Through knowledge towards prosperity - Research and Innovation Strategy for Smart Specialisation of the Slovak Republic

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1 INTRODUCTION

The Slovak Republic has been an integral part of the European Union since 2004 and is a successful example of positive aspects of the European integration. Slovakia is very interested in increasing the effectiveness of integration and real cohesion which is reflected in general support of the society. The treaty on the European Union lays down that the Member States shall consider their economic policies and support of employment as a matter of common interest and shall coordinate them in the framework of the European Council.

The Europe 2020 strategy, approved by the European Council on 17 June 2010, is a strategy for employment, smart, sustainable and inclusive growth, constituting a coherent framework to mobilise resources, policies and coordinated action. The areas of innovations and energy are the initiating policies to start the EU potential for growth. The support of growth and competitiveness and, especially, dealing with deep imbalances as well as progress in structural reforms focused on unleashing domestic growth potential, inter alia through opening the economic competition in network industries, support of digital economy, use of the potential of ecological economy, removal of unnecessary restrictions imposed to service providers and facilitation of business start is a condition to increase competitiveness of the EU in the global competition.

In accordance with the effort to support the process of increasing the competitiveness of Europe and employment, the Member States have to intensify the efforts to progress in structural reforms. Better use of the European economic and industrial potential as a basic component of the growth and competitiveness programme is crucial. A strategic objective is the implementation of policies to support technological and societal innovations using the potentially strong areas and competitive advantages of particular regions and Member States.

Such orientation of policies can unleash a growth potential of the EU by supporting the innovations in all regions and ensure complementarity among support of innovations, research and development, business and information and communication technologies on the EU, national and regional levels. In the future period of a new multiannual financial framework the regional policy will become a key tool transforming the EU innovation priorities into local practical measures, especially in transitive economies.

The Communication of the European Commission No. 553 of 6 October 2010 lays down measures to achieve the objectives of the Europe 2020 strategy related to smart growth through regional policy and through its funding. The first measure to achieve the objectives of the Europe 2020 strategy, related to smart growth through regional policy and its funding, is elaboration of smart specialisation strategies. The aim is to concentrate resources to the most promising areas of comparative advantage, i.e. the current sectoral or cross-sectoral activities, ecological innovations, markets with high added value, existing networks or special research areas. In order to increase effectiveness and coherence of particular strategies, these areas are subject of international peer review. Based on these conditions and in order to achieve an effective cohesion policy, elaboration of smart specialisation strategies has become an ex ante conditionality in a draft legislation – general regulation for the European Structural and Investment Funds (hereinafter as ESIF) for the 2014-2020 period.

A basic precondition for the elaboration of a Strategy of research and innovation for smart specialization of the Slovak Republic (hereinafter as RIS3) is that it demonstrates its ability to strategically manage and concentrate permanently limited sources with the aim of sustainable development and develop the country in harmony with principles of smart, sustainable and inclusive growth in order to strengthen the competitive advantage of the Slovak Republic and the European Union as a whole. This is why the strategy and its implementation have to comply with the partnership principle, complex communication and participative preparation, approval, implementation, monitoring and evaluation of achieved results with the involvement of direct and indirect stakeholders.

Such a procedural approach has resulted in a vision, objective of which is **to drive a structural change of the Slovak economy towards growth based on increasing innovation capability and research and innovation (hereinafter as R&I) excellence to promote sustainable growth in income, employment and standard of living.**

The Slovak Republic is a small and very open economy. Its size is comparable to the size of regions in large EU countries. Due to this reason the concept of smart specialisation has not been applied in a formal regional dimension and remained only at national level. The presented strategy creates conditions for development of the Slovak Republic as a whole, while respecting regional specifications.

Structural changes are necessary due to the fact that, though the Slovak Republic in the framework of the European Union belongs to the most rapidly growing economies (its gross domestic product per capita in purchasing power parity increased from 47 % of the EU27 average in 1995 to 73 % in 2012), its competitive advantage was made by low taxes and labour price. In the international comparison the Slovak Republic still belongs to the countries with the lowest innovation performance, lagging behind the EU average considerably.

Slovakia permanently lags behind in the intensity of innovation activities on the level of enterprises, in expenditures for projects of research, development and innovation resulting in practice, in technology transfer, in the use of cooperation potential, patent activities, in cooperation of research institutions with industry, in the use of venture capital and in a number of aspects conditioning the effective use of human resources. There is still a low level of cooperation between the institutions of science and research, education and economy in development and growth of competitiveness of the industrial basis, in connection with creation of competitive innovative products, technologies and services.

The share of knowledge-intensive services in GDP and export, compared to other countries, is very low and the use of innovative processes in the areas services, creative industry and social sphere has started only in the recent years:

The area of research and innovations can be considered as a weak link in the Slovak economic system, which is demonstrated by long-term adverse trends (1989-2011):

- Decrease of total expenditure and the number of labour force and especially the decline of enterprise research. The number of labour force in research and development dropped from 60,548 to 28,596 and expenditures in research and development as percentage of GDP from 3.88% to 0.68% in the 1989-2011 period;
- Increasing share of public funding of research and innovation. The share of enterprises in total expenditures in research and development dropped from 69 % to 34 % in the 1993-2011 period;
- Loss of target-orientation and growth of “untargeted” general research without clear thematic priorities. The share of untargeted and general research increased from 38 % to 58 % in the 1993-2011 period;
- Increasing share of basic research at the expense of applied research: The share of basic research in the total funding of research and development grew from 22.6 % to 48.9 %, while the share of applied research decreased from 49.4 % to 24.6 % in the 1994-2011 period.

This situation requires adopting concrete, clearly formulated and quantified measures for the 2014-2020 period. New strategies and changes in state economic policies are necessary, especially in relation to the funding and management of education, research, innovation and support of business.

Due to the limited resources and capacities, the strategy concentrates on a limited number of priorities which are defined based on strengths and international specialisation of Slovakia. This fact has been reflected in orientation of particular investment measures so as to avoid fragmentation and to concentrate structural funds, public budgets and private resources on priorities with competitive advantage and with the highest development potential.

The presented document has been prepared on the basis of the methodological recommendations of the European Commission: Guide to Research and Innovation Strategies for Smart Specialisations, Regional Policy, European Commission, of May 2012.

Finally, it is necessary to mention that the period of validity of the National Strategic Reference Framework 2007-2013 (hereinafter as NSRF) was planned for a relatively extensive development. It was influenced by the 2005-2006 period of global economic growth. Links between the renewed Lisbon strategy and the cohesion policy were not systematically defined, there was relatively low flexibility of changes in documents and strategies which was manifested in impacts of the global economic and financial crisis after 2008, fully showing decreasing competitiveness of the European economies, which was however insufficiently reflected in the changes of the National Strategic Reference Framework and particular operational programmes. In the 2014-2020 period, the efforts have to be concentrated on a small number of priorities in order to maximise the effectiveness of ESIF resources as regards their contribution to growth, competitiveness, employment and convergence.

2 ANALYSIS

2.1 ANALYSIS OF SELECTED FACTORS OF THE SLOVAK ECONOMY

2.1.1 Sources of economic growth and nature of competitive advantage

The Slovak Republic in the framework of the European Union belongs to the most rapidly growing economies. The gross domestic product per capita in purchasing power parity increased from 47 % of the EU27 average in 1995 to 73 % in 2012. The pace of convergence to the EU27 average in Slovakia was faster than in other new member states from the Central Europe. A rapid convergence in gross domestic product rates per capita in Slovakia has been conditioned by a rapid growth of labour productivity. While in 1995 the labour productivity per hour in purchasing power parity in Slovakia was only 47 % of the EU27 average, in 2011 it was 73.8 %. Approximately one half of the labour productivity growth has been ensured by the total factor productivity (TFP). The contribution of TFP to economic growth in Slovakia was considerably higher than in the EU27 and similar to those in the Czech Republic, Hungary and Romania. A great share of TFP[1] in economic growth is associated with reducing technological gap through diffusion of knowledge from abroad. A great part of this diffusion has been made by foreign direct investments (FDI) of multinational companies. In 2011, the share of foreign direct investments in the total gross domestic product of the Slovak economy reached 57.4 %. This value was comparable to those in the Czech Republic (62.0 %) and Hungary (64.1 %). However, the foreign direct investments in Slovakia have not been accompanied by business investments in research and development. In the 2006-2011 period, the foreign companies invested in Slovakia annually on average EUR 2071 million of foreign direct investments, but their investments in research and development in this period made only EUR 19.7 million annually, which is less than 1 % of foreign direct investments.

A relatively high level of GDP per capita in Slovakia in the framework of the region can be seen from a different point of view when decomposing the GDP according to incomes. In the European Union 49 % of GDP on average goes to compensation of labour power, 39 % is made by gross operating surplus and approximately 12 % by production taxes. In Slovakia the share of salaries in GDP in 1997 was 43 %, but in 2012 only 37.5 % which was the third lowest in Europe after Bulgaria and Romania. On the other hand, in 1997 the share of profits in GDP was only 48 %, achieving 55.4 % in 2012, which was the second highest value in Europe. This was caused by a different tax structure in 1997 as well as by the policy of ''attracting'' FDI through tax stimuli. The type of competitiveness selected by Slovakia was based on low taxes and salaries instead of investments in research and development. This competitiveness style is not sustainable from the long-term point of view. So far, the growth of labour productivity has been achieved mainly by transfers of technologies and organisational innovations in the framework of multinational companies (MNC).

A competitive ability of countries is assessed on annual basis by a *Global Competitiveness Report* which is published by the World Economic Forum (WEF). The report monitors 12 pillars of competitiveness in 144 countries.

The Slovak economy achieves a strong position, both in comparison with the Central European economies and with the innovation leaders, only in the area of foreign direct investments and transfer of technologies. Increased arrival of foreign investments into the economy is demonstrated by the high level of a production process where the Slovak economy is ranked relatively well (34th position), when compared with the neighbouring countries.

[1] TFP – total factor productivity

In the indicator of the nature of competitive advantage the position of Slovakia among the V4 countries is the worst (115th position). From the point of view of this indicator the Slovakia's competitive advantage still depends rather on factors of prices and costs (labour costs, low taxes, tax stimuli and others) than on quality factors (e.g. quality of institutions, education system or national innovation system). There is a risk that after gradual (and naturally expected) depletion of competitive advantages in terms of prices Slovakia will not have any adequate quality factors of economic growth.

In innovation factors as a potential for innovations, quality of scientific and research institutions and expenditures for research and development or availability of scientists, Slovakia has a very poor position, occupying a ranking in the second half among 144 assessed countries. In these indicators Slovakia considerably lags behind even its neighbours.

A characteristic feature for the whole Central European region, including Slovakia, is considerable lagging behind in the indicator "governmental orders of technologically advanced products" (127th position). The public sector can stimulate development of domestic enterprise environment through demands for technologically advanced products.

There is a relatively poor ranking of Slovakia also in the area of quality of education in mathematics and nature sciences (83rd position). This is an important factor of human capital which determined future innovation development of any country.

When compared to reference countries of Central Europe there is a relative good availability of the risk capital in Slovakia (60th position). This indicator assesses availability of the risk capital instead of its use, which belongs to the poorest in Europe, as we had mentioned in the previous text above.

2.2 TRENDS IN EXPORT SPECIALISATION

2.2.1 Basic trends in development of the Slovak export

The economy of Slovakia is small and very open. The share of export of products and services in the gross domestic product grew in the 1995-2012 period up to 95.4 % (Graph 1). The openness of our economy has increased dramatically, especially after 2000 in relation to introduction of economic reforms, global economic growth and position of the Slovak Republic as a future EU member state. Further significant growth appeared after 2005 with arrival of large foreign investors in the sectors of automobile and electronic industries. At present, Slovakia achieves a high rate of integration in global networks of trade in goods and services.

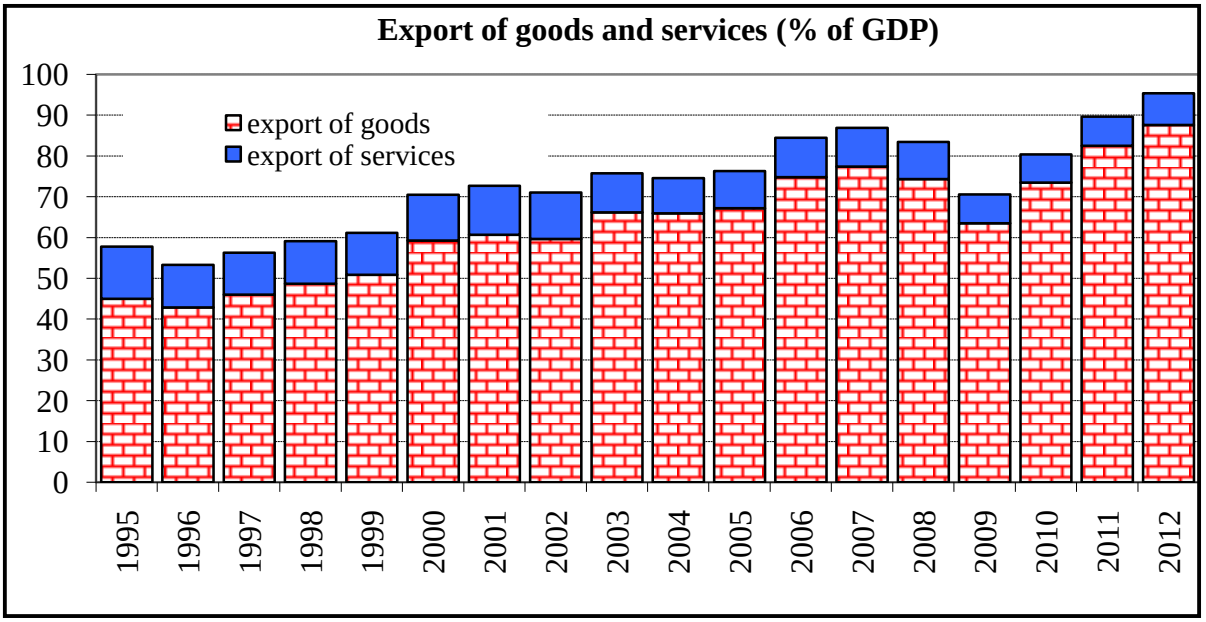
2.2.1.1 EXPORTS OF GOODS

In the 1997-2011 period, a clear trend towards specialisation in certain product types could be seen in the Slovak export of goods:

- the share of eight most important product classes in the total export increased from 53.5 % to 73.9 %,
- the share of three most important product classes (84 – Nuclear reactors, boilers, machinery and mechanical appliance, parts thereof, 85 – Electric machinery, equipment and parts thereof and 87 – Vehicles other than railway and tramway rolling stock and parts and accessories thereof) increased from 26.0 % to 53.2 %.

In 2011, more than a half of the Slovak export was made by only three product classes. The most rapid growth was recorded in the class 85 – Electric machinery and equipment (from 7.0 % to 29.0 %). In 2009, the share of this class in total exports achieved as much as 25.8 %. However, this sector showed to be relatively vulnerable in the crisis.

Graph 1 *Integration of the Slovak Republic in the global network of trade in goods and services (exports as % of GDP).*



Source: *Statistical Office of the Slovak Republic: Slovstat database, National Bank of Slovakia: Statistics of payment balance.*

Of other important export sectors, there is decreasing importance of export of iron and steel (the share in total exports decreased from 12.4 % to 6.0 % in the 1997 – 2011 period). There are more or less stable shares in exports in the sectors connected to the automobile industry, as rubber production (2.3 % versus 2.4 % in the 1997-2011 period), plastics (4.4 % versus 3.3 %) and products from iron and steel (3.8 % versus 2.7 %).

A competitive advantage of Slovakia in the major export markets (the European Union, China and Russia) can be characterised by indexes of export specialisation. The Balassa index of revealed comparative advantage (RCA^2) indicates that, comparing to the EU27, most of the Slovak advantages are concentrated in export of automobiles (RCA = 1.628), consumer electronics (RCA = 5.005), electronic machinery and equipment other than consumer electronics (RCA = 1.131) and iron and steel (RCA = 1.832). Slovakia has a moderate advantage also in export of machinery and equipment (RCA = 1.041).

2.2.1.2 EXPORTS OF SERVICES

In the 1995-2012, services recorded a relative decrease of importance in the Slovak exports. It is given by growing importance of exports of automobiles and motor vehicles, on one hand, and by stagnation of income growth from export of services in tourism and transport, on the other hand (including incomes from transit of oil and gas).

In 2011, the share of knowledge-intensive services in cash-ins of the current account of payment balance was 48.13 % in the EU27 and only 23.13 % in Slovakia. The Balassa index of revealed comparative advantage indicates that, comparing to the EU27, most of Slovak advantages are concentrated mainly in export of services with low level of added value. The structure of service export in Slovakia was dominated especially by transport services (31.3 %, RCA = 1.54) and tourism services (36.7 %, RCA = 1.84). In the framework of knowledge-intensive services Slovakia lags behind in cash-ins for services in research and development (RCA = 0.79) and for services in advertisement, marketing and design (RCA = 0.82). However, Slovakia holds a relatively good

[2]RCA index higher than 1 indicates a comparative advantage and specialisation of a given country in certain goods or service comparing to the EU27. Index lower than 1 indicates that the country export in the given commodity is less than the average for the entire group.

position and above-average specialisation in the area of computer and information services (RCA = 1.15). The share of these services in total exports of the Slovak services still grows, from 0.37 % in 1996 (first available data) to 8.67 % in 2011. Slovakia was successful in exporting computer and information services to the USA, where as much as one fourth of exports was oriented in the 2008-2011 period. The trend in other commercial services was adverse, as their share in the total export of services dropped in the 1996-2011 period from 22.4 % to 14.9 %.

Further development of information and communication technologies will be supported by implementation of the Strategy for further development of digital services and infrastructure of access network of a new generation in Slovakia. It will create conditions for development of the sector of information and communication technologies through public procurement of technologically developed solutions. The digital economy will directly affect the implementation of the Smart Specialisation Strategy through application of the following measures:

- involvement of the Slovak citizens in building and improving the system (e.g. through ensuring a general access to broadband internet which will enable their effective participation in the single European market),
- effective provision of electronic services to citizens and entrepreneurs,
- gradual transfer of the public administration (eGovernment) to a smart public administration (Smart Government).

2.2.2 Technological complexity of sectors

Importance of particular sectors for the Slovak economy should be assessed also from the point of view of technological complexity of their production, since there is a clear connection between the technological level of the society and the living standard of population. Sectors with higher technological complexity of production are able to achieve good results on foreign markets due to high quality (and not only due to low prices), create higher added value and lead to technological development of a given country.

When comparing the shares of technologically intensive production of the processing industry in its total production, Slovakia achieves slightly above-average values both in high technologies (13.7 % compared to 9.6 % in the EU27) and in medium-high technologies (40 % compared to 33.1 % in the EU27). The Slovak economy is significantly specialised in the area of industry, especially in the area of industrial production with Medium-High Technology Manufactures (MHTM) with localisation quotient 1.80 and Medium-Low Technology Manufactures with localisation quotient 1.70 (MLTM). In the EU27 approximately 4.5 % of labour force works in the industrial production with medium-high technology, whereas in Slovakia this share is 8.1 %. Slovakia is the third most specialised economy in this area in the EU. In Slovakia almost 65 % of this production is created by production of motor vehicles and spare parts thereof. Such a high share in the production demanding medium-high technologies can be seen in no other EU27 country. Similar situation is in the case of industrial production with medium lower technology where in the EU27 the share in the total employment is on the level of 4.4 % and in Slovakia 7.5 %, which makes 176 thousand workers.

Production of pharmaceutical products and preparations makes in the EU27 roughly 38 % of the total production in the processing industry demanding high technologies. In Slovakia the share of production of pharmaceutical products and preparations in the high technology group is only 4.4 %.

When assessing the share of knowledge-intensive services in business services, Slovakia belongs among the countries with lower share of these services. Of 39.6 % share of these services in Slovakia the knowledge-intensive services with high technologies make only 12.6 % (average in the EU27 is 15.7 % in total business services).

The share of research and development services in knowledge-intensive services related to high technologies is 5.2 % in the EU27, while in Slovakia it is only 1.7 %.

The above mentioned facts show that the prosperous countries of the Western Europe are technologically more developed and have a higher share of advanced technologies in economic activities. Slovakia should create conditions for further technological convergence also through development of its own technological solutions and not only through purchase of foreign technologies, especially from developed countries.

2.2.3 Energy mix

There is a balanced proportion of nuclear fuel and fossil fuels in domestic energy consumption in the Slovak Republic. The shares of individual resources in gross domestic consumption in 2011 were as follows: natural gas 26 %, coal 22 %, nuclear fuels 22 %, oil 21 % and renewables including hydropower plants 9 %.

Situation in energy and fuel supply in Slovakia

The total consumption of fuel in Slovakia decreases from a long-term point of view. In 2011 it was 7,500 kilotonnes (kt). The decrease of consumption is 15.6 % during recent four years. Especially, there was a considerable drop in the import of black coal. Domestic production of brown coal and lignite is roughly 2,300 kt per year, consumption at the level of 3,000 kt. The total extraction reached 2,376 kt in 2011 and 2,292 kt in 2012 – the decrease is 3.5 % which is compensated mainly by import from the Czech Republic. The production of domestic brown coal is almost exclusively used to produce electricity and heat in Elektrárne Nováky power plant (ENO) because the extraction is closely linked to the operation of this power plant.

A main source of our oil industry is oil imported from Russia and Azerbaijan. The current oil transport is on the level of 10 – 11 million tonnes per year. Of this amount, 6 million tonnes are supplied to Slovakia and the rest goes to refineries in the Czech Republic and a small volume for other costumers. Domestic consumption of natural gas in recent years decreases and is at the level of 6 – 5.2 billion m^3. The consumption level was 5.4 billion m^3 in 2011 and 5.2 billion m^3 in 2012. The domestic extraction covers approximately 2 % of consumption of natural gas.

Biomass has the biggest potential as a renewable resource with a theoretical potential of 120 PJ, which is 15 % of energy consumption in the Slovak Republic. Hydropower plants play an important role in our energy industry, covering 17 – 19 % of electricity consumption. At the end of 2011 the installed output of photovoltaic resources reached approximately 500 MW. Geothermal energy is currently used only to heat some buildings and greater development of geothermal power plants is not expected before 2020. Roughly 6.8 % of municipal waste was used for energy production in 2009 which is a low value. This situation is due to the legal constraints applied to the use of wastes for energy production in private incinerators.

Electricity supply in Slovakia is reliable due to the constant optimal structure of the production basis and a well-built network system. After completing two blocks in the Mochovce nuclear power plant in 1998 and 2000 Slovakia became independent in electricity supply and by 2006 it even exported the electricity. After the decommissioning of V-1 block in Jaslovské Bohunice nuclear power plant in 2006 and 2008 and other units in heat power plants Slovakia became dependent on the import of electricity at the end of 2006. The installed output of power plants in 2012 grew by 279 MW (3.4 %) and reached 8,431 MW. Maximal capacity increased by 2.6 % and reached the value of 4,395 MW. The share of carbon-free production of electricity is at the level of 74 % of total production.

Energy intensity in the 2001 – 2005 period (12.158 TJ/million EUR) decreased in 2008 by 31.5 % and by even 33.2 % in 2009.

Development of absolute consumption in the industry has been decreasing since 2001. The interannual decrease of energy consumption in the industry in 2008 and 2009 was 13.65 % which was caused by reduction of energy intensity of operations, transfer of new, energy-saving technologies and crisis. These savings have been reached due to investments into innovations and competitiveness growth and were financed especially from private sources, partly from the EU sources and partly from the state budget as investment stimuli. The highest savings were reached in the machinery industry (automobiles) and in the food industry. There are especially high savings in the industry sector in the two periods.

The total consumption in the service sector fluctuated in the 2001 – 2009 period with a moderate growth since 2007. Non-electric consumption decreased since 2000, but grew again after 2005 which can be explained by growing quality and extent of services provided – increasing number of entities providing services. Electric consumption decreased moderately by 2004, there is a growth recorded after 2005. The two indicators showed savings of energy when compared to the 2001 – 2005 period which can be explained by introduction of energy saving devices and lightings in this sector.

Research and development in the energy sector

Slovakia has been actively involved in the international activities in the area of research, development and innovations in the form of bilateral agreements on cooperation in science and technology with the EU and non-EU countries. Slovakia is an IEA member through agencies of universities and the Slovak Academy of Sciences and takes part in the cooperation in the framework of the Seventh EU Framework programme and EURATOM.

