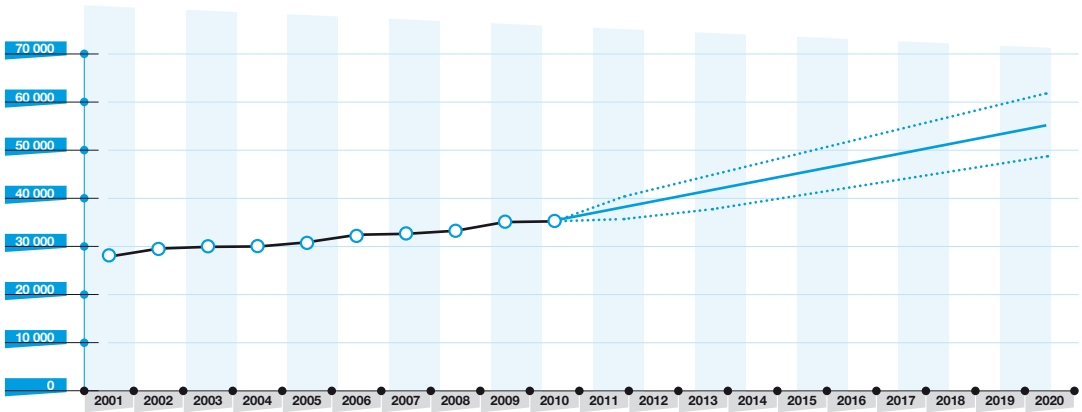
Source: KSH data until 2010

Figure 30 BERD/GDP target value: 1,2%



Source: KSH data until 2010

Figure 31 Target value: 56,000 researchers and developers employed



Source: KSH data until 2010

- It hosts a foreign researcher in every year in order to carry out meaningful research activities (the stay is longer than 6 weeks).
- It operates in an identifiable disciplinary field, which does not exclude the possibility to bring the basic and applied researches close to each other by jointly using more disciplines.
- It has an infrastructure available preferably for other researchers and institutions.
- In case of a public research institution, it has multi-level and multi-directional interactions with enterprises;
- In case of a private research organisation, it typically has significant linkages with the public research sector. The linkages are indicated by joint patents and international publications.

The following additional indicators support the measurement of the presence and performance (appearing in a critical mass) of the above mentioned groups:

- number of joint international-national scientific publications,
- number of joint public-private publications,
- number of institutional patents,
- indicators of the participation in the Framework Programmes.

The baselines of the larger research and technological development groups are determined according to the data of the NEKIFUT Register and the databases of the Strategic Research Infrastructures (hereinafter referred to as SRIs) in the first instance (subsequently, we review the groups together with the Hungarian Academy of Sciences; **where appropriate, modifying the methodology)**. The Register includes, inter alia, the number of internal researchers operating and using specific research infrastructures. It is our fundamental assumption that the number of the larger research and technological development groups can mostly be calculated by reviewing the research infrastructures; the part defining research groups in Annex 7 of the Strategy also stipulates the existence of infrastructures[54].

Since the values in the databases are not updated (the Register includes data on headcount from 2008 and 2009) and sometimes they are not suitable for measurement (due to the ambiguous responses of data providers) the Register will be updated by the RDI Observatory in 2013 in order to give full details on the RISs and RIs and the number of researchers using them - thus also on the actual number of larger research and technological development groups.

The Register currently comprises 63 RISs and the number of related research infrastructures is: 361. 19 RISs of the 63 RISs operate in a network, 15 RISs operate in a group (i.e. within an organisation) and 29 RISs operate individually.

The number of research organizations can be determined by the number of researchers in relation to the research infrastructures. It is expected from the larger research and technological development groups to have research infrastructures; these RIs can be monitored in the Register of the NEKIFUT project. Their exact number (i.e. the baseline of the Strategy related to this group) can already be measured at the end of 2013 if the update of the Register is carried out; the current distribution is included in the following table:

The number of the research institutions operating research infrastructures whose research personnel exceed the given number of researchers (according to 2008-2009 data)

at least as many researchers are employed at the research organisation	10	15	20	25
the number of research organisations	105	58	35	29

Currently the Register has 29 research infrastructures with a research personnel of more than 25 persons, in case of 10 persons there are 105 RIs. The disciplinary classifications can be filtered from the database of the NEKIFUT project; however, these categories cannot always be brought into line with the disciplines in the Strategy – a solution for the problem will be sought when the Register is updated.