Support of science and research is one of the priorities of the EU Strategy by 2020. The European Commission has adopted a strategic document „Strategic Energy Technology Plan“ (SET plan) which constitutes a technological pillar of the EU energy policy. One of the industrial initiatives concerns the nuclear energy. Within this initiative Slovakia takes part in the Allegro project which is a tool of cooperation in the area of nuclear energy among Slovakia, Hungary, the Czech Republic and France.

2.2.4 Potential of Slovakia in raw materials

Along with several exemptions, Slovakia is not very rich in raw materials to satisfy its economic needs. Therefore, it is necessary to concentrate available resources and science and innovations into those areas where Slovakia has sufficient resources in the European context.

Water resources:

The sustainable development strategy mentions that availability of water resources is one of global problems of the world[3]. At present, Slovakia has a relatively good access to water resources. However, it is necessary to use water as a strategic resource and address the water issues as a question of national security. With continuing climate change, it is expected: reduction of water resources and average annual runoffs, growth of variability of average annual flow rates and increasing runoff extremes and considerable reduction of groundwater resources. From the point of view of adaptation to climate change it will be necessary to take measures focused on landscape revitalisation (e.g. construction of dams, reservoirs and regulation of riverbeds). In the water management sector there will be decreasing employment despite increasing production. The analyses of consequences of climate change and potential adaptation measures show that reduction of employment will be accompanied by the gradual growth of labour productivity. If no adaptation

[3]National Sustainable Development Strategy(adopted by the Government on 10 October 2001)

measures are implemented, we can expect almost 5% decrease of production in 2050, when compared to the basic scenario[4].

Magnesite:

The Slovak economic reserves and potentially economic reserves of magnesite are estimated at 1,157 million tonnes[5]. At the current level of extraction in the most important Slovak deposit site in Jelšava it will be possible to produce magnesite for more than 100 years. The extracted raw material is processed in processing plants to semi-products – brick magnesite, steel magnesite, alkali heat resistant materials, caustic magnesite, crushed magnesite – or final heat resistant construction materials are produced. Production of magnesium in Slovakia, using magnesite as an input raw material, would be very important both for Slovakia and the European Union. In the 2001-2012 period, consumption of magnesium doubled and 7% inter-annual growth is expected in the forthcoming years. Almost a half of global production of magnesium (803 kt in 2012) is used in Europe. **The European Union has declared magnesium as one of 14 critical elements with high import risk due to the total dependence on supplies from non-European regions and high consumption.** Of the total production (756 thousand tonnes in 2011) almost 87% of magnesium is produced in China. China uses only obsolete, environmentally unfriendly and labour-intensive thermic reduction, which is however much cheaper when compared to the modern electrolytic method. In order to make decision on production of magnesium in Slovakia it will be necessary to work out an independent feasibility study. The study will have to assess whether it is possible to introduce in Slovakia a production technology able to be competitive with the Chinese technology and to assure resource security of the EU, while complying with the European environmental and other legal requirements and quality standards applied to the final product. It is also necessary to assess the barriers to be overcome in order to accept magnesium and products thereof produced in Slovakia from the side of consumers, especially in the automobile sector.

Wood:

The Communication of the European Commission to the Council and the European Parliament on innovative and sustainable wood processing industry mentions that the wood processing industry in the EU **with production in the value of EUR 365 billion and added value approximately EUR 120 billion provides more than 3 million jobs in 344 thousand enterprises**. It plays an important role in preserving the employment in rural areas. The wood processing industrial sectors are generally competitive and are world leaders in many areas. However, they face many problems, especially when it comes to access to raw materials, innovations, trade in forestry products and information.

The wood processing industry in Slovakia currently produces goods in the value of **EUR 3 billion annually and provides approximately 40 thousand jobs**. It is an important factor of sustainable employment in rural areas. In the 2000-2011 period, the wood supply grew roughly by 50% (from 6 million m^3 to 9 million m^3). Export of wood (in absolute figures) grew in this period from **1.3-2.6 million m^3 to 2.6 million m^3 in 2009 and 2011,** which is a doubled value. It is necessary to mention, however, that these facts relate to export of raw wood and that means that the state is losing tax incomes from wood processing with adverse impact on creation of stable jobs and rural development.

Taking into account the potential and tradition of wood processing as an ecologically friendly and renewable raw resource, the domestic forest and wood processing sector has an ambition and conditions to become an important sector of the Slovak economy. It also contributes to mitigation of climate change by storing carbon in forests and by using the wood instead of non-renewable resources.

[4]Nejedlík, P. a Minďaš, J. (2011): Dôsledky klimatickej zmeny na možné adaptačné opatrenia v jednotlivých sektoroch, Slovenský hydrometeorologický ústav, Projekt OPŽP-PO3-08-5 ITMS 24130120015.
[5] Štátny geologický ústav Dionýza Štúra. Nerastné suroviny SR 2009. Špišská Nová Ves - Bratislava 2009.

2.2.5 Embeddedness of the most important sectors in the Slovak economy

Connection of the most important sectors to the domestic production, i.e. helping in development of domestic economic activities of major sub-suppliers, is an important parameter of development of the society showing their connection with the economic and social framework of the country. Only in the case of the sufficient rooting of export-intensive sectors in the structure of economy it is possible to use and develop this potential.

In an ideal case the sectors, to which the country is specialised in export, are (a) lucrative from the point of view of high added value, (b) well rooted in the production structure of economy and (c) linked to other sectors of the national economy.

The main export sectors of the Slovak industry are characterised so far by a high rate of intermediate consumption and low rate of added value (production of motor vehicles 13.8 % in the 2007-2009 period, production of computer, electronic and optical products 13.2 %, production of metals 28.4 %, production of metal structures 38.5 %, production of coke and refined oil products 13.4 %, average level of added value in the Slovak economy 40.7 %). In the monitored period the share of added value in the total production did not grow significantly in any of monitored sectors. In services there was a positive trend in growing importance of export of computer and information services.

In absolute volumes the export is dominated by goods, especially motor vehicles, articles of consumer electronics and metals and metal structures. Input-output analysis for the 2007-2009 period indicates that especially sectors of production of motor vehicles and consumer electronics are still more and more integrated into the production structures of the Slovak economy, i.e. their complex import intensity is decreasing. Strengthening position of these decisive export sectors in the Slovak economy

- has positive effects on employment and economic growth,
- reduces risk of economic collapse in the case of departure of important foreign investors from Slovakia,
- contributes to the employment growth.

The analysis of inter-sectoral flows of goods and services indicates that the main export sectors are mutually relatively well interlinked in the framework of networks of suppliers and customers and also to other, medium-important sectors (production of rubber and plastics, production of machinery and equipment, production of electric machinery, production of metal articles and structures). This is a traditional example of interlinked complementary functions which are combined in production of complex articles, such as automobiles or consumer electronics.

From the point of view of the smart specialisation it is appropriate to focus on further development of complementary sectors linked to production of automobiles and consumer electronics and increase their added value. Increasing added value can be supported also by the research, especially in the area of metal and non-metal materials. These are priority areas in the field of material research and industrial technologies (transport, machinery, electronics). An important priority is constituted also by information and communication technologies which are still better sold both as a separate article and as a complementary input in production of automobiles and consumer electronics (e.g. navigation software, management systems, communication systems, etc.).

2.2.6 Linking the priority sectors to research and knowledge intensive services

Slovakia belonged in 2011 in the EU27 among the countries with the lowest share of the enterprise research and development in the gross domestic product – only 0.2 % of GDP (EU27: 1.9 % of GDP). Very low enterprise expenses were reflected in Slovakia in very low inputs of research and development in the production of key

sectors, both in absolute and relative figures. In the largest Slovak sector – production of motor vehicles – the input of research and development was EUR 20.3 million annually (on average), which is approximately 0.2 % of total inputs in this sector. In absolute values, this input was roughly 10 times lower than in the main competitors of Slovakia in production of automobiles (Czech Republic and Hungary). A slightly better situation of Slovakia was in production of electric machinery and equipment. The average annual input of research and development in the 2007-2009 period was EUR 11.8 million which was the second highest in the region after Hungary. The total input intensity (0.2 % of total inputs) was, however, very low.

As regards inputs of the knowledge-intensive services (sectors NACE J62-63, M69-75), after deduction of research and development services, the input volume of knowledge-intensive services in Slovakia is comparable with the Czech Republic and Hungary. The classes M69 (legal and accounting activities), M70 (management consultancy activities) and M71 (architecture and design) are dominant in all countries compared in inputs into key sectors. When compared to other competitors, Slovakia has higher inputs of services in classes J62-63 (computer and information services). For Slovakia it will not be simple in a short time to get to the level of the Czech Republic and Hungary in expenditures to industrial development and research.

However, Slovakia is relatively competitive in the area of inputs of the knowledge-intensive services for the key economic sectors, especially in the area of production of motor vehicles, consumer electronics, machinery and equipment and metals.

The strengthening position of the sectors has to be supported by implementation of proper mechanisms, especially in the area of research, development and innovative activities.

2.3 INNOVATION ENVIRONMENT IN SLOVAKIA

2.3.1 Evaluation of innovation performance

From a long-term point of view, Slovakia according to the Innovation Union Scoreboard (IUS) international comparison belongs to the EU countries which lag behind the EU average in the innovation performance. Of 27 EU countries, Slovakia occupied the 20th position in 2011 and still belongs to the group of so-called moderate innovators with the second lowest innovation performance in the group. In order to be more specific, we would like to mention that Slovakia belonged to the countries with the highest growth of innovation potential in the 2010-2012 period (19.9%) till the entering into force of the Europe 2020 strategy

According to a more detailed breakdown by NUTS II regions in 2011 (Regional Innovation Scoreboard 2012), the Bratislava region belongs to moderate innovators with high performance (stable position since 2007, except 2009), the Western and Central Slovakia belongs to moderate innovators with medium performance (in 2007, the Western Slovakia had high performance while the Central Slovakia low) and the Eastern Slovakia belongs to moderate innovators with low performance (since 2007).

According to IUS the first dimension for innovation performance assessment is sources divided into human capital and financing. The positive aspect of innovation development is a high share of PhD graduates (3.1 per 1,000 inhabitants in age 25-34, but with insufficient representation of technical and nature sciences) and a share of young people with completed secondary education (93.3 %). In these two indicators Slovakia achieves the best position within the whole EU. A worse situation is in the share of population with higher education in age 30-34 where Slovakia occupies the 24th position in the EU (23.4 % of population in age 30-34 with completed higher education, but with an anticipation of reaching the EU 2020 Strategy goal of 40 % in the year 2020).

Quality of the system of science and research in Slovakia lags behind considerably in several criteria according to the IUS assessment. Slovak science is considerably enclosed. The degree of involvement into the

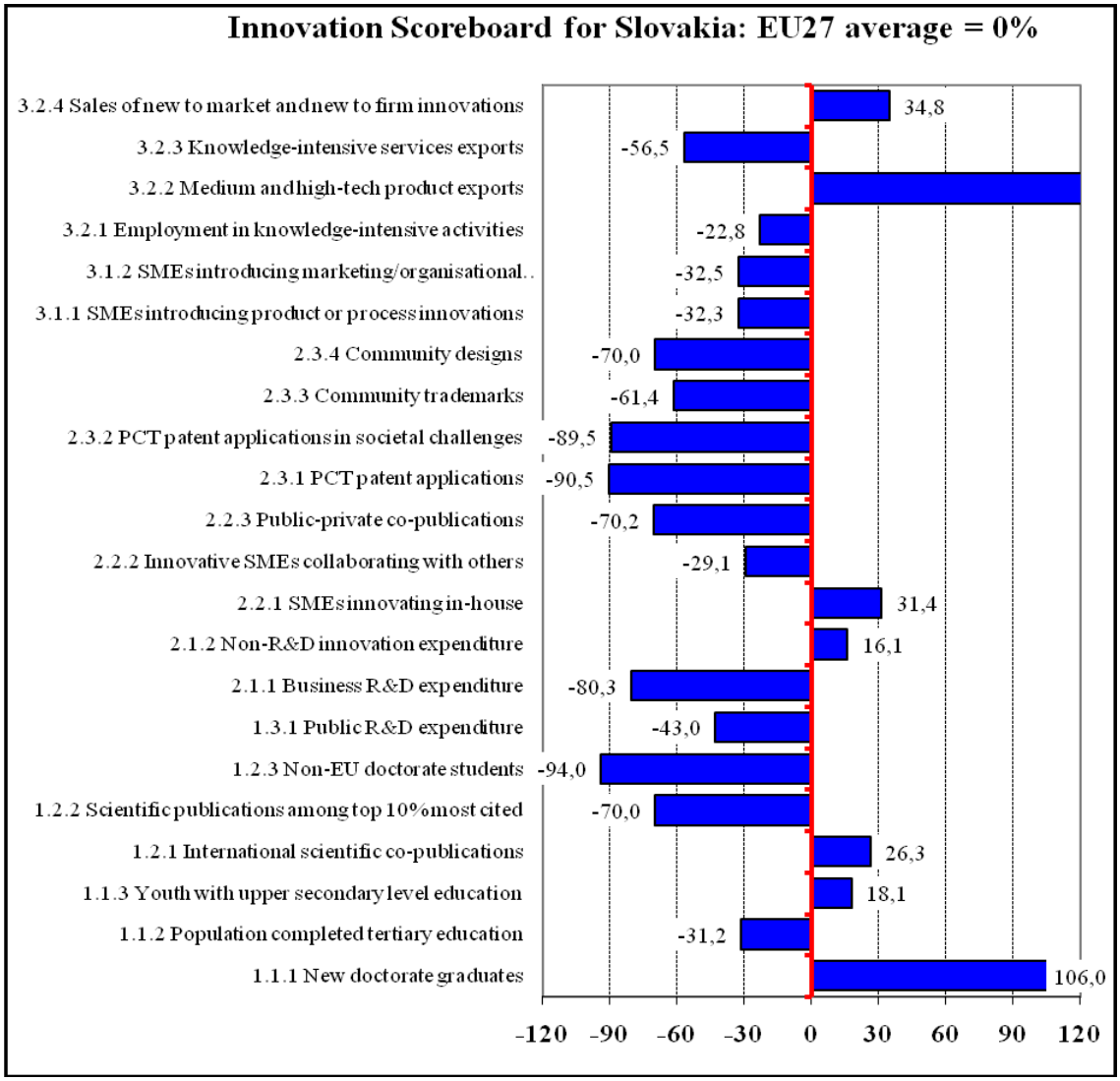
international research context is low as well as the amount of most cited scientific publications. On the other hand, as regards the number of international scientific publications with at least one co-author from a non-EU country, Slovakia is above the EU average (379 publications in Slovakia versus 300 publications in the EU) which is caused mainly by considering publications in Slovak language in the Czech Republic as international scientific publications.

In the area of funding the innovations, Slovakia from a long-term point of view can be characterised by insufficient use of risk capital. The reasons are the insufficient competitiveness of this tool as well as its problematic application into practice. In 2010, the amount of invested risk capital made 0.03 % of GDP, while in the EU the investments of risk capital are six times higher (0.2 %).

The second dimension of assessing the innovation performance is enterprise activities. Unsatisfactory situation is first of all in the area of intellectual property where we are lagging behind the EU average, neighbouring economies and the European innovation leaders, especially in the area of patents. The countries like Finland or Sweden create almost 25 times more patents than Slovakia (measured per a billion of GDP). This adverse situation in the area of forms of intellectual property can be partly explained by a comparison of two IUS indicators – enterprise expenditures in research and development and expenditures in innovations which are not related to research and development. The Slovak enterprises prefer purchase of ready-to-use technologies (in OP Competitiveness and Economic Growth or OP Bratislava Region it is mostly the support for acquiring the CNC machining line), external knowledge or external research and development (0.65 % of turnover of enterprises in Slovakia versus 0.56 % of turnover of enterprises in the EU) against enterprise expenditures in their own research and development (0.25 % in Slovakia, 1.25 % in the EU).

There is a low level of patenting in Slovakia (also) due to the fact that enterprises invest insufficiently in their own research and development and buy ready-to-use technologies and knowledge instead. The reason of this reality is that the present multinational companies carry out these activities mostly in their home countries.

Graph 2 *Indicators of innovation performance of Slovakia according to Innovation Scoreboard 2012*



The innovation development is also linked to mutual cooperation of enterprises with research and education institutions, creation of partnerships, clusters and enterprise networks. In the share of innovative small and medium enterprises (SME), cooperating in innovation activities with other stakeholders, Slovakia reaches the value of 8.3 % of all SMEs (the EU average is 11.7 %). We are lagging behind the developed countries in this indicator, but our value is higher than that in Poland and Hungary. The IUS measures the cooperation among enterprises and public research and development organisations through co-authorship of scientific publications. In this indicator Slovakia achieves only one-third performance of the EU (15.7 publications per a million of inhabitants in Slovakia and 52.8 publications per a million of inhabitants in the EU) and a half of performance in the Czech Republic and Hungary (but three times higher than Poland).

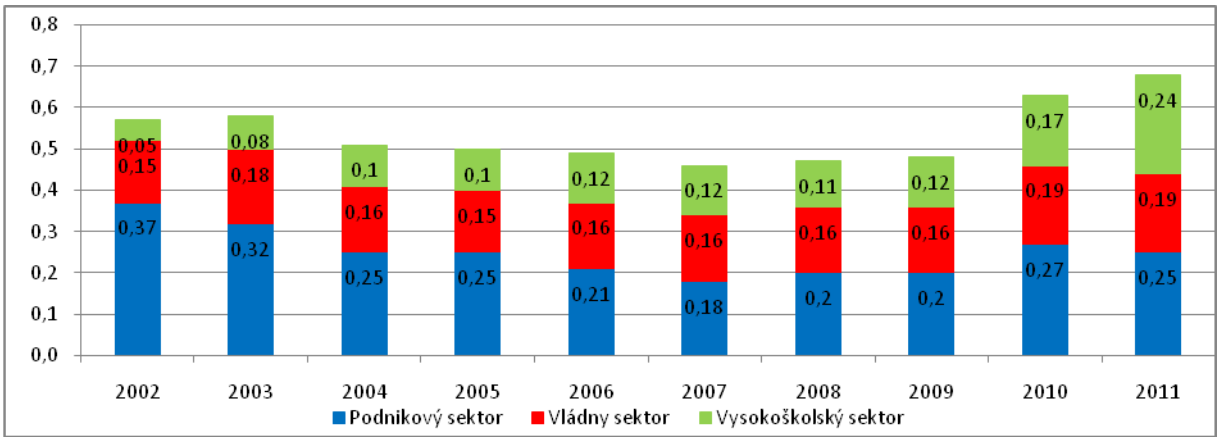
The third dimension of innovation performance is represented by economic effects of innovations. Of the analysed indicators, Slovakia achieves a relatively best position in the contribution of export of medium-high and high technologies to the trade balance (4.35; the EU average is 1.28), where it occupies the 6th position in the EU, and in the sale of products which are new on the market and new for a firm (as % of turnover), where we are the second in the EU with the value of 23.3 %. The worst situation in the economic effects is in the indicator of incomes from the sale of licences abroad where Slovakia according to the IUS achieves minimal values. Incomes from the sale of licences for patents are directly linked to the low patent generation of the domestic research and development.

2.3.2 Funding of research and innovations

From the point of view of expenditures on research and innovations Slovakia permanently provides insufficient resources in this area. One of the reasons has been the selected form of privatisation of large companies when research and innovation departments have been separated and privatised which has led to their separation from practice. In the previous decade, the total expenditures for research and development were roughly 0.5 % of GDP, growing to 0.6% in recent years (in 2011 it was 0.68%). This growth has been made by growth of capital expenditures for appliances and equipment which can be caused by the use of the structural funds in research and development. In the 2010-2011, resources for wages and social and health insurance funds increased significantly which was caused mainly by the change in the accounting of costs by public universities. When comparing the total expenditures for research and innovations in other European economies (2.03% of GDP in 2011), Slovakia belongs to the countries with the lowest expenditures. An important part of public sources in research and innovations covers expenditures of basic research without connection to economic performance of the country.

The share of business expenditures in research and innovations is roughly 0.25% of GDP (2% of GDP in developed economies). In Finland this figure in 2011 was 2.67%, in Sweden 2.34%, in the Czech Republic 1.11% and in Hungary 0.75% (Eurostat, 2013). The reason of this reality is that the present multinational companies carry out research and innovation activities mostly in their home countries. However, the Slovak companies and medium enterprises intensively develop their research and innovation and intend to build research and innovation centres in Slovakia.

Graph 3 *Structure of expenditures in research and development in Slovakia by sectors (% of GDP)*



podnikový sector – business sector; vládny sektor – governmental sector; vysokoškolský sektor - universities

Source: *Internal compilation based on EUROSTAT data (2013)*

If we look at the structure of expenditure in research and development (in terms of resources), we can observe two main trends: the dominance of the public sector (in 2011 the Slovak public sector funded R & D expenditure of the amount of 0.34% of GDP) and increasing share of foreign sources; while there is the significant impact of EU structural funds, which in 2011 accounted for 60% of all foreign sources of R & D expenditure flowing to Slovakia. The following parameters in terms of RIS3 development can be considered as critical:

- inappropriate structure of PhD graduates with an insufficient share of technical and scientific fields,
- low number of excellent research teams,
- low amount of total R&D expenditure and orientation of the R&D ,
- insufficient innovation activity of SMEs,

• insufficient cooperation among innovation stakeholders (especially as regards companies; R&D departments),

• low representation of knowledge-intensive activities in the economy,

• low patent activity.

2.3.3 Tools of funding of research and development

Tools to support research and development under the existing legislation are as follows:

National programmes are conducted pursuant to the Act 172/2005. Ten national research and development programs in accordance with the priorities of the state science and technology policy were approved by the Government. This instrument pursuant to the Act has been in force since 1 July 2005.

Slovak Research and Development Agency (hereinafter referred to as SRDA) supports research and development programmes in accordance with Act 172/2005. Agency programmes are approved by the Government after consultation of the Government Council for Science, Technology and Innovation. By 31 December 2012, SRDA through a grant scheme supported 22 projects in the amount of EUR 1,023 thousand. The SRDA will be transformed to become a more effective institution, coordinating its activities with the Agency for EU structural funds (hereinafter as ASFEU). In the 2014-2020 period there are planned expenditure on operations and programmes of SRDA in total sum of EUR 316 million. This tool will be now tripled which assumes more effective activity.

Incentives for research and development are provided to entrepreneurs in accordance with the Act 185/2009 on incentives for research and development as amended to deal with R&D projects with the aim to base their development and business plans on the results of research, development and innovation, to extend the staff capacity of R&D, as well as to increase investment in research and development. Totally, 16 subjects were supported with the amount of EUR 7,500 thousand. In the 2014-2020 period, expenditures on R&D incentives in total amount of EUR 108 million are planned. It is an essential tool for promoting business sector. That sum should be doubled by 2020.

Grants to legal persons and natural persons are provided in accordance with the Act 172/2005 on the organization of state support for research and development by the central state administration bodies (hereinafter as CSAB). This tool was introduced on 1 July 2005. In the 2014-2020 period, the budget for R&D is planned at the sum of EUR 115 million.

Grants for scientific and technical services are provided in accordance with the Act 172/2000 on the organization of state support for research and development. Grants may be provided from the state budget for activities of legal persons and natural persons - entrepreneurs to support research and development. Providers may be central state administration bodies or the Slovak Academy of Sciences. The grant is state aid. In the 2014-2020 period, the budget for scientific and technical services is planned in total sum of EUR 73 million.

EU funds resources are in the programme period 2007-2013 a key source of financing for R&I (OP R&D, OP Competitiveness and Economic Growth, OP Bratislava Region) and an important source of financing in the field of education (OP Education).

Operational Programme Research and Development

Operational Programme Research and Development (hereinafter as OP R&D) plays the role in modernising the system of support for research and development and improvement of infrastructure in order to increase the competitiveness of the economy, reduce regional disparities, create new innovative (high-tech) SMEs, promote creation of the new jobs and improve the conditions of the educational process at universities. By 31 May 2013, more than EUR 1,118 thousand were contracted, which is 81.91% of the total allocation. The total number of projects is 485. Effectiveness can be increased by introduction of rules on coordination and communication between the management authority and the implementing agency ASFEU and communication with SRDA. The following weaknesses have been identified in the process of implementation:

- Insufficient connection to state policies of research and development and relative separation of the Operational Programme Research and Development;
- Missing strategy of implementation for the entire programming period related to the objectives of the Operational Programme Research and Development; low rate of complementarity and synergies in the

process of implementation of the Operational Programme Research and Development and activities and initiatives of the European research area;

- Excessive administrative burden imposed on the applicants for a non-returnable financial contribution;
- Inappropriate set of indicators;
- Existing barriers between individual projects, especially ban on the use of infrastructure built in one project in other activities of the applicant, including the use in international projects;
- Inappropriate rules of state aid which do not allow to use the infrastructure built from public resources to meet the needs of industry and practice. The same applies on the rules of the use of this infrastructure by public operators for payment;
- Criteria for project assessment are not transparent; there is an absence of the assessment of the quality based on previous results and result indicators;
- Conditions do not motivate public research and scientific institutions to involve business sphere into its own R&D and to obtain private financial resources;
- Absence of long-term financing.

Positive effects of projects funded by the Operational Programme Research and Development:

- building a basic public infrastructure and reduction of long-term lagging;
- increasing potential for involvement in international projects of research and development;
- starting the bottom-up process of identification of strong thematic orientations of the Slovak science and technology that the industry is interested in;
- definition of priorities and linking the scientific teams allowed the universities and the Slovak Academy of Sciences to start building the science parks and research centres of national importance.

Operational Programme Education

Operational Programme Education (hereinafter as OP E) plays the role of ensuring long-term competitiveness of Slovakia by adapting the education system to the needs of the knowledge society. Through the grants from the European Social Fund it supports the formation and promotion of human capital in the acquisition of basic skills and key competencies needed in the knowledge economy and the labour market. Demand-oriented projects carried out by ASFEU do not exceed EUR 2 million. By 31 May 2013 there was contracted EUR 565 345 874.13, which is 101.60% in relation to the total allocation. The total number of projects is 832. Weaknesses of implementation:

- Insufficient support of professional education, natural sciences, practical skills (changes appeared in 2012 which is not sufficient, taking into account the needs to harmonize the education with the needs of labour market),
- Insufficient support of the life-long education area as a tool for increasing competencies and an area of education of persons with specific needs (due to various handicaps).

Operational Programme Competitiveness and Economic Growth

Basis of the Operational Programme Competitiveness and Economic Growth (hereinafter as OP CaEG), the Managing Authority of which was the Ministry of Economy, was a priority axis 1 "Innovation and growth of competitiveness". So far 456 projects were supported through non-returnable financial contribution contracts, which is cca EUR 395 million, including 83 new enterprises on the whole Slovak territory.

The projects resulted in the increase of innovations of technologies and products in enterprises and services, prototypes and tests, innovations of management systems, etc. Almost 2,000 new jobs were created. As the projects continue, 2,000 further jobs are expected in the future.

In the framework of the measure "Innovation and technology transfers", which was oriented to innovation and technology transfer, 403 projects were supported, including 376 projects of small and medium-sized enterprises. These enterprises were particularly interested in the purchase and restoration of technology park.

The measure is very popular and used by businesses, but the sources were not used only for the purchase of high-tech technologies. This situation is mainly due to the current status of technology companies in Slovakia and that is why the measure is evaluated as positive.

Within the measure "Support of innovation activities in enterprises" 42 projects of research and development were supported, of which 37 in the area of small and medium-sized enterprises and 4 projects in large companies.

From the funds allocated to the Operational Programme Competitiveness and Economic Growth also so called "Common services to businesses" were supported to promote public sector in building infrastructure for business development in industry and services sector, in particular micro-, small- and medium-sized enterprises (SMEs). In total, 11 projects were supported, which should lead to creation of more than 3,200 new jobs, especially in industrial parks in Slovakia. The main drawback was the lack of action synergy and complementarity with other Operational Programmes, stemming for example from the unfinished road infrastructure, etc.

In order to improve financing of business activities, the Operational Programme Competitiveness and Economic Growth started using financial engineering tool JEREMIE from July 2013, on which EUR 67 million is allocated. The following weaknesses were stemming from the process of implementation:

- complicated management process under the JEREMIE initiative because of a lack of coordination (Ministry of Finance, Ministry of Economy, EIF, managing authorities of particular operational programmes),
- complicated bureaucracy - the administrative burden both for donor and recipient,
- exclusive orientation to SMEs without the use of the potential of large companies
- inadequate funding system (reimbursement of eligible costs)
- inappropriately (ambiguous) set procurement system,
- system of the evaluation of the programme is focused more on the quantitative side than on quality assessment,
- complicated financing from three operational programmes (OP CaEG, OP R&D, OP Bratislava Region),
- the complicated structure for JEREMIE implementation was chosen (Slovak Assurance and Development Fund), the goal of which was to create sustainable tool from a long-term perspective and to ensure transfering of know-how from EIF to Slovak institutions,
- complicated rules of particular operational programmes in relation to adhering to the rules of EU structural funds, which are set primarily for non-returnable help. This caused huge limitations for returnable help,
- plenty of limitations on a national level as well as from the European Commission (for example only a part of resources is possible to use in the Bratislava region, where a third of SMEs and a half of the Slovak research and development potential is located),
- time consuming negotiations of relevant contractual documents.

Despite these weaknesses, the Operational Programme Competitiveness and Economic Growth in promoting growth, competitiveness and job creation succeeds in reaching its intentions and goals. OP CaEG is the producer of jobs also for disadvantaged groups – the young unemployed up to 29 years of age. On the basis of currently accepted applications for non-returnable financial contribution it is possible to expect that roughly 1,600 new jobs will be created in the promotion of innovation and technology and in the support of tourism service provision 320 new jobs should be created, occupied by young people under 29 years of age.

The support of projects focused on innovation and competitiveness growth also brings increased value added or sales growth of the supported businesses, and increase of private investment. In these areas it is possible to see the physical progress, as the enterprises so far have invested more than EUR 188 million from their own resources. Their value added on average grew by almost 70%, and sales grew by more than 110%.

2.3.4 Management of innovation process till 2013

Until 2006 there was no central authority for coordination of innovation. Specific measures were taken and implemented by various government authorities, particularly by the Ministry of Education and Ministry of Economy and agencies under their control. Such fragmentation of responsibilities caused low efficiency of the innovation system, being characterized by underdeveloped coordination and consultation mechanisms of the responsible institutions. This problem should be tackled by the Government Council for Science and Technology (established by Government Resolution no. 277 of 29 March 2006), involving all stakeholders. It is necessary to mention the fact that the research community as well as industry associations were rather involved in formulating national science and technology policy, than in preparing the concrete measures of innovation policy. The result was weak links between basic and applied research and the business sector. Vertical coordination - between national and regional innovation systems - did not work. To streamline the activities described above a government entity was established on 2 February 2011 to coordinate knowledge-based economy in the form of the Plenipotentiary for Knowledge Economy.

The Government, in an effort to develop a scheme for government policy in the innovation area, approved in March 2007 the Innovation Strategy of the Slovak Republic for 2007 to 2013 (hereinafter referred to as "IS SR") and in February 2008 the Innovation Policy of the Slovak Republic for the years 2008-2010 and innovation policy for the years 2011 - 2013 (hereinafter referred to as "IP SR"), which constitute the national umbrella of innovation as one of the strategic tools of building a knowledge-based economy and achieving economic growth of the Slovak Republic. Innovation strategy and innovation policies have created a comprehensive framework for promoting innovation.

The government in this period due to the financial and economic crisis has used state budget resources for particular measures aimed at subsidizing jobs and overall approach to maintaining employment. Since for the planned activities the necessary financial resources were not earmarked, many measures (even the low-cost measures) funded from the state budget have not been implemented, even though there was an assumption of the business interest. The main measures financed by the Operational Programmes of the National Strategic and Reference Framework have been implemented.

In addition, the research and development was supported by the implementation of the national science and technology policy, giving priority to support basic research. In 2006, the state science and technology policy till 2015 was approved, defining R&D priorities. The main problem was the determination of a large number of priorities (12) as well as focus primarily on basic research without connection to the innovation strategy.

The Structural Funds through the priority axes of the Operational Programme Competitiveness and Economic Growth (Ministry of Economy) and the Operational Programme Research and Development (Ministry of Education) remain the main source of funding for the innovation activities and research and development, implemented by several implementing agencies. The Operational Programme Competitiveness and Economic Growth was implemented through SIEA, NADSME, SARIO and SACR. This fragmented system had implementation deficiencies and so in 2012 the rights and obligations were transferred from the SARIO and NADSME and SIEA has become the only implementing agency for innovations and energy and SACR for tourism. This led to the significant increase of effectiveness of the system and clarification of the flow of information. In the case of the Operational Programme Research and Development the ASFEU is the implementing agency for national projects, the Division of Structural Funds in the Ministry of Education is an implementing agency for so called national projects.

The two Ministries, due to strict implementation of the Competence Act, and their agencies cooperate insufficiently, which leads to fragmentation and duplicity of support.

In the Slovak regions the higher territorial units (Self-Governing Regions - SGR) do not have innovation structures, there is no scheme for management of the state innovation policy and regional innovation strategies. An institutional framework for a more efficient connection between industry and selected services and results of research and development and practice is also missing. Therefore, the Ministry of Economy together with the Ministry of Education, Science, Research and Sport and the Ministry of Labour, Social Affairs and Family were cooperating in a project focused on creation of regional innovation centres (RIC) in the framework of the Operational Programme Competitiveness and Economic Growth, the Operational Programme Research and Development and the Operational Programme Employment and Social Inclusion (OP EaSI). The

intention was to ensure implementation of the regional and state innovation policy in regions in order to assure the growth of competitiveness, reduction of regional disparities and growth of regional employment through development of innovation tools at the regional level. The Government Resolution 256 of 20 April 2011 on the National Reform Programme for 2011-2013, paragraph D.1., stopped the building of RIC. The main reason was lack of verifiability of the sustainability of the project according to the terms of ERDF funding, and outstanding unsolved issues resulting from Council Regulation (EC) no. 1083/2006, for example issue of dealing with financial relations arising from the project, which generates income, and consequently a risk of unauthorized state aid for the commercial sector. Slow implementation and lack of coordination and consensus among the relevant ministries appeared to be critical.

2.4 BUSINESS SECTOR AND INNOVATIONS

2.4.1 Small and medium enterprises

An important parameter of the innovation performance of a country is the condition of small and medium-sized companies (SME). The Slovak economy is characterized by a dominance of the SMEs[6]. Their share in creation of added value, revenues and profit achieves a level over 50 %. A lower share is reached in the category of gross production, where their share is only 40 %, and lower competitiveness is demonstrated in a low internationalisation of business, when the share of SMEs in foreign trade achieved in 2011 only 30 %.

SMEs constitute 99.9% of Slovak enterprises and create 77.2% of the jobs in the private sector[7]. The Methodology of the Statistical Office does not take into account the classification according to the Commission Recommendation 2003/361/EC of 6 May 2003 on definition of small and medium enterprises (OJ ESL 124, 20.5.203, p. 36). It classifies the enterprises only by the number of employees, not based on ownership structure. Taking into account the Recommendation, a part of SMEs would be re-classified as large companies. Due to these facts, in the analytical part it is possible only to present the classification based on the number of employees which partly distorts the analyses.

Of the total number of 552,223 business entities, registered at the end of 2012, there were only 615 large enterprises or 438 large enterprises (when applying the turnover criterion[8]). The prevailing legal form of SMEs are entrepreneurs-natural persons who account for 70 % of SMEs. This is a category consisting of self-employed persons, freelancers and farmers. The main growth of the number of entrepreneurs-natural persons appeared after 2003 after introduction of flat tax rate and preferential taxes and payment rates for this segment of the economy. There was a certain correction (getting more realistic figures) after 2013 next to changes in the payment rates. Recently (after 2008) the number of micro-enterprises (up to 10 employees) is increasing due to transfer of larger enterprises to this category which is connected with rundown of business activities, lowering of competitiveness and threat of companies' economic sustainability. With regard to the objectives of RIS3, there is a potential especially in the categories of SMEs (above 10 employees), without limitation of support for innovation activities also in micro enterprises category. Increasing number of micro enterprises lowers potential and abilities of many SMEs to execute business innovations and join higher levels of supply structures for MNCs.

SMEs are characterised by a dominant representation of micro-enterprises (entrepreneurs and firms employing less than 10 employees with a turnover lower than EUR 2 million per year). Micro-enterprises constitute 96 % of all enterprises in Slovakia. That means that there are only 14,339 enterprises in Slovakia with more than 10 employees and with an annual turnover higher than EUR 2 million. This SMEs structure in combination with ongoing trend of marginalization is a great obstacle for development of innovation in this category of enterprises. SMEs in Slovakia are concentrated in the sector of services with 49.6 % of enterprises and 31.2 %

[6] A business up to 250 employees and with a turnover less than EUR 50 million or account balance less than EUR 43 million per year.

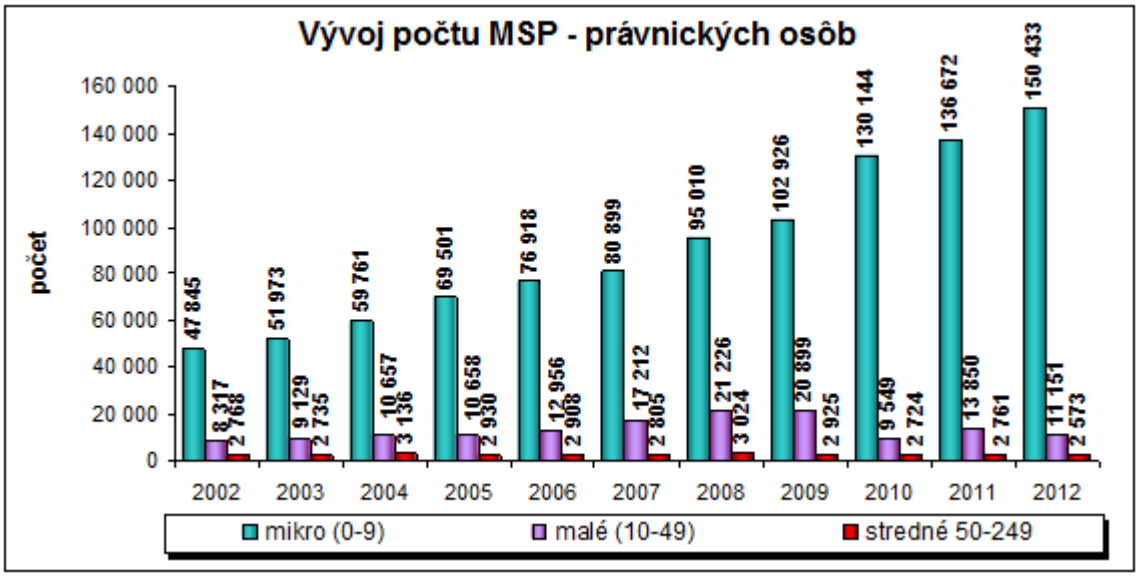
[7] A methodology of the Statistical Office of the Slovak Republic does not consider sorting according to the recommendation of the Commission 2003/361/EC from 6 May 2003 about the definition of small and medium enterprises (EUR-Lex ESL124, 20. 5. 2003, p.36), but sorts enterprises according to the number of employees. After applying the recommendation a part of SMEs would according to the ownership structure move into the category of large enterprises.

[8] According to the EU definition (Regulation (EC) 800/2008, Annex I.).

of entrepreneurs – natural persons at the end of 2012. In the industry there was registered 9.1 % of enterprises and 16.1 % of entrepreneurs – natural persons. As regards revenues, the largest share in 2011 was held by the trade sector (44.2 %), the share of industrial production was approximately 1/3, and services achieved 12.2 %. In the last 10 years, the share of business activity in trade and industry has been decreasing, while the share in the service sector has increased from 1/3 to 1/2 for the same time period. That indicates the necessity to implement also the measures appropriate for the service sector implementing mainly non-technological innovations.

The proportion of the knowledge economy sectors is low, in the sectors with a high technological level there is only 3 % of enterprises registered in the sector of industrial production. In the knowledge-intensive services there were 35.4 % of enterprises registered in the service sector.

Graph 4 *Development of the number of SMEs in the 2002 – 2012 period*



počet - number; Vývoj počtu MSP – právnických osôb - Development of the number of SMEs – legal entities; micro- (0-9); small (10-49); medium- (50-249)

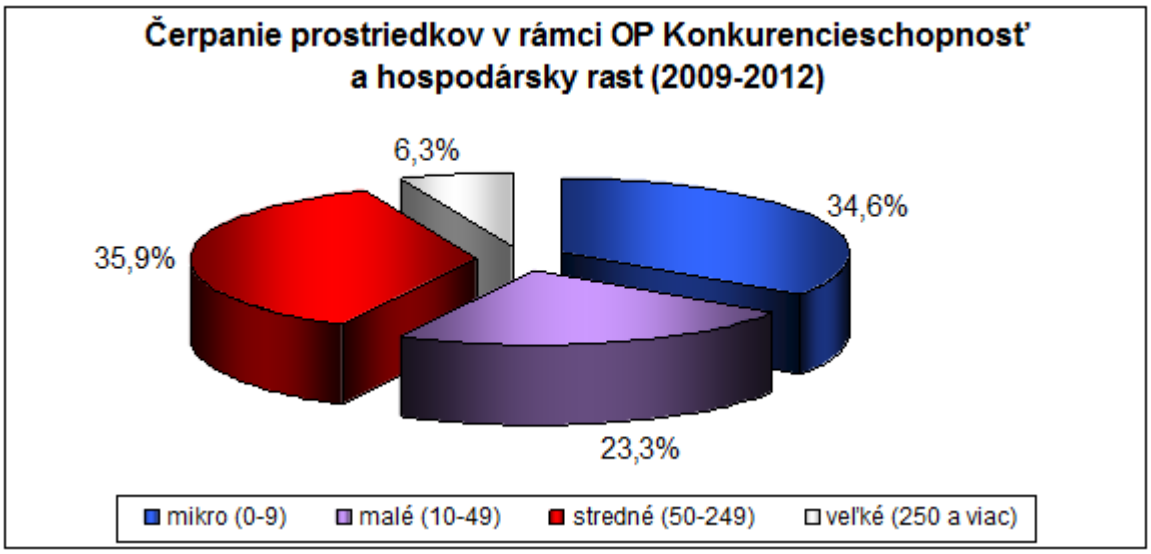
Source: *Statistical Office of the Slovak Republic, processed by NARMSP*

Due to external economic impacts and low competitiveness the economic parameters of SMEs are worsening. Only a half (56 %) of SMEs achieves a positive economic result. There is a gap in financing as bank loans are used only by 16.4 % of SMEs (2011). This creates a space for application of financial engineering tools.

According to the survey performed in 2012 by GEM 2012 Slovakia has recorded a decrease of business activity both in the category of beginning entrepreneurs (interannual decrease from 9.2 % to 6.65 %), new entrepreneurs (from 5.3 % to 3.91 %) and established entrepreneurs (from 9.6 % to 6.38 % - fall from the 3rd place to the 14th place within Europe). According to the Flash Eurobarometer survey of 2012, running a business in Slovakia is a preferential career choice for 33 % of inhabitants, which is below the EU average level. It is necessary to take measures supporting the motivation to run business and to create innovative start-up firms.

83 new enterprises in Slovakia were supported in the framework of the objective innovation and growth of competitiveness of the Operational Programme Competitiveness and Economic Growth. As the following graph shows, the representation of particular categories in the use of aid was unbalanced: 34.6% went to micro-enterprises, 23.3% to small enterprises, 35.9 % to medium enterprises and 6.3 % to large enterprises.

Graph 5 *Representation of particular categories of enterprises in the use of sources of the Operational Programme Competitiveness and Economic Growth*



The use of sources of the Operational Programme Competitiveness and Economic Growth (2009-2012); micro- (0-9); small (10-49); medium- (50-249); large (more than 250)

Source: *Ministry of Economy, processed by NADSME*

2.4.2 Large companies and SMEs

During the recent two decades since 1991, the Slovak economy has been subject of unprecedented changes. In 1995, 135 enterprises were producing 66% of the total production, 70% of export, 51% of employment and 63% of assets of processing industry as a major sector of the economy. 90% of these enterprises were in state ownership or in a mixed state/private ownership. The horizontally and vertically integrated enterprises with high concentration rate and savings were the most effective. In 2010, practically the same figures in the Slovak economy were made by approximately 215 enterprises with 85% owned by foreign companies and decrease of employment by almost 50% since 1995.

The share of export in this key segment increased in the 1995-2010 period by more than 30% of GDP up to the level of more than 80% of GDP, the rate of intrasectoral foreign trade grew from 40% to 75%. Slovakia has so become the most involved economy of the EU and OECD into so-called „global supply chains“ with 85% rate of synchronisation of economic cycle with economic growth in the „old“ EU15. A part of the segment of SMEs was being created after completion of the process of privatisation through dislocation or outsourcing of some parts after privatisation of state-owned companies.

This has affected the structure of the Slovak industry and linkage between large companies and medium enterprises. According to the 2013 survey one large company owned by Slovak entity (not MNC) is linked directly to 600-1 200 small and medium enterprises as sub-suppliers (except for self-employed persons). The linkage among sectors is more important in civil engineering which is characterised by seasonal nature and dominant cooperation with SMEs and self-employed persons.

In 2012, the Slovak economy was the fourth most open economy in the EU and the 14th most open economy in the world and the value of goods and services exported from Slovakia in 2012 made almost 96% share in GDP. Due to the very limited internal market, the Slovak economy will remain very open. This requires special effort to maintain export ability and internal competitiveness. Its sustainability cannot be preserved without support

and involvement of all stakeholders. It is therefore necessary to concentrate on support of cooperation between large companies and SMEs and also on cooperation of these business entities with the sector of research and development in the area of innovations. Regulation based on the size of applicant would be more than ineffective in this respect.

Comparison of division of business expenditures in research and innovation from the point of view of size of companies (large companies versus SMEs) and from the geographical point of view (foreign versus domestic enterprises) shows that Slovakia ranks among the countries with the highest dynamics of changes between 2005 and 2010.

Due to the fact that Slovakia belongs within the OECD to the countries where the share of enterprises in funding research and innovations is relatively low, there is a potential to create mechanisms for stimulation of MNCs operating in Slovakia to transfer research and innovation capacities to Slovakia and to support creation of research and innovation centres in large companies and SMEs. This will contribute to the embeddedness of major export sectors to domestic economy. It is necessary to take into account the specificities of large companies and SMEs in implemented support tools.

2.4.3 Status of clusters in Slovakia

At present, creation of networks and clusters is becoming a determining factor for growth of firms, mainly SMEs. Firms in such a structure benefit from mutual cooperation and vicinity to other firms due to so-called economy of agglomerations, while the total number of firms in a region determines the achieved economic benefits. Moreover, geographic concentration of firms in the same or similar sector creates a labour market for qualified labour force.

MNC operating in Slovakia have attracted a lot of suppliers as a part of their chains (up to the level of TIER 4) and the role of these companies grows in supplier-consumer relationships, which is manifested in growing embeddedness of the sectors in the economy. Only several domestic firms achieved the level of TIER 1 in global chains due to high added value (e.g. CEIT, Matador).[9]

The evolution development of economy leads to creation of new natural clusters in regions. In the region of the Central Slovakia – the Banská Bystrica self-government region (Žiar nad Hronom) an aluminium processing cluster is developing. A formalised cluster organisation has not been established yet. The cluster was established at the aluminium producer – the company of ZSNP in Žiar nad Hronom. It is an innovative cluster where the Slovak Academy of Sciences founded a research and development centre INOVAL in order to cooperate with firms in research and development projects and commercial application of innovative solutions. The cluster involves innovative, export-oriented companies (e.g. Fagor Ederlan Slovakia, a.s., Sapa Profily, a.s., or Thermosolar, s.r.o.). In the Banská Bystrica self-government region there is the second important cluster operating in the area of production and processing of metals. Of production sectors in the Banská Bystrica self-government region an industrial production with medium-low technology is dominant. This applies especially for the sector of production and processing of metals, where the share in regional employment is 2.64times higher than the Slovak average. A similar situation is in the Košice region where the production and processing of metals is considerably concentrated, while LQ (localization quotient) is as much as 4.29 due to the presence of US Steel Košice.