[54] *Research infrastructure (RI)*

A research infrastructure (hereinafter referred to as: RI) within the NEKIFUT project means equipments, assemblies of equipment, banks of living and non-living material, data banks, information systems and services that are essential for scientific research activities and the dissemination of results. The related human resources form an integral part of RIs that enable the professional operation, use and services. The structure and size of the research infrastructure largely depend on the characteristics of the specific discipline and the needs of the research using using the infrastructure.

Research infrastructure of strategic importance (RIS)

An RI is a research infrastructure of strategic importance (hereinafter referred to as: RIS) if all of the following criteria are met: it contributes to solving national tasks of strategic importance; it enables the carrying out of a research activity considered high level by international standards; it provides a research opportunity for more independent research groups and it is open, with equal opportunities for users if they meet the conditions set out in the publicly available regulations; its institutional, funding, management and human resources situation ensures the operation in accordance with the above mentioned criteria.

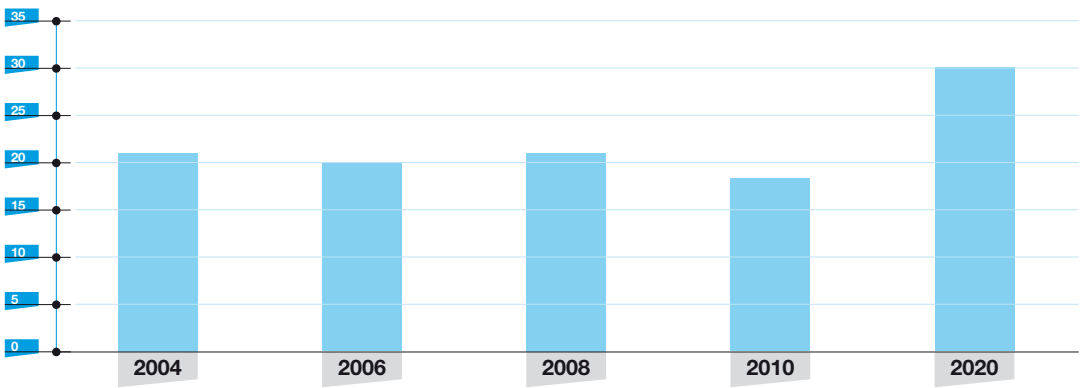
Additional indicators related to the objectives and prioritized during the strategic monitoring

➢ Increasing the ratio of companies (with more than 10 employees) engaged in technological innovation to 30%

The ratio of companies (with more than 10 employees) introducing new products and processes is measured by the survey system named Eurostat Community Innovation Survey (see Figure 32)

➢ The number of active groups important from the Hungarian viewpoint and concentrating a critical mass of knowledge

Figure 32 Target value: 30%



Remark: companies with more than 10 persons
Source: 2004-2008: Community Innovation Survey data

Annex 8:

Review of the implementation of the mid-term strategy on science-, technology- and innovation policy adopted in 2007

The mid-term science-, technology- and innovation policy (hereinafter referred to as: STI strategy) was established by Government Decision No. 1023/2007 (IV. 5.) and the 2007-2010 programme of measures for implementing the Strategy (hereinafter referred to as: STI programme of measures) was established by Government Decision No. 1066/2007 (VIII. 29.) . Based on the past experience of the STI programme of measures effective since 2008 and taking into account the effects of the economic crisis, a proposal had been made for the STI programme of measures for 2009-2010, which was adopted by the government in February 2009[54]. The new programme of measures for 2009-2010, which was an annex of Government Decision No. 1019/2009 (II.19.), defined the most important and realistically achievable tasks of the professional field. On the other hand, the Government Decision stipulated that a report shall be made for the government on the tasks of the STI programme of measures for 2007-2010 that were fulfilled in 2007-2008, and in every year a report shall be made on the situation of the STI programme of measures for 2009-2010.

The Research and Science Policy Council (KTT) requested the minister for national development and economy at its meeting on 17 February 2010 to evaluate the 2007-2008 tasks of the STI programme of measures and make a joint report for the government on the monitoring of the 2009 tasks with a deadline of 31 March 2010.