[9] Producers mainly in automobile industry sometimes include firms of their supply chain in groups – TIER. The stated level of TIER means „commercial distance“ in relationship between producer and supplier. There is not a unified definition and number of TIER – levels in chain. Often the next classification is mentioned: OEM (an original equipment manufacturer) is the company producing final product for consumer market. TIER 1 suppliers are direct and usually main suppliers of parts for OEM, TIER 2 firms are key suppliers for TIER 1, TIER 3 supply TIER 2, TIER 4 firms usually supply with primary commodities, e.g. steel or glass, other firms of higher TIER level. One company could be TIER 1 for one other firm and at the same time TIER 2 for other company, or TIER 1 for one product and TIER 2 for the other product. Source: http://smallbusiness.chron.com/difference-between-tier-1-tier-2-companies-25430.html

Along with traditional sectors, cultural and creative sectors are developing in Slovakia. The firms in creative sectors are considerably concentrated in space and create clusters. The Bratislava region is one of prominent EU regions from the point of view of concentration of employment in the creative sector since in this region approximately 5.01 % of the labour force work in these sectors, pointing out at significant specialisation. Moreover, 46 % of all firms in the creative sectors are seated in the Bratislava region, of that 91 % directly in Bratislava. Design and computer programming can be considered as the most prospective orientation of the creative industry in Slovakia.[10]

Despite the above mentioned facts the role of clusters in the economic development of Slovakia is still underestimated. Despite absence of systemic support a number of clusters have appeared through the "bottom-up" approach, in many cases due to activities of regional self-governments. Basically, there are two types of cluster organisations – in tourism and technological cluster organisations. Number of clusters has increased during last years. Vitality of existing technological cluster organisations is various and depends on a number of factors. Six of them received a Bronze Label of the European Cluster Excellence Initiative (ECEI) in 2013, issued by the European Secretariat for Cluster Analysis. The label was assigned to the following cluster organisations: The Automobile Cluster – Western Slovakia, Slovak Plastics Cluster, The First Slovak Machinery Cluster, Košice IT Valley z.p.o., Cluster AT+R, NEK. The European Bronze Label was also assigned to two tourism clusters – Klaster LIPTOV – A tourism association, Klaster ORAVA. Moreover, the Electrotechnic Cluster – Western Slovakia, which involves also the MNC company Samsung, has increased its activity. But the clusters are insufficiently linked to final producers. In 2012, the Ministry of Education, Science, Research and Sport of the Slovak Republic provided the first single support to science and technology services. Five best projects of technology clusters received support. In 2010, the cluster organisations established a Union of Slovak Clusters

[10] Creative industry is the complex of industries based on exploitation of intellectual creative activity results, such as art, culture and other sectors. Its essence consists in business activities based on individual creativity, skill and talent with the potential to create wealth and jobs through developing intellectual property. It comprises the whole chain, from creation of conditions for creative activity through manufacture to re-design of its results. The cultural industry is a part of creative industry adding economy value to intellectual activities´ results (especially art and memory institutions). In Slovak economy context, following areas can be mentioned in connection with creative industry (main areas and sub-areas): Architecture, interior design and garden architecture – Theatre, dramaturgists, choreographists and other authors of drama and audio drama works as well as non-music interpretational art (actors, dancers, mimes, etc.) – Design, industrial design and art design as well as useful art – film and video, audiovisual industry including film industry (producers of original audiovisual works as well as publishers of their copies), as well as related jobs and offering of audiovisual media services on demand – Hardware and related services, development, production, import, export and selling of related hardware (among others PC, mobile devices, televisions), carriers and offering of related technological base (among others webhosting) – support services, art agencies, event agencies, organisations of collective administration of rights, consultancy companies, copyright clearing etc. – Music, music composers and music interpreters (singers, musicians) as well as scripters; also music industry (producers of audio records of music works) – ICT, electronic communication and offering services of information society, as well as specific content services (among others re-transmission, direct to home (DTH), multiplex) – Communication medias, media industry including radio and television broadcasting, press agencies, publishing of periodical print and offering e-news as well as related jobs (among others journalists, news reporters, documentary and news photographers); does not include audiovisual media services on demand (for example video on demand (VoD) and services of information society) – Cultural heritage and natural heritage, memory reservations, memory zones, immovable cultural monuments, movable cultural monuments, intangible cultural heritage, archeological findings, archeological sites, natural monuments, protected landscapes, caves, natural waterfalls, observatories, planetariums, open-air museums, arboretum, botanic gardens, city gardens and parks, castles, chateaus, manor houses, important sacral buildings – Literature and book market of writers, editors, interpreters, redactors, publishers of non-periodical publications as well as publishers of audiobooks – Fashion industry, haute couture and parfumeries as well as designing in a related areas (for example nail design) and related jobs (stylists, arrangers, florists etc.) – Multimedia industry, game industry as well as publishing multimedia works and computer and console games – Memory institutions, collection pieces and funds of museums, libraries, galleries, archives, Slovak film institute, Institute of national memory and Radio and television of Slovakia – Advertising industry, advertising agencies, media agencies, marketing and public relation – crafts, traditional folk crafts and city culture – Software, development and production of software; does not include development and production of computer and console games – Art Market, legal market with antiquities and auction houses as well as related jobs (for example conservators) – Visual art, all forms of painting art, art photography and lighting design as well as new forms of multimedia installations etc. – Entertainment industry, zoological gardens and spare-time activities not listed elsewhere (among others variety show, cabaret, circus, lunaparks, amusement and sport events, amateur art production, craft courses), development of toys.

(UKS) in order to make activities more effective. The objective of the Union is to support economic growth and competitiveness of all regions through creation of clusters.

In order to achieve synergy in innovative and economic activities with positive effects on economic growth and employment it will be necessary to create mechanisms for the support of cooperation in clusters and cluster organisations and involve research institution in their activities.

2.4.4 Barriers to innovation activities in innovative enterprises

Firms are facing numerous barriers constraining the optimal execution of innovation activities, whereby several types of possible hindrances for companies to innovate exist – cost based factors of companies, deficit of necessary information, market factors or a lack of demand.

The main highly important factors that limits the possibilities of further innovation of Slovak innovative companies is cost based factors such as insufficiency of resources within the enterprise (27 %) or too high costs of innovation (23 %) in relation to own assets. Within these two factors we can observe a significant difference between Slovakia and most innovative countries.

Innovative companies in Slovakia are also limited by market factors as well as by the fact that already established companies exist on the market (15 %) and there is a volatile demand for innovative products and services (13 %). Lack of qualified workers can be to a certain extent a barrier to innovation, but innovative firms in most innovative countries or neighbouring countries encounter the same problem.

Deficit of information in Slovakia (about markets or technologies) is a barrier only to a small extent and it is comparable with the reference countries. Companies during the innovation use a lot of external information sources (other actors of the innovation system). According to the importance they contribute to particular information sources, we can assess the character of the innovative environment in Slovakia and indirectly also the intensity of relations between the innovative companies and other actors of the innovation system. Slovak innovative companies use mostly customers (43.1 %) and scientific publications, or more precisely business or technical publications (11.3 %) as a source of information for innovation.

Only a small share of Slovak small enterprises in comparison with e. g. Finland or V3 average considers as important the information from universities, public scientific and research institutions and bodies. In case of medium enterprises in Slovakia the situation is similar, the important source is customers or environment in which the enterprise or enterpreneurial grouping operates. The medium enterprises still lag behind its neighbours in using the information from universities, public scientific and research institutions and bodies. In case of large companies in Slovakia it is evident that in comparison with the referenced countries they attribute a lower importance to information from universities, public scientific and research institutions and bodies as well as to consultants, commercial laboratories or private research and development. They attribute higher importance to suppliers of equipment, material, components or software. The depicted state is caused especially by insufficient quality and structure of services offered from the side of universities and public scientific and research institutions.

Own research and development is not the only source of business innovations. Companies can innovate in a form of buying machinery, equipment and software, external knowledge or exnternal research and development. Slovakia as a technologically converging economy gives priority as a form of innovation to purchasing finished technologies/knowledge in the form of acquisition of machinery, equipment and software. This form of innovation was used by more than 70 % of innovating enterprises in 2010.

Other forms of innovation such as the purchase of outputs from external research and development or acquisition of external knowledge (e. g. from domestic or foreign R&I institutions) was used only by 7 %, or more precisely 4 % of innovating enterprises. Such low values indicate low interconnectedness of innovating

enterprises with external environment („scientific knowledge producers“ utilizable in industry – universities or SAS institutes). Own research and development is utilitzied by only 17 % of innovating enterprises. Nevertheless, the method of innovation in most innovating economies (Sweden, Finland, Denmark) is the opposite. Expenditure for own research and development and expenditure for purchasing external research and development are dominating. Purchase of finished technology by innovating companies is a marginal matter in these countries. Besides that the barrier is the public procurement, which does not contribute to increasing the innovation intensity of the economy.

The abovementioned implies that it is necessary to implement measures that:

- interlink innovation actors,
- increase technological level of companies,
- increase the quality and availability of human resources,
- enable the funding of development activities,
- use public procurement as a tool supporting innovations in economy.

2.4.5 Venture capital

The important factor of development of innovation activities in Slovakia is a solid financial condition of companies. Therefore alternative financing instruments have been developed since the beginning of the transformation of the economic environment in Slovakia, including the investment of venture capital (investments in property and capital funds).

The first institution of venture capital financed from public funds, the Seed Capital Fund, was created already in 1994. Fund's resources came from the EU pre-accession program PHARE. Afterwards, Venture Capital Fund - Slovak Post-privatisation Fund was created. In 2002 Regional Seed Capital Fund aimed to support SMEs, followed by The SISME Fund established in 2005 that was focused on innovative projects in the area of industrial production, manufacturing and business services. In 2006, the Venture Capital Programme has been launched, which created a portfolio of investment funds aimed at supporting businesses in different stages of their life cycle. By the end of 2012 the Venture Capital Fund approved 191 investment proposals, of which 160 were implemented. Overall, more than 115 companies were supported. According to the analysis of the Ministry of Finance of the SR in 2009 no innovative projects were supported.

As a new complex instrument, the JEREMIE project was prepared, but has not yet been implemented. JEREMIE Holding Fund in Slovakia is financed by EU structural funds for the period 2007-2013 from three operational programs (OP Competitiveness and Growth, Operational Programme Research and Development, Bratislava Region Operational Programme). Despite the fact that already in 2009 the Funding Agreement between the managing authorities and the EIF were signed and the SADF holding fund was founded, so far the JEREMIE initiative failed to support any SME.

The main reasons of failure to implement JEREMIE initiative in Slovakia can be described as:

• the Slovakia chose complicated structure of relations for the implementation of JEREMIE, for example SADF and other contractual relations),

• complicated financing from three operational programs (OP Competitiveness and Economic Growth, OP R&D, Bratislava region OP),

• rules of the OP in relation to compliance with the rules of the EU Structural Funds were set primarily for non-returnable financial contribution, causing major limitations of repayable assistance,

- complicated structure of implementation of JEREMIE, that is aimed to create sustainable tool and secure transfer of know-how from EIF to Slovak institutions, many restrictions on national level as well from the EU level (e.g. in Bratislava region, only a small part of sources can be used, while there are located 1/3 of SMEs and ½ of R&D Slovak potential),

- time consuming negotiations of contractual documents.

Identified weaknesses of the system are primarily a lack of strong incentives for private sector investors, nonexistence of capital market and in particular lack of interest of enterpreneurs for this type of financing of highly perspective developing projects, as well as the lack of deal flow, i.e. lack of attractive, suitable risk investments Certain limitation is also a conservative behavior of the funds that invest mostly in less risky projects. To improve this state, the support of R&D projects with market potential will be needed, as well as raising the awareness among entrepreneurs about the benefits of using the financial engineering instruments. In spite of the negatives stated in the sections concerning the use of venture capital and financial engineering and after the elimination of the critical places, there is an enormous interest of responsible institutions in coordination with the Ministry of Finance of the Slovak Republic to apply the upgraded model of usage of innovative financial tools in order to support the Smart specialization strategy's measures in the 2014 – 2020 period.

2.4.6 Incubators

Up to now, with the support of the state budget, the pre-accession Phare programme, cross-border cooperation programme CBC, structural funds and funds of other donors (e.g. the Flemish Fund, municipalities) there were built 16 business and technology incubators and 1 tutorial incubator (the virtual), which formed the base network of incubators in Slovakia

Table 1 *Results of the technological and business incubators involved in the program Support SMEs through the network of incubators and the implementation of the Research-based spin-off method*

Year	Total Area for Rental	Total Occupancy	Total Occupancy	Number of Incubated Firms (IbF)	Number of Jobs in IbF	Number of jobs in the Management and Operation of the Incubator	Budget
	m^2	m^2	%				EUR
2007	17 416,78	15 038,01	86	269	1 159	71	144 208,90
2008	20 694,03	18 210,81	80,82	274	1 182	37	70 950,79
2009	17 577,00	13 852,00	79,00	177	688	39	53 598,04
2010	16 156,84	13 979,89	87,00	146	778	48	29 877,80
2011	14 009,22	12 469,31	89,00	88	602	37	14 771,83
2012	-	-	-	-	-	-	9 000,00
Average	**17 170,77**	**14 710,00**	**84**	**190,8**	**881,8**	**46,4**	**51 475,54**

Source: SIEA

The analysis of incubators indicates that the development support of incubators was unsystematic in the period 2007–2012 which causes their insufficient functioning. Due to the underfunding of the operation system of incubators the most of incubators cannot provide sufficient staff and comprehensive services necessary for the development of incubated firms. The concept was also absent during the introduction of financial, organizational and technical support tools which resulted in the problematic sustainability of some incubators. The support of incubators should be applied selectively based on the regional capacity.

2.5 RESEARCH AND DEVELOPMENT POTENTIAL OF THE SLOVAK REPUBLIC

R&D is the fundamental precondition for the competitiveness and sustainable development of the society and they are inevitable for the long-term growth of living standards in Slovakia. The Slovak R&D has a long-term tradition and in some areas they achieve the world standards. The R&D potential in Slovakia is concentrated in the public sector (two thirds of expenditure on research and development is realized in the public sector). In abroad the R&D funded by the public financial funds is traditionally realized by the universities or other research organizations of the public sector.

Slovakia is among the OECD countries which has a relatively low proportion of universities in the public research and development (48% share). As in other Central European Economies the National Academies of Sciences (and the departmental research institutes to the limited extent) play an important role.

The main benchmark of the R&D potential of the country is the total number of employees in R&D which are available in the country. The share of employees of R&D was only 0.77% at the total employment in Slovakia in 2011 which was below the EU average and the innovatively developed economies and neighboring countries. The structure of employees of the R&D sector is following: 16% of the corporate sector, 67% of the universities and colleges (university teachers and researchers together) and 17% of the governmental sector (Slovak Academy of Sciences and departmental research institutes).

In 2011, the average registered number of employees of the public universities was 21 538. Of the number 53.5% are academics and/or researchers and 46.5% is other staff (administration, operational services, etc.). 11 522 teachers and researchers were employed in the public universities and colleges. In 2011, 1 813 researchers were employed in the Slovak Academy of Science and 350 researchers in agricultural research institutes. 2 700 researchers are employed in the research institutes of the business sector what is almost 16% of the total number of R&D employees in the SR.

Slovakia has a very high proportion of basic research and 77% of public spending on research and development is aimed at this field which is the highest value among the other OECD European countries. A high proportion of basic research with an insufficient support for applied research and the lack of institutions aimed at the transfer of scientific knowledge into practice can be a barrier to the innovation progress of the Slovak economy. An exception is the R&D of departmental research institutes and centers where applied research and a subsequent development and knowledge transfer into the practice dominate.

2.5.1 Slovak Academy of Sciences

The public R&D sector consists mainly of the Slovak Academy of Sciences which is an autonomous state scientific institution of the Slovak Republic established by Law no. 133/2002 Z. z. about the Slovak Academy of Sciences (SAS). The main SAS mission is to implement basic and applied research in engineering, natural sciences, humanities and social sciences through the research organizations and with the support of specialized service organizations.

The budget of SAS is nearly 60 million euros per year (2011) which during the year was adjusted to 75 million euros. SAS employs over 1 800 scientists and nearly 500 postgraduates. Organizations of SAS are external

educational institutions for postgraduate study. SAS develops intensive international cooperation, which incorporates Slovak science into transnational context.

Scientific SAS Institutes (total 57) are autonomous legal entities. They are budgetary or subsidized government organizations directly financed from the state budget. The SAS Presidium acts as manager of the chapter of the state budget. Budgetary rules for budgetary and subsidized organizations limit the commercialization activities and make impossible an effective capitalization of intellectual property of the SAS. Therefore, in 2012, there was approved the transformation of the research SAS organizations into public research institutions with the form of public service management, while maintaining SAS budget chapter and two-stage model of governance. After the implementation of the transformation the SAS becomes a modern institution conducting not only excellent but also applied research and linked to the economy and this institution will be able to commercialize the results of scientific and research activities.

2.5.2 Universities

Legislative rules for universities are approved by Act no. 131/2002 Z. z. of higher education as amended. According to the act there are universities: the state (3), public (20) and private (13). State and public universities (hereinafter as PU) are established by the law and the Government gives an authorization for the private universities. The large number of universities operating in the Slovak Republic has been the reason of the devaluation of the educational process, but established universities with the long tradition maintained the good quality and reputation. The result of these trends and the fragmentation of funds is a low quality of the universities according to the international ranking comparing their quality.

Universities have been transformed into public institutions by law in 2002 which allowed developing of the multi-source financing. The basis is the state budget subsidy to which are added other sources on the base of standard contract. According to the law the public universities are defined also as businesses, so they can benefit of its intellectual property. The most successful ones are able to obtain about 40% supplementary resources from the state budget in the form of grants or contracts for work. In the area of R&D there is active only a few public universities and one state university.

Public universities are funded from the state budget in the form of subsidies (grants), which depends on the performance of a particular school in the previous period. Public universities are financed from the state budget of approximately EUR 440 million (2013). This amount includes expenses to cover the cost of education, the needs for research (institutional research funding), the social scholarships, housing allowances for students and support sports and cultural activities. Public universities are self-governing organizations legally divided into faculties. If a public university is divided into faculties the faculty has the strong position in determining the curriculum, conditions of admission of students to study but also in economic or personnel area. This makes it difficult to manage the entire organization as the approval by a majority of representatives in the Academic Senate of the school is necessary for the important decisions.

Activities of public universities are regularly quantitatively assessed each year. These data are used to calculate the amount of the subsidy by calculation formula calculated on the basis of "methodology of sharing subsidies to public universities." Approximately 1/3 of subsidy is divided according to the number of students and 1/6 the number of graduates. Other funds are determined on the basis of the evaluation in the comprehensive accreditation (evaluation takes place once every six years), the number of publications, the success of domestic and foreign research grants. In the past, the dependence on the number of students was very high but in about last seven years its weight has been reduced. In 2011 there was a change in the methodology in favor of publishing books at the expense of project success which disadvantaged science and engineering disciplines.

It has also changed the methodology for allocating scholarships for PhD students in full-time - allocation of funds for a specific PhD location was replaced by allocating money to the block grant and it is up to the

university, whether these funds will use for PhD scholarships or otherwise reason. While it is too soon to assess the impact of this measure, the first information indicates a decrease of PhD students in some schools. In principle, the five largest schools provides the vast majority of research performance and most educational performance.

The current support for higher education has systemic distortions that are reflected both in reducing the quality of higher education, but also reducing their scientific excellence. In 2006 and 2007 the European University Association realized an audit of all public high schools and the system as a whole. Final recommendations have not been implemented yet. At present, a report on higher education was presented, which should be the basis for changes and adjustments in the future period.

It is necessary to redesign the support system so that high-quality universities benefit from the financing with regard to:

- increase the quality of higher education,
- increase the quality of higher education research and development,
- select the elite universities with global reputation,
- support the cooperation with practice,
- commercialize the results of R & D activities.

2.5.3 Sectoral research organizations

The Ministry of Agriculture and Rural Development of the Slovak Republic (hereinafter as MAaRD SR) is the founder of 6 subsidized organizations (research institutes and research centers), whose principal activity is to perform basic and applied research, development and related innovations for the agricultural practice, based on "The Strategy of Research, Development and Innovation in the Agricultural Sector by 2020", which is compatible with the Europe 2020 Strategy and the EU Framework Programme Horizon 2020.

MAaRD SR finances R&D projects, technical assistance and the tasks assessed by experts from academic sector, industrial practice and departments of MAaRD SR. It also manages the research projects financed by sources out of MAaRD SR, mainly by Ministry of Education (OP R&D and SRDA) and foreign sources. Departmental institutes cannot participate in some grant schemes. They are also external educational institutes for the PhD study and develop a huge international cooperation and integration of the Slovak (mainly agricultural) science into the international science world. The knowledge gained from the research are transferred into the practice by many ways (contracts with users, outputs necessary for decision-making and management process in the agricultural sector).

In 2012, 810 employees (including 345 scientists and R&D personnel) were working in research institutes and centers of the MAaRD SR. Institutions own the specialized technical infrastructure, spatial databases, metadata and know-how for specific laboratory experiments and experiments with biological material in its natural environment and are also sufficient critical mass for an effective and successful implementation of science, research, development and innovation in agriculture (involving plant and livestock production, food processing, soil resources, forestry), which cultivate more than 80% of the area of the Slovak Republic

More than half (16) of organisations under the competence of the **Ministry of Culture of the Slovak Republic (hereinafter as MC SR)** lists research in their founding documents. There is no organization within the ministerial competence which is oriented only towards research and development and has a statute of a research institute – scientific and research work is only one of many activities the organizations are conducting. The focus of scientific and research work is solving tasks, which are related to the specific objective of individual organisations and which are elaborated in the plans of mains tasks of these organisations. Overall, 74 employees possess a qualification of scientific worker of a various degree: 26 at Slovak National Museum, 15 at Slovak National Library, 10 at Slovak National Gallery, 5 at Theatre Institute, 5 at University Library in Bratislava,

3 at National Cultural Centre, 3 at the Museum of Slovak National Uprising, 3 at Slovak Film Institute, 2 at State Scientific Library in Banska Bystrica, 1 at State Scientific Library in Presov and 1 at Slovak Central Observatory. Financing of scientific and research activities is ensured through resources allocated to respective organisations from the MC SR budget, in rare cases also from other sources (in partnership with other applicants through SRDA while solving projects). The main contribution of scientific and research activities of organisations under the competence of MC SR is exploring and documenting the Slovak cultural heritage, its preservation and presentation.

Ministry of Health of the Slovak Republic (hereinafter as MH SR) did not organise so far a targeted and organized thematic research with a more significant support of the ministry itself. There were only several MH SR calls to carry out research in the area of public health and medicine, which were financed directly from the MH SR budget. This research, however, did not have a more significant impact on the creation of research teams of critical importance in terms of personnel and facilities and from a perspective of a long-term stability. This situation is currently changing – the ministry organises a scientific certification of all its important end-user facilities, such as the university hospitals and highly specialized institutes, which will lead to unprecedented broadening of their experimental research and biomedicine research capacity. In the following years the development of medical research will be carried out through: direct organisation and support of research in biomedicine from the MH SR for its departmental institutions, which are eligible to carry out research in biomedicine; targeted organisation of cooperation of university hospitals and specialized institutes with universities and SAS institutes with an aim to secure multi-source financing of research and innovation in medicine from domestic and foreign support schemes that are dealing with research and innovation; initiating the creation of new study courses in the area of education, which should be focused on covering currently missing specializations, for example: research in medicine (medical science) and the management of biomedical research, development and innovation in order to increase the transfer of results of science into clinical, diagnostic practice and production in Slovakia; by creating scientific capacities in terms of personnel and facilities in university hospitals and specialized institutes it would be possible to directly carry out biomedical research, which would lead to scientific and innovation outputs as well as to a development of a better quality health services in Slovak public health facilities. This will allow a participation of elite health organisations in domestic and foreign scientific programmes. The number of sufficiently large and professionally capable scientific teams will be higher. These teams will be eligible and most importantly capable of applying for european funds and grants related to reseach and innovation. Research and development will be strengthened with a possible practical outputs, for example in the area of diagnostics and treatment with high value added and there would be a space for investment by domestic an foreign business subjects. The conditions for offering research services (e. g. outsourcing) will be widened in the area of biomedical and pharmaceutical research and development along with the adequate methodical, publication, knowledge, qualificatory and economic benefit for the Slovak innovation potential in the biomedical field.

University hospitals (UH) that are according to the law eligible to carry out research in biomedicine are undergoing a significant redevelopment in recent period in order to increase their effectiveness. A part of this process is also gaining accreditation from the MESRaS SR as scientific and research organisations. UH have essential predispositions for carrying out applied research and have all the possibilities for transfering research into practice. Creating a more tightly interconnected scientific UH consortia with other organisations of science and development is the only way for a higher effectiveness in the area of biomedical research in Slovakia. Up to now the scientific institutions that are certified by the MH SR are: Children's Faculty Hospital with Policlinic Banská Bystrica, Children's Faculty Hospital with Policlinic Bratislava, National Oncological Institute, National Institute for Rheumatic Diseases, St. Elizabeth Oncological Institute, Regional Institute of Public Health with headquarters in Banská Bystrica, East-Slovakian Institute of Heart and Venacular Diseases.

Ministry of Transportation, Construction and Regional Development of the Slovak Republic (hereinafter referred to as MTCRD SR) does not have under its competence budgetary or contributory R&D organisations

that are managed directly. MTCRD SR is a founder of two non-profit organisations – institutes that are focused on the area of research and development: The Research Institute of Posts and Telecommunications and Bulding Technical and Testing Research institute. These organisations are not directly linked to the budget of the ministry.

Ministry of Interior of the Slovak Republic (hereinafter as MI SR) has within its structures the department of scientific and technical development and under its competence as a founder the Criminalistic and Expertise institute of the Police Force, the Fire-technical and Expertise Institute of the MI SR, Slovak National Archives and Academy of the Police Force. They all carry out research activities.

Ministry of Defence of the Slovak Republic (hereinafter as MD SR) is a founder of Military Technical and Testing Institute at Záhorie. It is a founder of Armed Forces Academy of General Milan Rastislav Štefánik in Liptovský Mikuláš. One of its organisational branches is an Institute of Security and Defence Studies. Training Analytical and Supply centre RCHBO Čereňany is subordinate to the Chief of the General staff of Armed Forces of the Slovak Republic. The abovementioned units carry out research activity.

Ministry of Environment of the Slovak Republic is a founder of research institutions Slovak Hydrometeorological Institute, Water Management Research Institution and State Geological Institute of Dionýz Štúr

R&I organisations of non-governmental sector

A part of departmental research institutes have transformed into non-governmental organisations or interest groups of private legal character for the past decades. They do not redistribute its potential profit, but they reinvest it in line with their mission. The non-profit organisations do not have an institutionalized representation in bodies related to research and development and as a consequence, there is a push towards designation of official representative of this segment as well as towards the preparation of detailed analysis of its quality and quantity in the current period. The R&I activities of this sector are currently partially accounted as private and partially as public according to the character of their founders or members.

Business R&I institutions

After a long-term transformation of research organizations of business sector (privatization), the current number of entities actively involved in the R&D in this sector is about 240 companies. These companies are established according to the Commercial Code and do their business in the field of R&D in the open competition market economy.

Over 4,500 employees are employed in the research organizations of the business sector. Of this number 2,700 are the researchers and the rest (1,800) are the employees of technical and implementation departments. The business sector represents 16% of employees of R&D in comparison to the total number of R&D employees. It can be a minimal starting point for further revitalization of the potential R&D in the industrial sector and for the development of the creative sector of the Slovak economy.

Expenditure on R&D are EUR 175 million per year in the business sector, of which only EUR 18 million (10%) represent funds received from State resources. The significant increase of business resources in research and development is expected after the introduction of appropriate incentive instruments (tax relief for R&D investment for entrepreneurs).

2.5.4 Scientific performance of research institutions

The result of the insufficient inputs is below-average outputs as measured by biblioanalysis, as evidenced by the low values of the relative number of the scientific publications and citations and the below-average citation

index. The scientific performance of universities and SAS by publishing performance ranking Institutional research organizations - SCIMAGO Institutions Ranking World Report 2012 can be regarded as unsatisfactory. Ranking compares institutions that published at least 100 scientific documents of any type in the world database Scopus from Elsevier.

Only 6 of the institutions are mentioned in the reviews, one of which is the SAS as a whole and 5 universities: Comenius University in Bratislava, Slovak University of Technology in Bratislava, University of P. J. Safarik in Kosice, Technical University of Kosice and University of Zilina. This means that no other institution, university, research institute or enterprise published even 100 works in 2010 in international scientific journals in SCOPUS. The top three institutions are from Bratislava, although not all their performances come from the capital. The performance, which was published from these institutions in the territory of the Bratislava region is approximately 75% and it indicates a significant asymmetry of publishing among scientific institutions in the Slovak Republic. There is currently allocated more than 50% of personnel and technical research capacities in Bratislava. Based on the analysis it can be suggested that the quality of publications of those institutions is good, but there is no world-class R&D and the performance in the basic research is low in international comparison.

Nevertheless, it can be concluded relatively high efficiency of expenditures in terms of the average amount of spending and the number of publications in peer-reviewed journals database in 2005-2009. The publication in sciences was financed in Slovakia less than half of what in Denmark and fifth of what in Germany. Similar ratios of prices and quantities were reported in other fields. Similarly, the cost per citation is lower than the European average. Overall effectiveness of outputs, compared with the inputs, is not bad in Slovakia. The aim is to get selected prospective fields with the supercritical number of inputs among the world's elite.

Currently in Slovakia there are high quality teams with international reputations. Quality scientific results are a prerequisite for entry into the international scientific and technological cooperation and their quality is affected by a low participation of Slovak entities in the international cooperation.

It is necessary to appreciate more the people employed in the field of the research in Slovakia. It is important to continue in the modernization of the technological infrastructure and increase the salary of top and young researchers. The current average salary for the scientists and researchers (6,42 EUR per hour) does not create adequate motivation conditions comparing with the competitive fields (ICT services and the finance sector), even the conditions offered by foreign firms for the top experts. It is necessary to amend the current legislation and respective methodical guidelines in the field of financing of the research to allow a competitive and non-discriminatory salary for the R&D activities.

2.5.5 Participation of the Slovak Republic in the European research area and the preparation of the National Roadmap for building R&D infrastructure in the Slovak Republic

The Slovak Republic has seen the highest number of participations in project consortia (638) when entered the FP7 in 2007. It also received the highest EC contribution (15.23 mil. €) in the calls issued in that year. In the following years the interest in FP7 projects declined by more than a half and began to rise gradually in 2010. The decrease of the interest in FP7 projects is affected by more available resources from the Operation Programme Research and Development, in which the first calls were first announced in February 2008. This revealed a lack of administrative capacity for this type of projects.

Overall participation was recorded of 2 086 project applications, in which the project participation developed in 362 designed projects and the contracted EC contribution of 49,92 mil. €. That ranks us up to 25th place among EU countries in recalculation per capita. The better situation concerns the relation to the amount of GDP where we are placed on the 22nd place. The EC contribution per project is relatively small in Slovakia because of the

role of Slovak organizations in projects (we coordinated just 28 projects only 4 of which were research), but also the salaries of scientists, which form a significant part of the project budget. An important factor is our participation in projects in which there is a higher number of participants. At the same time a large number of our participation consists of projects primarily focused on their support, but not on the research itself (CSA projects).

The success of the SR in getting projects is 17,39% (19th place), however, the success according to the level of the EC contribution decreases to 10,63%.

Slovak participation in FP7 in terms of geography reflects human and technical capacities of Slovak research. Research institutes of the Bratislava region are involved in calls (of interest) at the level of 56% and reached 60% of all real participation and 63% of the financial contribution of the European Commission. Among the other regions especially Kosice and partially Zilina are successful.

The University sector is the most active in the number of participations in the applications (717), as well as in obtaining projects (114). However, firms are more successful in the amount of financial contribution and gained in 108 participations 17,36 million €. Research organizations (SAS and sector institutes) participated in 87 projects with a total EC contribution of 12.73 million €. Universities dominate in entire FP7 to a much greater extent than in our country, and at the expense of the business sector. However, it is positive in our country that we have a relatively high participation of small and medium sized enterprises (participated in 71 projects).

In total, 14 universities, 37 Institutes of SAS and other departmental institutes, 70 companies, 19 organizations of public and state administration and 13 non-profit organizations participated in at least one project FP7. It is the absolute number of 153 institutions and companies. In terms of thematic areas we engage to the greatest extent in ICT projects (51 participations and 9.34 mil. €), nano-science and Materials (30 participations and 6.52 mil. €) and to projects aimed at Security (17 participations and 5.16 mil. €).

Slovakia is weakly involved in joint European initiatives aimed at the coordination of research activities among member states. Out of a total number of 31 ERA-NETs we participated only in 9 (a total of 11). Only in 6 cases the Slovak participant is a research organization and not a grant agency or a Ministry. Slovak Research and Development Agency (SRDA) did not participate in either one of the ERA-NETs.

Slovakia participates in a total of 18 of the 36 European Technology Platforms (ETP) and 2 of 5 Joint Technology Initiatives (ENIAC and ARTEMIS), which are based just on ETP. Both of these initiatives have a significant impact on defining of the guidelines of the research support in the EU. Slovak participation in these activities should be systematically supported also by the state.

In the Joint programming, which aims to bring together ministries responsible for different areas at the national level, we are engaged only in 3 initiatives. The participation of Slovak entities in other EU programs supporting innovation (CIP) is also very low.

Slovak R & D organizations are involved in projects of large European ESFRI infrastructures. Slovakia currently participates in the creation of the ESFRI Roadmap through preparing a building the infrastructure R&D of Slovakia as well as the membership in ESFRI fora and the strategic working groups in the ESFRI Roadmap. The Action plan for building R&D in Slovakia (hereinafter referred to as “SK Roadmap”) will be consistent with the priorities of RIS3 and create conditions for the achievement of the stated priorities in building and maintaining domestic Slovak R&D infrastructure in favor of increasing employment and economic growth. In accordance with the SK Roadmap the participation of Slovakia will be more efficient in the projects and the priorities will be set for the participation in the new projects. It is intended to involve the countries of western Balkans to the regional groups of Central and Eastern Europe.

The National Plan for R&D infrastructure development will propose to build bodies, which according to priority areas for research and development in the SR concentrate a critical mass of human potential, the necessary technical infrastructure and have the necessary competencies of coordination and management. This creates inter alia connection between Slovak R&D infrastructures that are built in the infrastructure plan ESFRI Roadmap projects. In the framework of the SK Roadmap Slovakia will continue in supporting of the Slovak participation in the ESFRI Roadmap projects, in which it is involved, i.e. European XFEL, ESRF, ILL 20/20 ESSurvay, FAIR a PRACE. At the same time the Slovak research has a potential to participate in some infrastructures in the ESFRI Roadmap, where the ERIC consortiums will be created by 2015 such as JHR, MIRRI, MYRRHA, ELIXIR, EPOS-ERIC, LIFEWATCH-ERIC etc. SK Roadmap will identify the targets for setting priorities in building and maintaining the Slovak infrastructure of R&D. The participation in named and new consortiums will be assessed with regard to the consistency with the priority areas RIS3 and the economic efficiency of the infrastructure investments.

2.5.6. Infrastructure and reasearch capacities

Infrastructure for research, development and innovation is a prerequisite for increasing the technological and innovation level of the economy, while effective technology transfer. The quality and quantity of research, development and innovation infrastructure has been neglected for a long time and has a moral as well as physical obsolescence. Modernization of the scientific and research infrastructure has been the large part of the implementation of the Structural Funds in Slovakia, which partially reduce the deficit.

Before 2007 there were not any major research centers in Slovakia and even no real funding system, at least leading to the creation of such centers comparable with some other EU countries. One exception before 2007 were national programs for research and development in which there was one project realised with the investment character, which supported three centers: Biotechnology Centre of the Slovak Republic (BITCET, EUR 4.9 million), Laboratory of Nuclear Magnetic Resonance (NMR, EUR 6.5 million) and the Laboratory of electromagnetic Compatibility (EMC EUR 1.5 million). All these centers operate continually.

A significant change occurred only in the programme period 2007 – 2013 when research and development capacities were built mostly through EU structural funds investments – OP Research & Development. A managing authority was the Ministry of Education of the SR (currently the Ministry of Education, Science, Research and Sport of the SR). This programe supported especially projects from the area of ICT, biomedicine and biotechnologies, environmental protection, agriculture and food production.

The knowledge base in the Slovak Republic has a considerable asymmetry in terms of territorial parts. In terms of the research and development potential there is located more than 50% of all Slovak capacities. Departments located in the Bratislava region have more than 60% of performance in the field of international R&D engagement measured by the success in the projects of 7th Framework Programme of the EU and more than 70% of all scientific outputs of Slovakia published in respected international journals.

Educational, scientific and innovative activity in the Bratislava region is linked with the economic development of the whole Slovakia. Teams of researchers from research institutions in Bratislava cooperate with the economic practice (entrepreneurs) also outside the region and the teams play very important role for the whole Slovak economy e.g. automotive industry, mechanical engineering, energy etc. Bratislava educational institutions educate a substantial part of Slovak students from all regions and prepare the high-quality labour force, which is required by the industry to be competitive. Almost 80% of students of two largest universities - the Comenius University in Bratislava and the Slovak Technical University in Bratislava - are residents outside the Bratislava region.

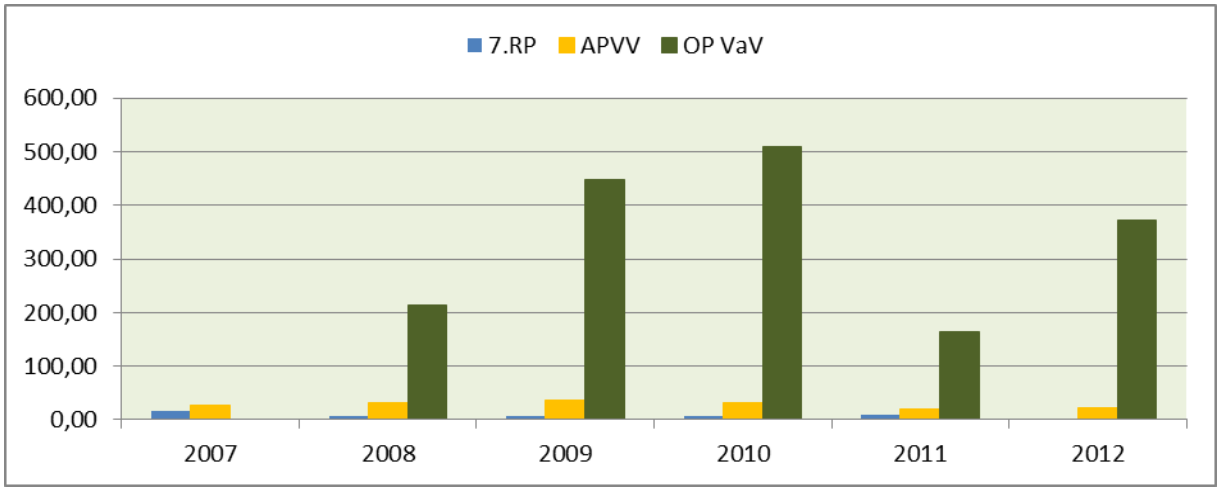
The Bratislava region is facing the negative consequences of long-term underfunding of education, research and development in spite of the statistical reporting of the high GDP per capita in the region. On this basis, the

European Commission granted to the Bratislava region an exemption of 30% of the total allocation in the Operational Programme Research and Development for the years 2007 - 2013. This exemption does not cover innovations.

The Bratislava region is a key part of the research-innovative ecosystem of Slovakia and it is not possible to meet strategic tasks of the economic and society development without this region.

In Slovakia in 2007-2013 OP Research and Development was the dominant source of competitive funding not only from the structural funds, but globally. This operational program supported the implementation of research and development in the newly established R & D centers.

***Graph 6**: Amounts of contracted funds in EUR by source of funding and by the year of the calls*[11]



***Data:** Annual reports of SRDA, State Budget for 2012; Annual reports on the implementation of OP Research and Development from 2007 to 2011; Calls in the OP Research and Development, E-corda 18/10/2012*

7. RP - FP7 programme; APVV - SRDA; OP VaV - OP R&D

This tool generally supported 419 projects in which 782 participants[12] participated. Overall, the projects were supported in total of EUR 859.37 mil. (NFC) and including co-financing was up to 931.56 million. €. Overall, 208 institutions were involved in the projects. Of which the 110 from business sector, 47 SAS institutes, 25 universities and colleges, 15 research institutes and ministries and 3 non-profit organization.

It is expected that the results of the project will have the positive impact for the whole society in the future, for example creating 599 new jobs, improving the quality of education of 5600 postgraduates who will benefit from the new infrastructure, improving the working conditions of the researchers themselves. It expected to award more than 80 patents and the creation of 14 start-up companies.

As shown in the chart, the dominance of the Operational Programme Research and Development is really strong and other competitive resources represent only a minor share of competitive funding. The annual allocations of the Operational Programme Research and Development exceed the amount of institutional funding of science in Slovakia.

The most involvement in the projects belongs to universities with a total of 365 participations in projects, SAS recorded 217 participations, entrepreneurs - 141 participations, sectoral institutes - 56 participations and non-profit organizations – 3 participations. Universities are the most successful of acquired NFC – EUR 548.5 million

[11] For the OP Research and Development calls in 2012 there are accounted allocation for building science parks and research centers, not contracted amount of NFC

[12] These are the summary numbers for all projects, not a number of genuine participants.

(total budget of EUR 574.89 million). SAS has received grants in the amount of EUR 149.35 million. Entrepreneurs received grants for the projects with the total budget of EUR 158.73 million.

Thanks to the OP R&D the most funds were invested in solving ICT projects (EUR 234.82 million), followed by biotechnology and biomedicine (EUR 174.91 million) and environmental protection, agriculture and food (EUR 137.8 million). On the other hand, the least funding is heading in sustainable energy and energy (EUR 75.29 million).

The thematic focus of the projects of the creation of centers of excellence was formed by the research community itself and it did not indicate in the calls for proposals. There were promoted the projects of excellent scientific teams with potential of the growth and development. Calls were on demand side and their evaluation was based on the quality of the proposal. The requirements are gradually increased in other calls. This procedure led to a few select strongest thematic research areas represented by several consortia of the strong R&D institutions. Crystallization of strong thematic areas and institutions can be considered as the most important contribution of the programming period 2007-2013.

In terms of support for the research infrastructure the projects can be divided into 8 types:

- Centers of Excellence (support excellent fundamental research)
- R&D centers (industry - academia)
- Competence Centers (relatively large clusters of academic institutions and industry)
- The applied research projects and technology transfer in the context of established research centers
- Projects for modernisation of the infrastructure of universities
- Modernization of equipment
- National projects
- University science parks and research centers - I. stage[13].

No form of support for research and development in various types of research centers meant the creation of separate legal entities. It was the creation of partnerships based on partnership agreements between the participating organizations.

It was funded a total of 67 centers of excellence (hereinafter as CE). These were projects of EUR 2-3 million focused primarily on materials research, nanotechnology, environmental protection and biotechnology and biomedicine. These projects represented the first step to a greater funding for the research infrastructure. At the same time they began to create cooperation between partners and within the organizations of research and development. An important limit of the CE usability is ineligible activities with the entrepreneurs.

R&D centers (hereinafter as RDC) represent the first major projects of cooperation between academic institutions and firms, while firms co-specified the topic of research for the project. The positive aspect of these projects is mainly the establishment of closer cooperation between institutions from different sectors. However, the rigid implementation rules for the use of equipment between the partners cause some problems. RDC were financed mainly in the field of materials research and nanotechnology, energy and sustainable energy and biomedicine and biotechnology. Most of these projects were solved in Bratislava and Trnava region.

Competence centers (hereinafter as CC) are the first major step towards building large projects integrating several partners from different sectors. They create linkage between collaborative public research institutions and entrepreneurs. Slovakia established eight centers of excellence in the four regions (3 in Bratislava region, 2 in Košice and Zilina region and one in Banska Bystrica region) with project partners from all other self-governing regions. Evaluation of submitted the creation of centers of excellence projects was on the basis of scientific excellence and interest from business partners, as well as assessing the potential economic benefits.

[13] Projects are beginning to realize at the end of the period 2007-2013.

The average support was at approx. EUR 8 million per project. Overall, 74 organizations from all sectors are involved in the projects. The support was given to the following centers:

- Competence center for research and development in the field of molecular medicine
- Competence center for new materials, advanced technologies and energy
- Competence center of smart technology for computerization and informatisation of systems and services
- Competence center for industrial research and development in the field of light metals and composites
- Brokerage center of aviation technology for transfer of technology and knowledge in transport and transport infrastructure
- Competence center for research and development of diagnostics and therapy of cancer
- Competence center for biomodulators and nutritional supplements (Probiotech)
- Competence Center of knowledge technology for innovation of production systems in industry and services

Competence Centers represent a grouping of partners implementing the research and development activities with an aim to its commercialization and there was built an adequate infrastructure for the implementation of the tasks.

RDC and CC are collaborative projects between academia and industry. There was a relatively high demand on the participation in research and development projects from the industry side.

Nowadays there is an implementation of projects of building university science parks (hereinafter as USP) in the amount of about EUR 300 million. To realize one park there will be allocated approx. EUR 40 million. This is the last phase of the OP R&D in the programming period 2007 - 2013. By 31 May 2013 there was approved a total of 11 projects in Slovakia. In the framework of the built science parks there have been supported scientific elite teams with the potential of the further cooperation so that the outputs could be commercialized in practice at the maximum level.

Table 2 *Review of approved USP projects as of 31 May 2013*

	Name of the project proposal	Name of the submitter
1.	University science park Zilina	University of Zilina
2.	University science park TECHNICOM for innovative applications to support knowledge technologies	Technical university of Kosice
3.	Research Center of advanced materials and technologies for current and future applications „PROMATECH“	Slovak academy of sciences
4.	Building the research centre „AgroBioTech“	Slovak university of agriculture in Nitra
5.	University science park „CAMPUS MTF STU“ - CAMBO	Slovak technical university in Bratislava
6.	Medical University science park in Košice (MediPark, Košice)	University of P. J. Šafárik in Košice
7.	Research centre in Zilina university	University of Zilina
8.	University science park for biomedicine Bratislava	Slovak academy of sciences
9.	Centre for applied research of new materials and technology transfer	Slovak academy of sciences
10	University science park Comenius university in Bratislava	Comenius university in Bratislava
11	University science park STU Bratislava	Slovak technical university in Bratislava

Source: MESRaS SR

Science parks are the complementary capacities of competence centers. Science parks with competence centers are the umbrella of the field of scientific specialization with possible economic outcomes. They present the scientific field of specialization with economic potential. To make their operations more effective it will be needed to create mechanisms for the efficient linkage of the innovation actors.

Overall, the Slovak science is still underfunded and EU structural funds do not change this fact. International comparisons show that the Slovak Republic should increase the amount of resources invested. Financial investment in research and development in Slovakia have long been underfunded and are far behind the EU average. Within the EU, Slovakia is placed on the last 3 places together with Bulgaria and Romania for long term. For example, among the countries of the Danube Region, Slovak Republic invests in research and development even less, such as Croatia, Serbia and Ukraine.

2.6 ANALYSIS OF SCIENCE AND RESEARCH AREAS IN THE SLOVAK REPUBLIC

The group of experts from universities, research institutes (including SAS), industry research institutes, representatives of the industry and industry unions was created for the analysis of science and research.

During the analysis of science and research the specification approach was applied based on two perspectives, the first is the utilization of the number of professional citations for the identification of professional critical mass and the second is the success in the FP7 projects, measured by the number of participations of Slovak teams and related financial sources.

The original scientific works of authors functioning in the Slovak Republic published in the registered international scientific journals in the period 2007-2013 listed according to the scientific groups are in table 3.

Table 3: *The original scientific works of authors functioning in the Slovak Republic published in the registered international scientific journals in the period 2007-2013 listed according to the scientific groups (SCOPUS)*

No.	Name – English language	Name – Slovak language	Number of citations
1	Agricult. Sci.	Poľnohospodárstvo	2 676
2	Biochemistry, Molecular Biology	Biochémia a molekulárna biológia	2 945
3	Chemical Engineering	Chemické inžinierstvo	744
4	Chemistry	Chémia	2 520
5	Computer Sci	Počítačové vedy	706
6	Earth Sci.	Vedy o Zemi	1 290
7	Economie	Ekonómia	416
8	Energy	Energie	234
9	Engineering	Inžinierstvo	2 357
10	Environm. Sci.	Environmentálne vedy	1 210
11	Imunology, microbiology	Imunológia, mikrobiológia	873
12	Material Sci.	Materiálové vedy	2 447
13	Mathematics	Matematika	1473
14	Medical Sci.	Lekárske vedy	4 003
15	Neurology	Neurológia	439
16	Pharmacy	Farmácia	707
17	Physics and Astronomy	Fyzika a astronómia	3 654
18	Scial sci.	Spoločenské vedy	736

Source: SCOPUS database

The classification mentioned is only indicative, but allows designating basic dominant areas of research in which a critical mass exists in Slovak Republic. It is evident from the data that in terms of production of new scientific knowledge the strongest areas are especially in the area of (listed according to the number of published works):

1. Material science, physics and chemistry 8 621
2. Medicine, biochemistry and molecular biology 6 948
3. Agricultural and environmental sciences 3 886
4. Technical sciences and chemical engineering 3 100
5. Mathematics and computing sciences 2 179

These areas include 80 % of publications of all areas and represent dominant research areas in the Slovak Republic. According to research outputs they quantitatively document the real critical mass of individual areas.