[54] Government Decision No. 1019/2009 (II. 19) on the programme of measures on science-, technology- and innovation policy of the government in 2009-2010; Government Decision No. 1066/2007 (VIII.29.) on the programme of measures on science-, technology- and innovation policy of the government in 2007-2010 was simultaneously repealed.

The STI programme of measures was fulfilled by reviewing and evaluating 32 measures; the KPMG Consulting Ltd was appointed by the National Office for Research and Technology to carry out the evaluation. The outputs of measures were evaluated, supplemented by the findings for the decision-makers on the possible directions for further development. The main results achieved by the fulfilled tasks:

- Encouragement of corporate innovation and facilitation of regional innovation: Approximately 2,400 applicants have won funding in the value of almost HUF 200 billion in 24 different programmes of the New Hungary Development Plan (Economic Development Operational Programme, Central Hungary Operational Programme, Regional Operational Programme) and the Research and Technology Innovation Fund (KTI Fund).
- Quality improvement of higher education: 53 applicants have won funding in the value of almost HUF 68 billion in the different higher education R&D funding arrangements of the New Hungary Development Plan (Social Renewal Operational Programme, Social Infrastructure Operational Programme, Central Hungary Operational Programme) for strengthening the co-operation between higher education and the business sector and developing the infrastructure of higher education RDI.
- „More environment-friendly" legal environment: The new rules improve the efficiency of processes in the fields of mobility and calls for proposals.
- The strengthening of international STI co-operations: a) Hungary has won the right to establish the European Institute of Innovation and Technology (EIT), whose seat is in Budapest; b) one of the locations of the pan-European „super laser" research large equipment will be in Hungary, the seat is in Szeged; c) 34 applicants have won funding in the value of HUF 146 million in the funding programmes supporting the Hungarian participation in the EU RDI programmes (FP7, CIP).

The main conclusions and findings of the evaluation:

The time horizons of the national public STI strategy and the EU RDI programmes of priority importance and the strategic goals and the programme of measures for their implementation are perfectly consistent with each other.

- Efficient mechanisms for resource coordination have been developed.
- Further development of monitoring, evaluation, impact assessment is needed.
- The institutional frameworks should be more stable.

The new programme of measures has defined the most important and realistically achievable tasks of the professional field **for 2009-2010**, grouped according to the priorities of the STI strategy: The Government Decision comprises 40 numbered measures that can be further broken down to sub-measures, meaning 56 tasks altogether. The tasks were implemented jointly by the ministries but one ministry has the main responsibility: Ministry for National Development and Economy-National Office for Research and Technology 27 tasks; Ministry of Education and Culture 20 tasks; Prime Minister's Office 3 tasks; Ministry of Justice and Law Enforcement-Hungarian Patent Office 2 tasks. By 14 tasks the deadline was extended due to the changes in the STI management system in 2009 and the financial austerity measures introduced because of the crisis. Out of 56 tasks, 25 tasks were fulfilled and 30 tasks were implemented in 2010; the financial conditions were missing in case of 1 task.

Measures of particular importance:

- Coordination of the national RDI resources by operating a Working Group for Resource Coordination and ensuring its new mandates. Creation and update of a funding map for applicants. Continuous overview on the situation of R&D funding programmes.
- Award of the title of research university for the outstanding universities by invitation of tender and provision of funding. Support for establishing innovation parks and cluster in the Pole Programme.
- Development of large R&D infrastructure (ELI), survey of the Hungarian strategic R&D infrastructure and elaboration of its development strategy (NEKIFUT).
- Priority funding for corporate and regional innovation by means of tenders and capital market instruments.
- Development of the international R&D co-operation, preparing for the R&D tasks of the EU Presidency.
- Amendment of the Act on the Hungarian Academy of Sciences.
- Support for the social acceptance of R&D.

The government noted the report on the implementation of the science-, technology- and innovation policy (STI) strategy and the report on the fulfilled 2007-2008 tasks of the STI programme of measures and their results and the report on the situation of the 2009-2010 tasks of the STI programme of measures **at its meeting on 27 April 2010.**

From May 2010 the guidelines of the **STI strategy** is specified by the Science and Innovation priority of the New Széchenyi Plan and the RDI part of the National Reform Programme, in accordance with the EU2020 Strategy, the Innovation Union initiative, the smart specialisation strategies (S3) and the principles of the Green Growth Strategy and Innovation Strategy of the OECD.

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