Research capacities in individual dominant areas are estimated as following:

1. Information and communication technologies – ICT – 1 100
2. Material sciences, nanotechnologies – MAT - 800
3. Industrial technologies – TECH – 700
4. Biomedicine and biotechnology – BIO – 2 000
5. Sustainable energy and energetics – ENERG – 700
6. Environment, agriculture – ENVIR – 450

From the perspective of identifying the areas of excellence on an international level it is possible to use the data related to the success in FP7 of the EU. These projects are regarded as elite projects confirming the excellence. At first glance the success may be termed as the number of participations in projects, but also as the amount of funds awarded from the financial standpoint.

Table 4: The participation of Slovak research teams in thematic areas of specific Cooperation programe

Thematic area	EC contribution	Number of participations
Information and communication technologies (IKT)	9 348 441,00	51
Nanosciences, nanotechnologies, materials and new manufacturing technologies (NMP)	6 528 634,45	30
Security (SECURITY)	5 165 852,27	17
Food, agriculture, fisheries, and biotechnology (KBBE)	3 352 937,00	23
Health (HEALTH)	2 795 712,47	15
Environment and climate change (ENV)	2 324 120,37	17
Transport (including air transport) (TPT)	2 294 472,20	20
Socio-economic sciences and humanities (SSH)	2 294 275,50	18
Energy (ENERGY)	2 138 514,31	15
Universe (SPA)	52 498,29	3

Source: Ecorda 18/10/2012

Based on abovementioned data the expert group formulated three basic groups of the thematic priorities:

- Research and Development priorities
- Technological priorities
- Societal priorities

The expert group mainly derived from the data analysis of the international success in projects as an objective criterion which reflects the international competitiveness of the Slovak science and research. With regard to the data concerning international published scientific works as well as existing infrastructure of the research the group identified following 7 themes of the scientific research where there is an assumption for the growth and cooperation with the business practice and solving of urgent societal problems:

Research and Development priorities:

1. Material research and Nanotechnology
2. Information and Communication technologies
3. Biomedicine and Biotechnology

Technological priorities:

4. Industrial technologies
5. Sustainable Energetics and Energy
6. Environment and Agriculture

Societal priorities:

7. Selected areas of social sciences (with respect to the most pressing problems of the Slovak society)

2.6.1. Priorities of reasearch and development

- **Material research and nanotechnology** focusing on new materials (especially lightweight structural materials and composites, organic materials, steel and special materials), surface treatment and diagnosis system for applications in the field of the Slovak economic specialization, especially in the automotive industry, mechanical engineering, engineering, electronics, metallurgy, energy. In these fields Slovakia has more than 1 000 researchers, who published almost 30% of all outputs in the international scientific journals.
- **Information and communication technologies** focusing on information and communication systems, including technological process management systems, as well as data mining services and processing of large databases and the safe use of ICT including web technologies and cloud solutions. These fields are the core for the creative industry, which is growing segment of the Slovak export of services for 10 years and currently 40 000 employees work in this segment. Together with business services it represents more than third of the Slovak export of services. This field has a potential for the creation of new small businesses, development of existing firms and the creation of new jobs with high added value. This agenda is crucial for implementing of the digital agenda in Slovakia. Almost 1 300 R&D employees work in the academic institutions with this specialization and 1 500 alumni finish the Master´s study in this specialization per year. This segment is the most successful in the FP7 in all research sectors.
- **Biomedicine and Biotechnology** focusing on new diagnostic and therapeutic approaches for cancer, heart disease, blood vessels and brain, endocrine and metabolic disorders, infectious diseases and allergies. In the field of the biotechnology the focus is on pharmacological and industrial biotechnologies. Almost 2 000 researchers work in the segment and they publish more than fourth of all Slovak publications in international scientific journals. The results are used in the field of the diagnostic, prevention and therapy of diseases in cooperation with three medical faculties.

2.6.2. Technological priorities

- **Industrial technologies** focusing on automation, control, robotics, as well as the technology for forming, cutting and joining of new metallic and non-metallic materials and composites, logistic technologies, processing technologies for polymers, wood and products thereof. Slovakia has about 700 research employees in the field, who published more than 10% of all outputs in international scientific journals.
- **Effectively usable energy sources** (reduction of the energy intensity, emission reduction, program ALEGRO, smart grid technology, the safety of nuclear power plants, etc.). Slovakia has experiences with construction, operation and decommissioning of nuclear power plants. At the same time it also has already built research and training capacities. It is therefore a real priority to ensure energy security of the country and finding new sustainable ways of producing electricity. Slovakia has 350 researchers in the field.
- **Environment, Agriculture, Food security** with a focus on advanced technologies and practices in agriculture and food production to ensure the sufficiency of good quality food production. The better utilization of the forests, which cover almost 50% of the Slovak area, is a good opportunity together with the subsequent processing of wood. Slovakia has about 450 researchers in this field, who produce about 9% of all outputs in international scientific journals.

2.6.3. Societal priorities

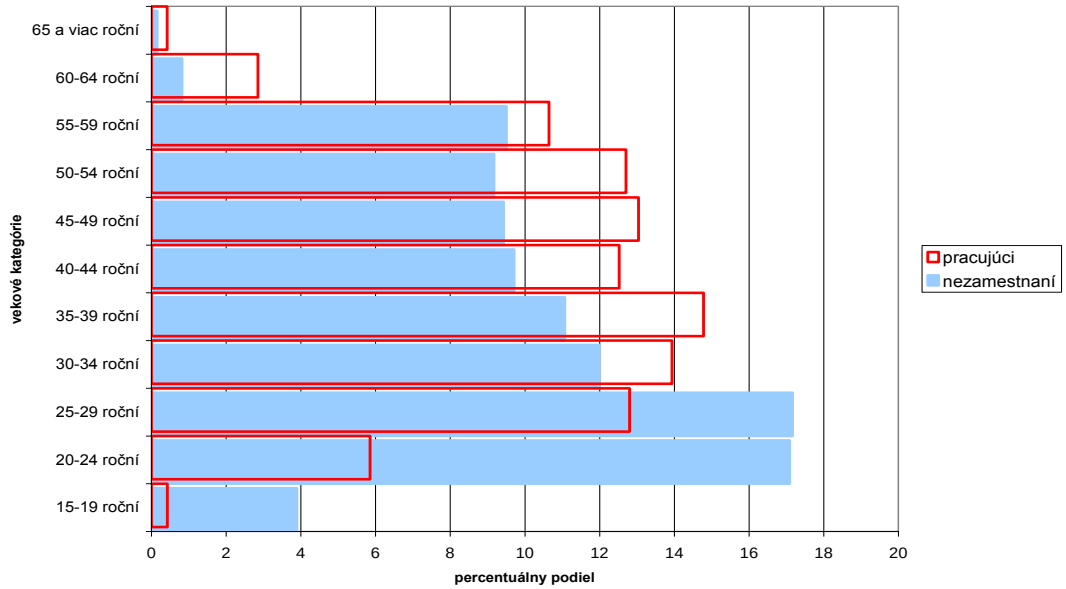
Societal thematic priorities are specified with regard to the most pressing problems of the Slovak society with the greatest burden for the Slovak society. Slovakia has a relatively adequate scientific potential in a broad range of disciplines of social sciences and humanities. Societal thematic priorities are:

- **The aging population and quality of life** focusing especially on the active aging, health security of aging fellow citizens including the help in the field of mental health, social security, elimination of barriers for handicapped and friendly self-government. According to the demographic prospects the Slovak population will be the one that is ageing the most rapidly in Europe. Therefore there is a grave need to look for solutions that improve the conditions for an active life of aged people and quality of their life.
- **Multietnicity, social inclusion and poverty problems** of some population groups. We will focus on seeking solutions and also effective solutions for the groups most affected by the poverty, to identify objective and subjective reasons of the poverty, habits and specifications. The emphasis will be based on long-term sustainable solutions.
- **Employment of young people in the changing conditions**. An employment of young people after finishing their studies and especially their first job are critical factors in the field of education and for the preparation of young people for the job. Due to the high rate of unemployment of the young people it is necessary to look for more efficient approaches. Currently, there are many alternatives for the employment of young people, not only an employment contract. Opportunities are also in the field of creative activities and doing own business. Therefore we will focus on the ways to support the employment of young people. Although there is a research capacity, which can handle it from a purely research perspective, the emphasis will be done on the practical support mechanisms.

2.7. HUMAN RESOURCES

As of 1 July 2012 the number of population was 5 407 579 in Slovakia. The proportion of women in the total population accounted for 51.3%. The number of the economically active people was in the same year 2 706 500 persons, of which employees were 2 329 000 and unemployed persons were 377 500. An unemployment rate was 14%.

Graph 7 *Employed and unemployed persons by age in 2012*



Source: Statistical Office of the SR

vekové kategórie - age categories, from 15 to 19 years to 65 and older; percentuálny podiel - percentage share from 0 to 20; red - employed; blue - unemployed

2.7.1. Ageing of society

In Slovakia the main demographic trends will be slowing or stopping the growth of population and continuing population ageing during the period 2011-2020. An important fact will be also stopping the growth of the productive age population and the subsequent decline. The aging population will have a significant impact on the sustainability of the public social services. On the one hand, the continuing decline of the productive age population will reduce the number of contributors to the system of public finances. On the other hand, it will increase pressure on the state funding of social services (especially in the health and pension area). According to the European Commission projections the Slovak Republic will be among the countries with the highest increases in gross public expenditure on pensions, health and long term care. The share of these expenditures in GDP will increase from 14.5% in 2010 to 15.7% in 2020 and 22.2% in 2060[14].

According to the European Commission projections a labour productivity growth dependent on the introduction of new technologies will remain a decisive factor in the economic growth of Slovakia in the long term. It is further assumed that the contribution of population size and labour force resources to economic growth is becoming less and after 2030 it becomes a negative factor for growth. The entire increase in gross domestic product (and hence sources of funding for public social services) should provide only new technologies and forms of work organization.

[14] European Commission (2012): The 2012 Ageing Report. Economic and budgetary projections for the 27 EU Member States (2010-2060).

The largest share of unemployed in 2012 was registered in ages from 15 to 29 years old, i.e. the young people, graduates of secondary schools and universities. In these categories the biggest difference has been recorded between the proportion of the unemployed and working people to the detriment of working people. In the season 2011-2012 it was an average of 23,697 registered unemployed high school graduates, of which 2 295 grammar schools graduates, 9 412 training courses graduates and 7055 graduates of courses having a widespread practical education and 5 601 unemployed university graduates. Of those groups, the labor market has **absorbed** mainly graduates of courses having widespread practical education (28%) and graduates of training branch (18%) and study branch (14 %) (UIPŠ, 2012). The number of vacancies for graduates was 2 453 on average in the 2011-2012 season, most in the Bratislava region (492), Trenčín Region (473) and the Trnava region (337) (UIPŠ, 2012).

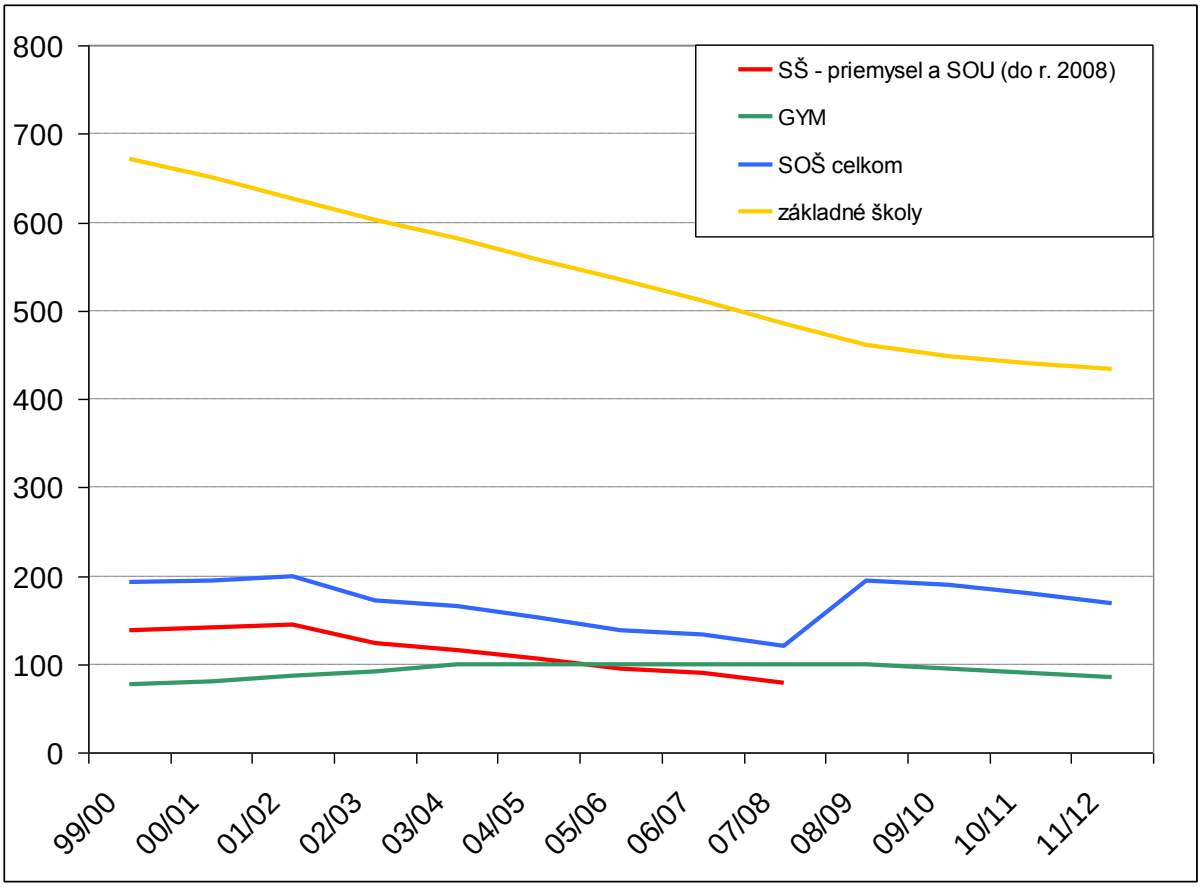
2.7.2. Primary and secondary schools

In the school year 2012-2013 there were registered 2 177 primary schools with 430 139 pupils, 244 grammar schools with 80 346 students and 467 secondary vocational schools with 159 121 students (full-time). 6 134 teachers taught at grammar schools, 12 372 teachers at secondary vocational schools. In the school year 2011-2012, 19 098 students completed their education at grammar schools and 47 170 students at secondary vocational schools.

For the last 13 years (school years 1999-2000 and 2011-2012) it continues a decline in the number of primary school pupils but with continuing of the education capacity in Slovakia. The downward trend is a natural reflection of demographic trends in Slovakia, i.e. reducing the number of population in the pre-productive age and the childhood. Nevertheless, during the monitored period the number of students at secondary schools increased gradually (except for a slight decrease in the last 2-3 years), from which one can infer stable or slightly increasing pupils' interest in end-year primary schools for this type of school.

On the other hand, since 2002 there is a significant decline of students at secondary vocational schools with an industrial specialization. In 2006 the number of students in these schools was lower than in secondary grammar schools and the downward trend continued. In 2009 there was a change in the classification of secondary schools, which resulted in the unification of all secondary schools and vocational schools. Despite this change, the number of students declines constantly in these schools. Currently, in this type of school there are studying more students than at grammar schools in absolute terms, but it is a pooled data from former secondary business schools, hotel schools, forestry schools, technical schools, etc. If the unification was not realized, it can be assumed that the difference between grammar schools and secondary vocational schools in the number of students (in favor of grammar schools), would continue to increase.

Graph 8: *Number of primary school pupils and selected types of secondary schools (1999 – 2011) in thousands*



Sources: *Statistical yearbook:* The Institute of Information and Prognoses of Education

SŠ priemysel a SOU - Secondary schools and Industrial and training colleges; GYM - Secondary Grammar schools; SOŠ celkom - Vocational schools (in total); základné školy - Primary schools

Technical specializations in the secondary school system lose popularity at the expense of grammar schools, but the pupils' interest in the sciences or specific subjects is not monitored. The monitoring would certainly contribute to a comprehensive picture, as well as a survey of attitudes and approaches to learning.

Mathematical skills are the cornerstone of engineering, science and ICT disciplines. The knowledge of the skills is very important for mastering engineering disciplines at secondary schools and universities and they also facilitate the selection, placement and adaptation of employees in the working environment of highly qualified professions, especially in the automotive industry, mechanical engineering and electrical engineering. The evaluation of PISA reflects the fact that in 2009 Slovakia placed on the 23rd place in ranking of the numeracy in the group with an average output, which is not significantly distinctive from the OECD average (NÚCEM, 2009).

At the secondary vocational schools, i.e. schools that "produce" the labour force for the industry, it is a relatively low percentage of students at the highest levels of numeracy. Such levels are desirable and necessary for the engineering fields and professions. Therefore it is necessary to support teaching mathematics at these and other types of schools.

Through understanding the natural sciences young people can be fully integrated into the society and working life, particularly in industries in which sciences and related technologies play an important role. Slovakia was placed on the 34th place in the ranking of the natural science literacy in 2009 in the group with an average output below the OECD average (*NÚCEM, 2009*).

Most students with the highest level of the natural science literacy (levels 5 and 6) attend eight-year and four-year grammar schools. However, despite the school's academic focus we find some percentage of students at risk group, t. j. with a low level of natural science literacy (level 1 and below 1). The students of vocational schools (with no GCSE exam) represent the largest part of the risk group, i.e. about 50 %. Those branches prepare students with a lack of a basic functional literacy at the end of the compulsory education for the labour market. In primary schools approximately 30 % of students are in the risk group. Students at level 5 or 6 of numeracy and natural science literacy are in the elite and represent the potential for the development of science and technology in the world.

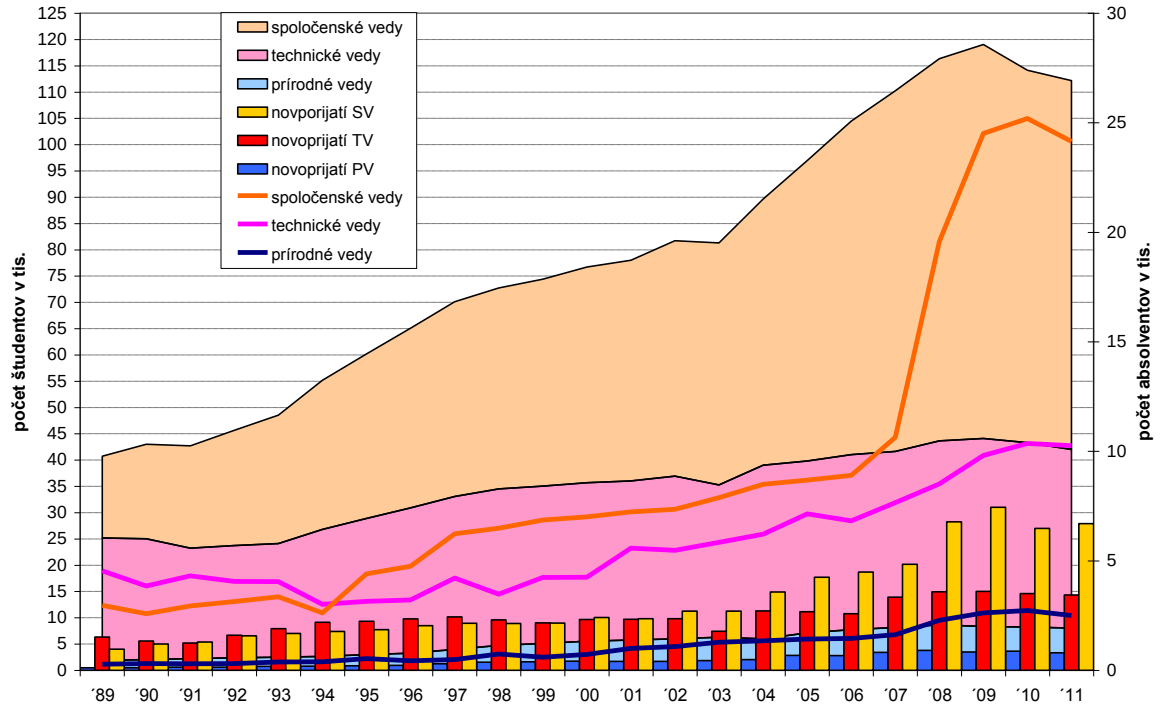
2.7.3. Universities

As of 31 December 2012 Slovakia had 36 universities with 132 faculties with 131 306 students at I. and II. level and 5 810 internal students at III. level and 58 035 students at I. and II. level and 4 925 students at III. level of the external study. 10 825 teachers taught at all universities. 42 493 students at I. and II. level and 1 343 students at III. level completed university studies in the school year 2011-2012.

In 2012 most candidates applied for economic sciences (13 007), pedagogical sciences (8 454) and teaching professions (5 513). 3 658 candidates applied for the Informatics and computing and 3 435 candidates applied for engineering and other metal processing production. The first five places in the number of applications for study programs and branches were: Teaching (7 336), Business management (6 422), General medicine (5078), Law (4 710) and Social work (4 243).

The number of students/graduates at universities in Slovakia segmented into branches and branch groups is monitored since 1989. When we look at the data, which are relevant in assessing the choice of the branch done by secondary school graduates, it is a mistake that we do not distinguish graduates of different types of secondary schools. Since 2009 the number of all university students (together at public and private schools) decreases and this trend is symptomatic for all branches. The social sciences are leading in the number of university students (about 58 % of the total number of university students during the monitored period). Engineering students are placed on the second place, but they do not form even one half of the number of students of social sciences. The number of students of the natural science is about 5 % of the total number of university students.

Graph 9 *Number of students and graduates in selected fields in higher education (1989 – 2011)*

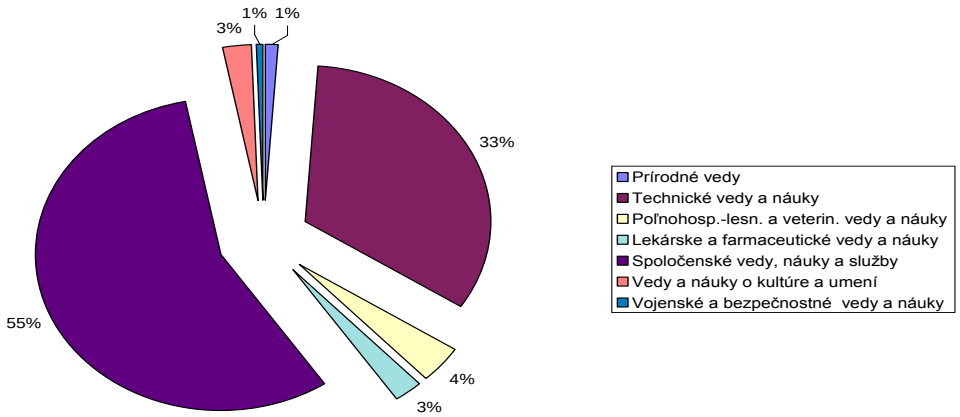


Source: Statistical Office of the Slovak Republic

počet študentov v tis. – number of graduates in thousands; Horizontally – time period; spoločenské vedy – social sciences (SS); technické vedy – technical sciences (TS); prírodné vedy – natural sciences (NS); novoprijatí SV – newly employed SS; novoprijatí TV – newly employed TS; novoprijatí PV – newly employed NS; spoločenské vedy – social sciences; technické vedy – technical sciences; prírodné vedy – natural sciences

NB. The right axis belongs to the Line Graph

Graph 10 *Share of employment candidates according to the field graduated (2011)*



Source: The Institute of Information and Prognoses of Education

Prírodné vedy – Natural sciences; Technické vedy a náuky – Technical sciences and disciplines; Poľnohosp. – lesn. a veterin. vedy a náuky – Agriculture, forestry and veterinary medicine sciences and disciplines; Lekárske a farmaceutické vedy a náuky – Medical and pharmaceutical sciences and disciplines; Spoločenské vedy, náuky a služby – Social sciences, disciplines and services; Vedy a náuky o kultúre a umení – Culture and art sciences and disciplines; Vojenské a bezpečnostné vedy a náuky – Military and security sciences and disciplines

According to the survey concerning the employers' interest in graduates of the concrete branches/fields, the Informatics (72.75%) and building industries (45.12%) are the most demanded. The interest of graduates in other technological and natural science branches is lower such as social sciences (32.04%), technology (27.89%), mechanical engineering (27.71%) and natural sciences (26.88%).

Despite the interest of employers the largest proportion of job seekers among graduates accounts for social sciences (55%) and engineering sciences (33%).

2.7.4. Further education

In 2011, 299 694 persons have attended 22,016 further training activities (UIPŠ, 2012). Most people have participated in activities concerning continuing professional (vocational) education (44.59%), training to obtain partial qualifications (22.75%), cultural education (11.42%) and civic education (2.35%). The seniors have participated in education at the rate of 1.24% of total number of involved persons. In the field of education ISCED 97, most individuals participated in the activities of preparing of teachers and economics education (17.61%), management, economics and administration (15.59%), humanities (13.43%), security services (10.11%) and Informatics and computers (7.76%). In the field of the technology, manufacturing and building industry 3.61% persons of all persons involved have attended the courses. Most educational activities have been realized in the field of humanities and arts (32.66%), social sciences, economics and law (11.20%) and education and training (10.64%). Taking into consideration the form of education, evening attendance, and weekend and other regular education (44.87%), intensive attendance education (17.55%) and short one-time activities (19.54%) were predominant. The distance education was used by 0.56% and the e-learning by 1.90% of all participants.

The introduction of decentralized model of elementary and secondary education management did not result in the improved quality of results. Inefficient school funding models and the market failure resulted in the deterioration of the school network. Founders of schools do not have the factual interest in the good quality and the problem also negatively affects universities. An unintended consequence of applying the method of decentralization and financing is also the non-correlation of the demography and the number of schools together with their focus and capacity at all levels.

At the secondary schools and universities most students are focused on social branches and humanities, which offer insufficient job opportunities at the labour market. In order to increase an interest in the technical training and attractiveness of vocational schools it is necessary to support teaching of mathematics, natural science and engineering with higher linkages into the business practice. The education should be in consistence with needs of the labour market (a dual education). It is necessary to support a professional specialization at primary schools through the development of polytechnic education and job skills together with the efficient work of teachers and school advisers who can reflect the requirements of the labour market. It is necessary to initiate and coordinate information campaigns and programs aimed at motivating young people to entrepreneurship and raising awareness on the protection of intellectual property at all levels of study.

3. SWOT ANALYSIS

3.1. SWOT ANALYSIS

SWOT Analysis of NSIS of Slovakia	
Strengths	**Weaknesses**
➢ Key industrial sectors represented by MNC ➢ Competitive technological level and production level in export sectors ➢ Increasing interest of businesses and industrial clusters in rebuilding of industrial R&I structures (entities) ➢ Increasing share of information services in export services ➢ Good results in selected scientific and technological disciplines, with concentrated research teams and workplaces (materials and nanotechnologies, information and communication technologies, biomedicine and biotechnologies, industrial technologies, energetics and energy, environment and agriculture, social sciences and humanities), ➢ Dynamic growth of ICT usage in all business processes ➢ The quality of human resources in the competitive production sectors stemming from the tradition	➢ Insufficient share of own (Slovak) R&I activities in export sectors in Slovakia ➢ Absence of corporate industrial research In Slovakia ➢ Insufficient integration of domestic businesses into sub-supplier chains for MNCs ➢ Undercapitalization of businesses associated with low innovation performance, especially SMEs ➢ Marginal application of revolving schemes including venture capital for R&I support. Absence of the system for the application of venture capital ➢ Low own added value of production of domestic businesses ➢ Absence of the complex R&I strategy and its implementation ➢ Excessive number of broadly defined priorities of state policy in the area of science ➢ Fragmentation of resources for building R&I infrastructure on a national level (state budget, structural funds) ➢ Extensively built R&I infrastructure ➢ Barriers for companies to access the infrastructure of public R&I workplaces ➢ Administrative barriers to implementation of projects financed from structural EU funds into practice ➢ Low level of cooperation between academic sector and industry ➢ Low share of national resources allocated to financing R&I ➢ Low involvement of Slovak bodies in 7. framework programme (FP7) ➢ Insufficient competitiveness of Slovak R&I organizations within EU ➢ Dysfunctional national innovation system ➢ Barriers to utilizing the protection of intellectual property rights ➢ Ineffective use of resources for the transfer of knowledge and technologies into practice ➢ Absence of indirect tools and motivational environment for the R&I support ➢ Low law enforcement ➢ Absence of legislation stimulating the acquisition of innovative products ➢ Educational system is not linked to the practical needs, especially in the area of technical and natural sciences ➢ Absence of the system and the support of business education and development of creativity in the educational process ➢ Low number of efficient R&I employees focused on the practical utilization of the results
Opportunities	**Threats**
➢ Broadening the connection of domestic sub-suppliers to global supplier MNC chains ➢ Creation of linkages between MNCs' R&I and domestic business R&I framework ➢ Concentration of R&I centres on the limited number of	➢ The shift of investors into territories with different comparative advantages in comparison to the SR (EU) ➢ Insufficient investments in products and technologies based on knowledge also due to insufficient links between MNC and local R&I infrastructure

RIS3 priority areas ➢ Deepening the trialogue between academic, business and public sectors ➢ Potential for using land and strategic domestic natural resources (water, timber, magnesite) in an innovative economy ➢ Support for the conversion to green technologies, materials and products due to legislation and undesirable ecological changes ➢ New "EU Industrial Strategy (Industry 2020)" heading towards the revitalization of European industry ➢ Dismantling the barriers to cooperation (increasing coherence) through quadripartity (quadruplehelix) as a basic governance principle of R&I ➢ The support of R&I projects within Visegrad Four countries and the EU Strategy for the Danube Region and interlinking within ERA also by utilizing the Centrope region potential (Bratislava-Brno-Vienna) ➢ Better use of community programmes, especially Horizon 2020 and the system of ESFRI programmes and projects ➢ Use of European technological platforms by integrating national technological platforms into their activities ➢ Broader use of Slovak republic's knowledge in carbon-free energetics including the level of security that is accepted by society ➢ Insufficiently used agriculture and water resources management potential ➢ Development of social innovations and creative industry ➢ Entry of national innovative firms into global markets ➢ The support for the creation and development of innovative spin-off and start-up businesses ➢ Utilizing the potential of networking (enterprises, R&I structures) ➢ Motivate the businesses to support the innovations and technological transfers by financial tools (innovation vouchers, venture capital funds) ➢ Utilizing the potential of services and products in the area of ICT in the context of Digital agenda 2020 ➢ Renewal of the tradition of vocational and technical education ➢ Creation of the suitable environment for the return of the Slovak citizens employed in foreign R&I organisations ➢ The support for inflow of foreign R&I workers and foreign students to Slovakia ➢ Involvement of young R&I workers in solving practical business problems	➢ Reluctance of businesses to invest in R&I in Slovakia ➢ Limitation of desirable financial support for the R&I system in the Bratislava region ➢ Autonomous functioning of sectors of education, R&I and business practice, which results into different understanding of R&I ➢ Changing population structure with increasing share of population with insufficient quality of education and low professional skills ➢ Persisting educational orientation towards the areas that do not correspond with the needs of the economic practice and knowledge society ➢ Deteriorating composition and quality of graduates in the educational process. Missing graduates especially in technical and natural sciences ➢ Persisting brain-drain abroad ➢ Imbalance of employees' age structure

4. IDENTIFICATION OF AREAS OF THE SLOVAK SPECIALISATION IN RIS3

Based on the analysis of the development of the Slovak economy there were identified the **areas of specialization** based on traditional sectors and **prospective areas of specialization** concerning the fast growing sectors, which have a high potential for the development of the Slovak economy. The analysis of economic development, infrastructure and R&D capacities and their interconnection are the basis for the specialization. An allocation of the Slovak industry does not correspond with the R&I capacities. For using of both potentials it is necessary to create R&I opportunities for existing businesses and to create an environment for the creation of enterprises using already built capacities of R&I. The priority areas must be consistent with the environment and society to make the best use of the potential and synergies. By this way it would be achieved the national and regional competitiveness of businesses, not only at the local but also the global market, which will help to increase the overall competitiveness of the European Union.

4.1. AREAS OF ECONOMIC SPECIALISATION:

- Automotive and mechanical engineering industries
- Consumer electronics and electrical equipment
- Information and communication products and services
- Production and processing of iron and steel

Development trends in the specialization areas of economy

- to increase domestic value-added products, particularly through the effective transfer of technology and science and research results into the production process,
- to develop production processes in industry focusing on better use of available resources, greater use of recycling materials and environment-friendly materials through the R&D&I development,
- the use, placement and replacement of previously used materials for advanced materials with a new and more complex performance, including technological processing (machining, forming, joining),
- to develop technological investment units, particularly in the field of metallurgy, engineering, energy and integrated industrial equipment, with respect to the application and use of light metals and advanced materials in the production of transport and construction facilities to reduce overall weight and contribute to the green economy, development and application usage of composite materials,
- to develop technological investment units, particularly in the energy and industrial facilities, with respect to internationalization activities and the development of so-called "Emerging countries“,
- to make more efficient the production and logistics processes,
- to use ICT and robotics in the production processes,
- to involve in supply chains and internationalization - "the purchase of cooperation is also a purchase“,
- know-how transfer from large to small subjects and vice versa in the framework of the cooperation,
- energy efficiency and renewable energy sources.

4.2. PROSPECTIVE AREAS OF SPECIALISATION:

- Automation, Robotics and Digital Technologies,
- Processing and increasing the value of light metals and their alloys,
- Production and processing of polymers and progressive chemical substances (including smart fertilizations),
- Creative industry,
- Increasing the value of domestic raw material base,
- Support of smart technologies in the area of processing raw materials and waste in the regions of their occurence.

Development trends in prospective areas of specialization

- new technologies allowing the transmission, processing and storage of data,
- smart production system,

- smart and industrial transport,
- smart technologies for the intelligent management of smart products consumption,
- progressive chemical technologies for the production of modern fertilizers,
- technologies and services for the active life and aging, i.e. health care, diagnostics and wellness,
- support of smart technologies in the area of processing raw materials and waste in the regions of their occurrence.

Some identified areas of specialization have partly created conditions for increasing their economic performance and competitiveness through the implementation of R & I activities in cooperation with R & I organizations with infrastructure capacity. To make more efficient their activities it will be needed to complete the necessary structure, mechanisms and linkages which will increase their innovation performance.

4.3. AREAS OF SPECIALISATION FROM THE POINT OF VIEW OF AVAILABLE SCIENTIFIC AND RESEARCH CAPACITIES:

- Research of materials and nanotechnologies,
- Information and communication technologies,
- Biomedicine and Biotechnology,
- Environment and agriculture including modern enviro-friendly chemical technologies
- Sustainable energy and energetics.

Development trends based on the available R&I capacities

- R&I in the field of new materials, their components, polymer composites and their application in the business practice,
- R&I in the field of linking dynamic parts of machines and mechanisms in order to increase the life and performance of devices,
- in the field of plastics it will be realized a research focused on for e.g. the use of recycling and biodegradable plastics in specific applications with reduced burden on the environment after their lifetime,
- R&I in the field of welding, surfacing and untraditional coupling of components,
- in the field of R&I technologies for the exploration and mining of raw materials,
- R&I technologies for acquiring of the electricity and heat from renewable sources (water, sun, wind, biomass and geothermal energy),
- research in nuclear energy with a focus on safety, storage of spent fuel; research of Generation IV reactors and problems of the nuclear fusion, Slovakia's participation in global projects,
- development in the area of improving the efficiency of energy transfer systems,
- development of innovative solutions enabling the rational management in the agriculture and forestry and reducing environmental burdens such as advanced fertilizer systems and chemical substances used in these sectors,
- technologies with a focus on the special chemical and pharmaceutical substances,
- development of solutions in the context of the climate change adaption and strengthening of the internal security.

In Slovakia those prospective areas currently have not established sufficient conditions for the economic revaluation and therefore it will be necessary to complete the links between the research institutes and the business sector as well as the mechanisms of direct economic revaluation.

The positive effect in addressing societal issues will be reached through the support of identified priority areas. The issues are:

- Employment of the young people in varying conditions,
- Population aging and quality of life,
- Marginalized groups and social inclusion,
- Reducing emissions, protection and better use of natural resources (especially water, land and forests),
- Climate change adaptation, etc.

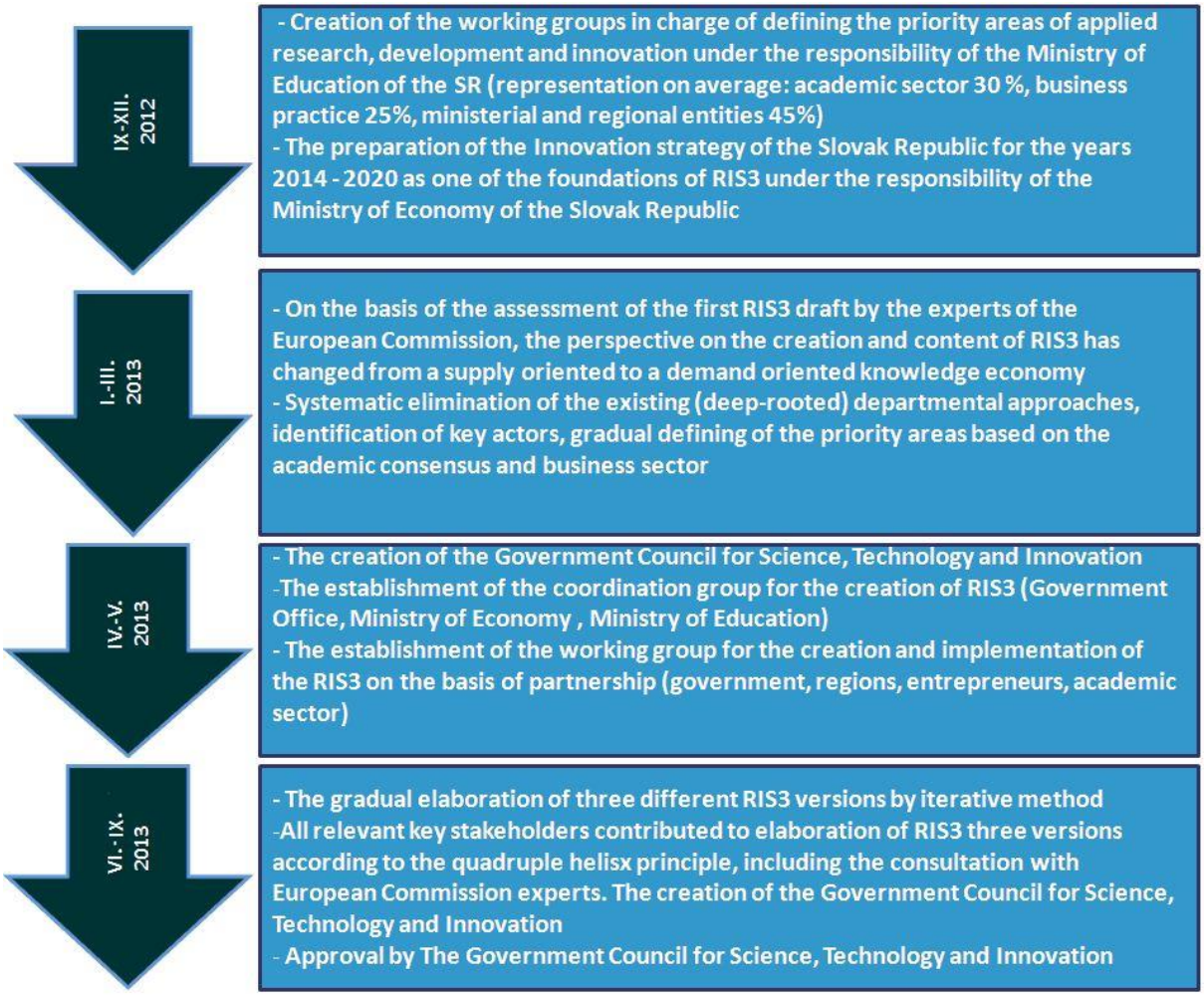
5. PUBLIC GOVERNANCE IN MANAGEMENT OF PROCESSES RELATED TO CREATION AND IMPLEMENTATION OF RIS3

The creation of the Strategy for smart specialisation of the Slovak Republic is based on essential EU[15] documents and essential methodology for RIS3[16] creation and on the practical experience of processing complex strategic documents in the recent period in the SR[17]. All key relevant stakeholders were involved in the process who influenced the creation and implementation of strategy based on a principle of quadripartity (quadruplehelix). The result is a document that is a consensus created with the participation of scientists, enterpreneurs (including SMEs), business clusters, academic sector, regional government structures, civil society structures and including a systematic consulation of foreign European Commission experts.

5.1. RIS3 CREATION

The works on RIS3 elaboration had begun indirectly in mid-2012 via the preparation of two Slovak strategies: a Strategic Direction of Science in the SR and an Innovation strategy of the SR, both with the outlook until 2020. The essential milestones for RIS3 elaboration are highlighted in the Picture 1.

Picture 1 *Essential milestones of RIS3 elaboration*



[15] Europe 2020 strategy- http://ec.europa.eu/europe2020/index-en.htm; http://ec.europa.eu/research/innovation-union/index_en.cfm;

[16] Guide to Research and Innovation Strategies for Smart Specializations (RIS 3); http://ec.europa.eu/regional_policy/sources/docgener/presenta/smart_specialisation/smart_ris3_2012.pdf

[17] Strategy of development of Slovak society, Economic institute of Slovak Academy of Sciences, Bratislava 2010, ISBN 978-80-224-1151-6;

The central coordinators and organizators of RIS3 creation were and still are (according to the Competency Act) the Ministry of Education, Science, Research and Sport of the Slovak Republic (MESRaS SR) (competencies in the area of science) and the Ministry of Economy of the Slovak Republic (competencies in the area of innovation, entrepreneurship support and SMEs). Newly created Government Council for Science, Technology and Innovation (hereafter GCSTI) took the function of essential managerial element in RIS3 creation. GCSTI is an advisory body of the Slovak government, chaired by the prime minister of the SR. Its vice-chairmen are the ministry of education, science, research and sport, the ministry of economy and the president of the Slovak Academy of Sciences. Members include the representatives of universities, civil society associations and industry. GCSTI created the **Coordination group for RIS3 elaboration** from the representatives of ministries, Slovak Academy of Sciences, universities, civil society associations and industry. The council approved a detailed harmonogram for elaboration with allocated responsibility for individual actions in RIS3 elaboration. The fundamental working method became the iterative procedure of involving broad range of specialists from individual areas of the SR in the form of **one-time**, but also **long-term working and expert groups into this process**. More than 120 experts participated on the processing of particular areas. They processed the summarized document in their area, containing analysis of world tendencies in the relevant science and innovation area, the state in the SR with the identification of critical mass in science and innovation of the SR and the needs of the SR from the point of smart specialization. Teams from Slovak Academy of Sciences, Slovak universities as well as the representatives of civil society associations and industry were significantly involved (Picture 1). SME segment was also directly involved in the creation through the National Agency for Development of Small and Medium Enterprises that is founded by the Ministry of Economy of the SR along with the Enterpreneurs Association of Slovakia and the Slovak Traders Union. In these groups the resolutions were made consensually, including the Coordination group for RIS3 elaboration. In order to clarify the RIS3 objectives and the process of its elaboration, specialized seminars and working meetings were carried out with a broad participation of representatives from business sectors, universities, self-governing regions, cities and municipalities. Industrial bipartity as a social dialogue body organized a seminar on a topic „Science as business“ with the participation of vice-president of the European Commission, the prime minister of the SR, the ministry of education and the ministry of economy, on which the process of creation but especially the method of RIS3 implementation was discussed.

The selected system of RIS3 preparation created the basic precondition for the document to be the result of a broad social agreement to strategically head towards the specialization of the Slovak Republic via science and innovation in the future, especially through its implementation. The working method with the principle of the *quadruple helix* demonstrated its advantages. By the participation of all stakeholders in the creation of the Smart specialization of the SR via science and innovation, the conditions were created for the creation of informal networks of existing scientific teams, with innovation teams in industry, including key MNCs in the SR and small and medium enterpreneurship. These wide-ranging discussions, dialogue and work of multidepartmental working groups resulted in formulation of governance processes of RIS3 implementation. Barriers of narrow thinking about the management of science and innovation of the SR were dismantled. Preconditions were created for the strategy of smart specialization to be the essential and effective tool for fostering processes of convergence in the SR and for increasing the employement in a medium term.

5.2. INSTITUTIONAL Structure for the Implementation of the Smart Specialization Strategy

Implementation of the Smart specialization strategy in the programe period 2014 – 2020 is a complex process. It reaches beyond the competencies of particular ministries, regional, city and municipal governments, civil society groups and business sector. Its effect is based on the integration of science with inovation, research institutions with industrial practice through the creation of optimal conditions in a regional and sectoral area.

As it follows from the SWOT analysis, it is necessary to create an innovation environment in the SR that eliminates weaknesses in the area of research and innovation, lowers the risk of threats and develops mostly strengths, opportunities, which create the conditions for fundamental enhancement of innovation environment. A **critical element** resulting from the SWOT analysis is above all the „*autonomous functioning of*

sectors of education, R&I and business practice, which results into different understanding of R&I". The **key elements** resulting from the SWOT analysis are above all the "*creation of linkages between MNCs' R&I and domestic business R&I framework*" and "*increasing interest of businesses and industrial clusters in rebuilding of industrial R&I structures (entities)*".[18] The experience with RIS3 creation demonstrated that a successful RIS3 strategy implementation requires a structural change of current competencies in the management of research and innovation in the SR and a principled manoeuvre in cultural change of innovation environment. A change of the management processes is needed in order for RIS3 objectives and priorities to be achieved through effective governance processes. The governance must primarily address critical and key elements resulting from the SWOT analysis. Effective governance radically improves the use of current and future human, material, non-material and financial resources of the SR. An institutional environment will be created that will ensure a targeted concentration of all resources in order to acomplish RIS3 objectives through realistically achievable designated priorities. The management processes will be arranged in such a way that the concentrated human, material, non-material and financial resources in public and private sector are the main instrument for faster convergence and employment growth of the SR.

An extensive building of public research and development infrastructure without the mutual and centralized coordination led to building of duplicite infrastructures in the same thematic priorities. Moreover, the framework of essential conditions for using infrastructure that was built from EU sources directly excludes its commercial use in favour of applied research and innovation. Therefore legislative preconditions will be created for the SAS and universities to better use their capacities for the purposes of applied research, based on specific practical appliaction tasks and demands and for financial compensation. Infrastructure building of basic and applied research necessitates the establishment of functioning, narrow, centralized management model for both basic and applied research according to *best practices* of EU member states.

Implementation of RIS3 priorities will be accomplished by processes that will *harmonize and mutually synchronize programmes, plans, projects, actions and calls of RIS3 priorities in light of the* **time of their implementation, concentrated** *use of* **all kinds of resources**, *in spacial and regional dimension and in competitively capable economic sectors*. Transformation, integration of the current fragmented managing structure and an introduction of clear and coordinated management process will ensure that the executed programmes, plans, actions and calls resulting from individual priorities are to be mutually harmonized and balanced in order to increase the synergical effect for economy and knowledge development of the Slovak Republic as well as the better use of **financial resources** for research and innovation - resources from the business sector, public budgets of the SR, EU structural and investment funds, Horizon 2020 programme, banks, institutional investors, venture capital. From the public national sources it is primarily the finances for state programmes of research and development and development of R&D infrastructure, incentives for the support of research and innovation, partnership in financing EU structural funds programmes, financing of research in SAS and universities and sectoral research institutions, VEGA and KEGA. An increase in **human resources** potential and a growth of knowledge potential of the SR that is connected with it is possible to accomplish by its effective involvement in the European research area via entry to European scientific solution networks and via involvement in the innovations and industrial research of transnational companies operating in the SR. Thereby it is possible to achieve a faster growth of non-material, material and financial resources that are essential for sustainable growth of scientific and innovation potential of the SR.

The Slovak Republic in cooperation with the EC will do its best for the maximum application of flexibilities in general legislation in order to use European Structural and Investment Funds, to use the potential of the Bratislava region, in which more than 50 % of personal and technical capacities in the area of research and development is allocated. The Bratislava region and its institutions bring prosperity in the form of an increase in competitiveness in less developed Slovak regions, it also saturates the demand for academic education from less developed regions and so forth.

Some important support tools mainly for the business sector to invest in R&I in Slovakia involve for example the system of measures for improving the business environment, improvement of law enforcement,

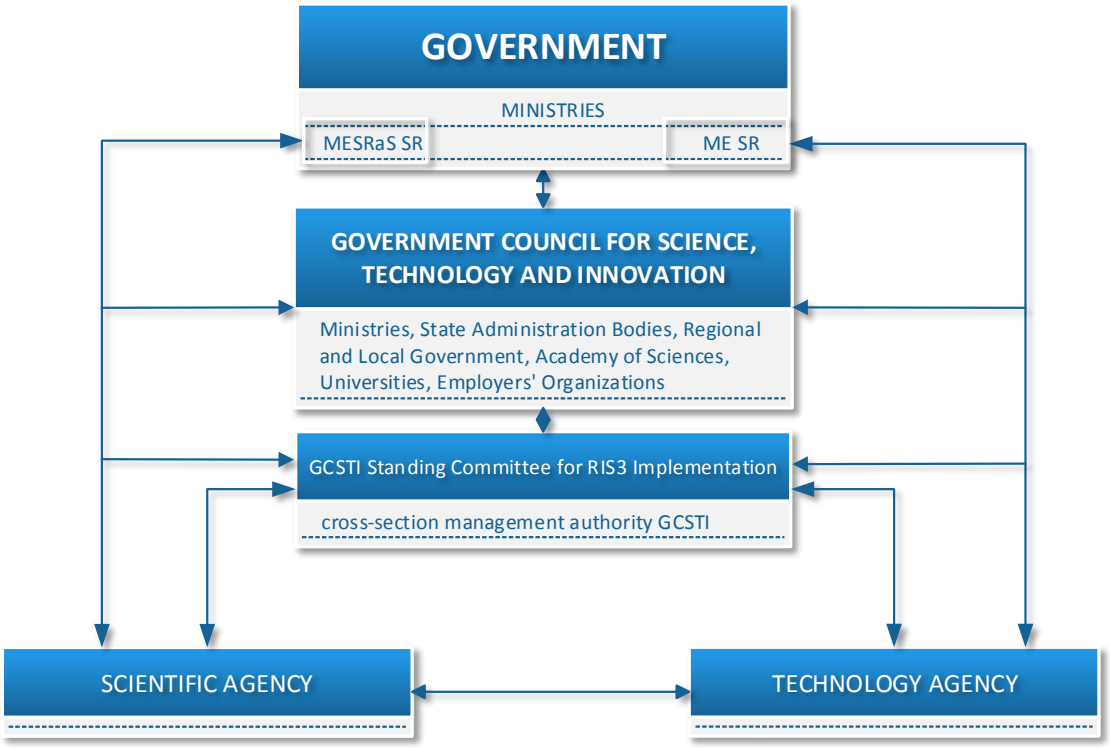
[18] See SWOT analysis

improvement of public administration, etc. An instrumentarium of incentive tools is also available. These tools consist of changes in tax legislation, a support for venture capital or direct subsidies focused on the highest possible co-financing of private sector. From the future perspective, the utilization of tax incentives for the support of R&D represents an important motivational tool for the whole spectrum of businesses that already operate in the relevant area or are preparing themselves to participate in the processes of research, development and innovation. Reorganisation of the R&I system – more significant application of results in the business practice – is to lead to change in the ratio of applied and basic research to: **70 % applied research and 30 % basic research.**

Steps needed to acomplish the stated objective:

- Reorganization of universities, transformation of SAS to public research institution and departmental research institutes
- Setting up of a system to achieve the statistically recorded expenditure on research and development by 2020 in a ratio 1:2 (public sources : private sources).
- An increase in the share of R&I financing from private sources
- Making the activities of agencies from the area of R&I more effective
- Legislative changes (for example Comprehensive Amendment to the Act No. 172/2005 Coll. on the state R&D support mechanism, Act No. 523/2004 Coll. on budgetary rules, Act No. 185/2009 Coll. on R&D incentives, Act No. 595/2003 Coll. on revenue taxes – introduction of tax reliefs for R&D, Act No. 133/2002 Coll. on Slovak Academy of Science, Act No. 528/2008 Coll. on aid and support granted from European Communities Funds, Act No. 131/2002 Coll. on universities, Act No. 184/2009 Coll. on vocational education and preparation as amended by later legislation, Act. No. 596/2003 on public administration in municipal education as amended by later legislation, Act No. 540/2001 Coll. on state statistics, Act No. 575/2001 Coll. on competiton of governement and central governmental administration etc.)
- Support for transfer of technologies and development of human resources
- Introducing the binding indicator for the support of R&I during the preparation of the Slovak state budget, which will define the percentage share of expenditure in R&I in relation to GDP

Picture 2 *Organisational scheme of institutional management of Strategy of smart specialization implementation until 2020*



To fulfill the RIS3 objective, there will be a change in the current system of science and innovation management that in the present frequently acts divergently, autonomously and without a focus on key areas of development of the SR. For the RIS3 implementation the institutional management scheme will be created which will significantly strengthen the strategic approach towards science and innovation management in the SR (Picture 2). The key authority for the management of RIS3 implementation is the **GOVERNMENT COUNCIL FOR SCIENCE, TECHNOLOGY AND INNOVATION**, which will for the effective process of RIS3 implementation establish as its working body **THE STANDING COMMITTEE OF THE GOVERNMENT COUNCIL FOR SCIENCE, TECHNOLOGY AND INNOVATION FOR RIS3 IMPLEMENTATION (SC GCSTI RIS3). In line with the strategic** objective of ensuring the complete and complex prioritization of science and innovation, other ministries and central state administration institutions will be involved in this process. The extent and scope of involvement will be designated by the corresponding action plan. For the sake of eliminating the current fragmentation and achieving the synergic effects, the existing network of implementation institutions (see chapter 2.5. for further information) will be transformed into two independent agencies: RESEARCH AGENCY and TECHNOLOGICAL AGENCY, which would be under the competence of MESRaS and ME SR. Methodically, they will be guided by the GCSTI and they will ensure the RIS3 implementation.

One of the causes of ineffective use of financial sources in science in Slovakia and the precondition for their higher volume through public and private partnership in the Slovak innovation environment is above all the currently fragmented and too atomized system for public projects and its use in private business sector. The critical mass of human and material potential for innovation in the Slovak economy through solution networks is therefore not being created. Splitting of priorities, their chronological, material, personal disharmonisation creates atomization of financial sources without direct synergic effect in practice.

The main mission and tasks of these institutional components of the management of RIS3 implementation are:

GOVERNMENT COUNCIL FOR SCIENCE, TECHNOLOGY AND INNOVATION

- is the managing authority for RIS3 implementation in the SR, created on a principle of partnership (state represented by ministries, academic sector, universities, SAS, private sector, employers' organizations and associations)
- is an advisory body to the government of the SR in the areas of science and innovation
- approves programmes, national projects, action plans that elaborate the RIS3 implementation in the respective years
- ensures the complete and complex prioritization of R&I through research and technological agencies
- monitors the execution of programmes, projects, plans, actions and calls of RIS3 implementation
- approves the monitoring plan of RIS3 implementation
- assesses the fulfillment of programmes, projects, plans, action and calls of RIS3 implementation
- discusses documents, resolutions, regulations of the government of the SR and laws associated with research, development, innovation and related areas relevant for RIS3 (education, human resources, informatization)
- submits to the government of the SR suggestions, recommendations relating to RIS3 execution and its assessment, the recommendations on how to ensure sustainable growth of research, development, innovation and related areas relevant for RIS3 (education, human resources, informatization) in the SR and their share in fostering the convergence and employment growth
- monitors the activities that are being done in relation to its recommendations
- reviews the state of integration of Slovak research and innovation entities into the European research and innovation area

STANDING COMMITTEE OF THE GOVERNMENT COUNCIL FOR SCIENCE, TECHNOLOGY AND INNOVATION FOR RIS3 IMPLEMENTATION (SC GCSTI RIS3)

- is a cross-cutting coordinatory working body of the GCSTI created on a principle of partnership
- representation consists of the experts from academic sector, business sector and representatives of relevant state administration bodies that represent state policies in the area of education, human resources, research, development, innovation and informatization

- functions as GCSTI Secretariat, its executive mechanism will operate in the structures of the Government Office of the Slovak Republic
- processes the methodology of management of research and technological agencies and submits it for approval to GCSTI
- coordinates the elaboration of programmes, plans, calls and submits it to GCSTI
- coordinates the assessment of fulfillment of programmes, projects, plans, actions and calls of RIS3 implementation
- coordinates the elaboration of documents, resolutions and regulations of the government of the SR and Acts related to science and innovation in the SR
- monitors the state of integration of the Slovak science into the European scientific and innovation area
- monitors the state of participation of Slovak science focused on industry in innovation programmes of transnational groupings operating in the SR
- monitors the state of excellent and industrial research in the SR
- assesses the investments in public R&D infrastructure to ensure the expediency of invested resources in order to prevent duplicate investments in infrastracture
- ensures the specialization of public R&D institutions

RESEARCH AGENCY

- Research Agency will be the managerial, communication and coordinatory institution functioning in the area of education, research and development
- is methodically guided by GCSTI RIS3 and organisationally is a part of the MESRaS SR
- the supreme body of the agency will be its presidium, which will be composed on a principle of partnership of public and private sector in a ratio 50 : 50, while at least one third of its members will be simultaneously the members of the presidium of the Technological Agency (and vice versa)
- the president of the presidium will be the vice-president of the GCSTI RIS3 and the minister of education, science, research and sport or a person delegated by him, who will have the decisive vote in case of a tie during the voting of the presidium
- ensures RIS3 implementation
- ensures the preparation, assessment of programmes, plans, actions, calls in the area of research while ensuring the synergy of RIS3 priorities
- coordinates its programmes, plans, actions nad calls with the TECHNOLOGICAL AGENCY in such a way that the process of RIS3 implementation is synchronised
- creates institutional precondition for the establishment of scientific teams consisting of SAS, universities, sectoral research institutions and business sphere.
- co-organises the participation of scientific and innovation teams from SAS, universities, sectoral research institutions in the European research and innovation area, especially by connecting into community programme Horizon 2020 and ESFRI programmes
- coordinates the preparation, assessment of programmes, plans, actions, calls in the area of research while ensuring the synergy of RIS3 priorities
- searches for opportunities of using the venture capital in excellent and industrial research
- cooperates with scientific and research platforms created on the EU level and in the Slovak Republic

TECHNOLOGICAL AGENCY

- Technological Agency will be the managerial, communication and coordinatory institution functioning in the area of industrial research, innovation and transfer of research results into practice
- is methodically guided by GCSTI RIS3 and organisationally is a part of the ME SR
- the supreme body of the agency will be its presidium, which will be composed on a principle of partnership of public and private sector in a ratio 50 : 50, while at least one third of its members will be simultaneously the members of the presidium of the Research Agency (and vice versa)
- the president of the presidium will be the vice-president of the GCSTI RIS3 and the minister of economy or a person delegated by him, who will have the decisive vote in case of a tie during the voting of the presidium

- ensures RIS3 implementation
- ensures the preparation, assessment of programmes, plans, actions, calls in the area of industrial research and innovation, especially by interconnecting research programmes and innovation programmes and projects
- coordinates its activity with the industry of the SR especially via Slovak Chamber of Commerce and Industry (SCCI) and employers' organizations
- creates institutional preconditions for the establishment of scientific teams consisting of SAS, universities, sectoral research institutions and business practice
- co-organizes the participation of scientific and innovation teams from SAS and universities in European research and innovation area, especialy by connecting to the community program HORIZON 2020
- coordinates its programmes, projects, plans, actions and calls with the RESEARCH AGENCY in such a way that the process of RIS3 implementation is synchronised
- monitors and identifies possibilities of connecting Slovak industrial research into innovation programmes of transnational companies operating in the SR
- searches for opportunities of using the venture capital in research and innovation
- cooperates with banking sector on offers for financing innovative projects and actions, especially *Slovenská záručná a rozvojová banka* (Slovak Assurance and Development Bank) (SZRB) bank and Export-Import bank of the Slovak Republic (EXIMBANKA).
- optimises multisectoral funding of innovations and industrial research and its interconnection with excellent research through private funding sources, esepecially from business as well as the creation of revolving financing schemes for science and technology
- cooperates with technological platforms established on an EU level and in the Slovak republic

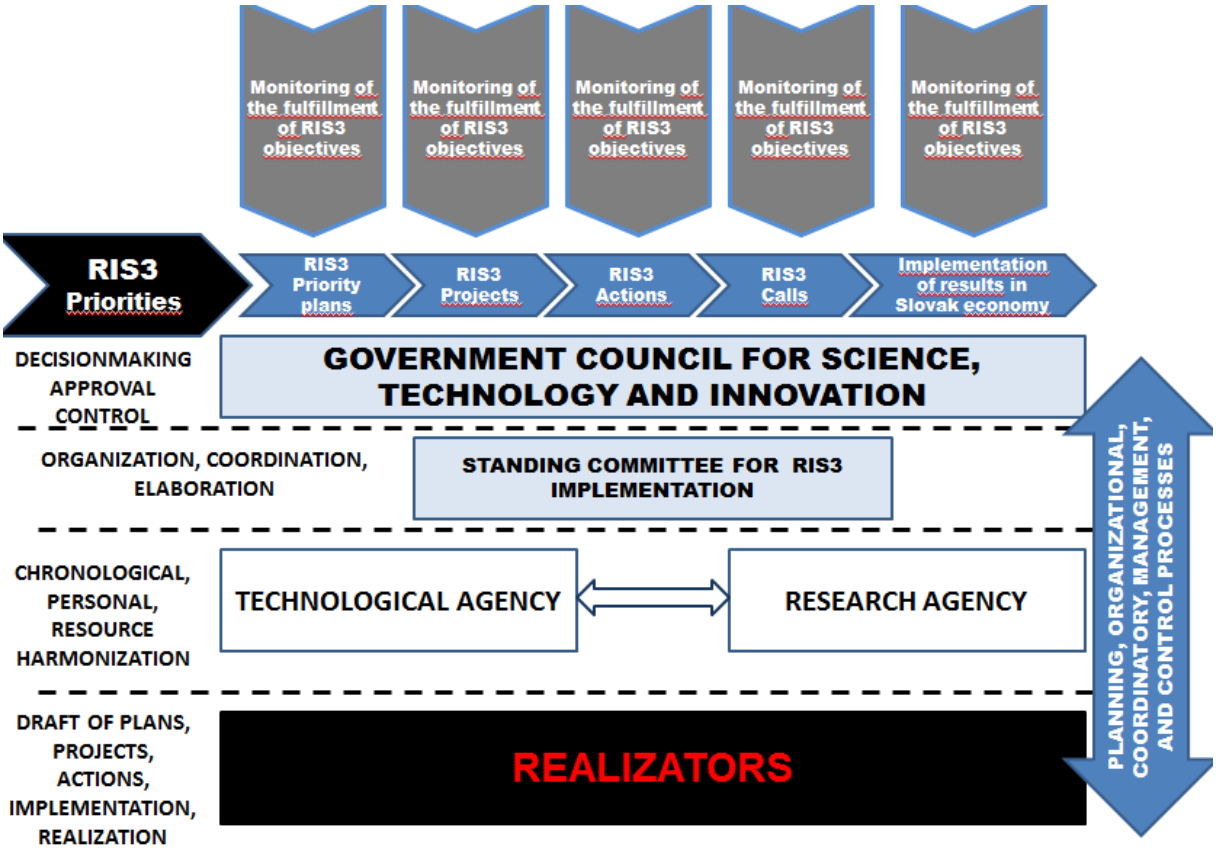
5.3. Procedural Arrangements of Institutional Structure for RIS3 Implementation

In order to fulfill the suggested scheme for the management of RIS3 implementation it will be necessary to make changes in Slovak legislature, especially change the law concerning organization of government and organization of central state administration, amend the statute of the Government Council for Science, Technology and Innovation (GCSTI), create the GCSTI Standing Committee for RIS3 implementation and create Technological and Research Agencies. In these changes it will be necessary to focus on the **processual side of the management of science and innovation in SR** according to the RIS3 objectives and priorities.

The main tools for the effective RIS3 implementation will be the processes of planning, decision-making, organization, management, monitoring and control. The basic framework of these processes in the institutional structure of management of science and innovation in the SR in order to accomplish the RIS3 objectives and priorities is in the picture 3.

In the picture there is a clear role, function and responsibility for individual processes of the individual organizational structures in the management of science and innovation in the Slovak republic. The key feature of management will be the planning process in the hierarchy "RIS3 PRIORITIES – programmes – projects – actions", which will be mutually interlinked and timely and resourcefully balanced. The monitoring system of the fulfillment of RIS3 goals and priorities will be adjusted accordingly, which will be elaborated into programmes and projects for the period 2014 - 2022 as a complex planning document. This document will be further elaborated into annual plans with a three year perspective (1+3). These annual plans will flexibly react to the progress in acomplishing the RIS3 objectives and priorities by the method of rolling forecasts. They will also flexibly react to changes resulting from the implementation of projects and changes in the external environment.

Picture 3 *General framework for the management of science and innovation in the SR according to the new institutional arrangement*



6. VISION AND STRATEGIC OBJECTIVES

RIS3 through the development of innovations, science and technologies in identified priority areas creates preconditions for sustainable growth of the competitive capability of the Slovak republic while supporting the structural diversification of the Slovak economy.

6.1. VISION

> **"To drive a structural change of the Slovak economy towards growth based on increasing innovation capability and R&I excellence to promote sustainable growth in income, employment and standard of living."**

By 2020 through achieving this vision a transformation of Slovak economy towards knowledge economy will occur. Main industrial sectors will be restructuralized towards the higher valued added production. Sub-supplier companies operating in automotive and electrotechnical industry, ICT and other sectors in Slovakia will be reflecting the global trends and there will be higher involvement in cooperation with MNC and a designation of new strategic segments. New strategic segmentation will allow rebuilding of own value chains, exploiting new market opportunities (niche markets) and opening new markets. Domestic research and development workplaces will be incentivized towards cooperation with local companies during the realization of their development and innovation activities in order to make production and logistical process more effective, which will result in lower overall energy intensity and last but not least in the implementation of information and communication technologies into intelligent applications in industry. Companies will also realize research, development and innovation activities in the areas of materials research, especially in the area of metals (steel, light metals and its alloys), plastic materials and compression molding and joining of materials with the aim of

improving the overall products and increasing quality and durability of produced goods. Research and development will be realized in new business research and development centres. Research and development of steel in cooperation with the producers will be oriented towards improving the properties, specific properties, better welding and steel joining. In the area of plastics research will be oriented towards using biodegradable plastics, which allows the production of ecological products with lower impact on environment after the expiration date and new kinds of polymeric materials for specific applications. There will be the development of automation sector, robotics and digital technologies, which uses new materials and ICT for creation of new innovative solutions. R&I acitivites will be focused on automatic or robotic reconfigurable and smart systems of production and logistic tools.

Due to product and process innovation the companies will become globally competitive and will be linked to supply chains of other MNCs in broader region, especially with the perspective in fast growing markets. The shift within the value chains of MNCs will create the preconditions for better cooperation with MNCs during the realization of innovative solutions. Besides that the companies will pinpoint perspective strategic segments through cooperation in clusters and as a result there will be diversification of productive portfolios of perspective sectors. Innovative solutions will be implemented not only in industry, but also utilized in global markets. An employment in the sophisticated production sector, ICT and knowledge intensive services will be increased. In order to eliminate adverse trends of lagging behind in innovation and marginalization of businesses, an effective systemic support of businesses will be created, based on the combination of long-term expert help and financing.

By 2020 the companies will use capacities of research, development and innovation centres built for the needs of smart specialization sectors, which will develop next generation demand products, technologies and materials.

Mechanisms for knowledge transfer as well as the mechanisms that motivate technical universities and selected SAV institutes to cooperate with businesses on innovative solutions will be implemented. The best universities and SAS institutes will be equipped with state-of-the-art technologies that will allow world-class scientific work and they will attract high-tech companies. In the area of automation, robotics and digital technologies, infrastructure capacities of R&D public and private sector workplaces will be created that will be useful for innovative solutions with low barriers to achieve spill-overs (effects in the alternative sectors or alternative applications). Capacities will be also used for solving all-society problems connected with active life and ageing and medical diagnostics. It is exactly this area that can intersect with practice and use the results of research and development that is carried out in medical research centres as a promising smart specialization area. Medical research will have its use in practice by knowledge transfer through selling patents and licences, but also through direct commercionalisation by setting up spin-off and innovative start-up companies. This kind of companies will be one of the ways to commercionalize the results of research and development in other promising areas as well. Strengthening cooperation between research and development organization in the area of agriculture and environment and businesses will contribute to an increase in the quality of life and in self-sufficiency in the production of good-quality food. Concurrently, there will be a better use of domestic natural resources. Individual areas will be supported by newly developed technologies in the area of energy production and distribution. Other sectors will also be developed, e. g. creative industry. For the necessity of economic growth with the smart specialisations sectors in mind, there will be a creation of conditions for academic sector and secondary education, conditions for solving scientific tasks also within international cooperation, conditions for accomplishing the goals for the EU strategy for the Danube region and transnational programmes e. g. OP Central Europe and OP Danube and for the flow of graduates employable in practice with a shorter period of adaptation into business processes.

6.2. STRATEGIC OBJECTIVES

The vision of this strategy will be accomplished through strategic objectives:

1. Deepening integration and embeddedness of key major industries increasing local value added through the cooperation of the local supply chains and turning local supply chains into embedded clusters

2 Increased contribution of research to the economic growth via global excellence and local relevance

3. Creating a dynamic, open and inclusive innovative society as one of the preconditions for the increase in the standard of living

4. Improving the quality of human resources for an innovative Slovakia

6.3. PARTIAL OBJECTIVES AND MEASURES

Strategic objectives that follow from the SWOT analysis are transformed into partial measurable objectives. Partial objectives are assigned to each strategic objective in such a way that the requirements for the transformation of the economic structure of the Slovak republic can be met.

Strategic objective 1: Deepening integration and embeddedness of key major industries increasing local value added through the cooperation of the local supply chains and turning local supply chains into embedded clusters

The Slovak economy is driven by large "key" multinational companies. Therefore the important factor is the support of the innovation and research and development activities in domestic enterprises operating in the supply chains or enterprises that have the potential to become sub-suppliers for supply chains.

Partial objectives for accomplishing the strategic objective

a) Create conditions for growth of added value generated at home in total exports by 5 % until 2020 in comparison to the current status.

Value added in total export will be supported through the restructuralisation of industrial sectors identified within the scope of the specialization of the economy, especially in automotive industry and consumer electronics, since these sectors are dominated by high level of marginal consumption and low level of value added. This will be done by creating the conditions for stimulating research and innovation activities of enterprises in collaboration with academic and research and development sector and the conditions for implementing the results of research, development and innovation into practice.

b) **Increasing the number of large companies that become Tier 2 suppliers**

Low number of companies in higher Tiers is caused by their inadequate innovation activity. The result is their low competitiveness. Conditions will be created for implementing the innovative technologies. The stimulation of enterprises to develop their own technologies, products and services will be especially supported.

c) Improve the linkages of local SMEs with large MNC suppliers.

Increasing the value added of supplied products and services of domestic companies as well as improving the position within the framework of supply chains will cause an increase of embededness of key industries through building of corporate research and innovation centres.

Measures

1.1. Development of innovative capacities through cooperation between enterprises and research institutions in key sectors of the Slovak economy

The measure aims to support the creation of consortia for solving multidisciplinary problems and embedding sectors through clusters and other forms of networking in order to develop innovation capacities.

1.2. Technological upgrade for structural changes in industry

The measure aims to support the increase of the technological level of companies in order to increase their competitivenes.

1.3 Support for building research and innovation capacities in Slovak enterprises

The measure is aimed at creation of industrial R&I centers and support of existing industrial R&I centers in Slovakia. The measure will allow the establishment of industrial centers with the participation (ownership and partnership) of academic and university sector.

1.3 Establishing indirect motivational tools

Indirect motivational tools for the support of R&I development will be looked upon, especially in relation to private sector.

Strategic objective 2 Increased contribution of research to the economic growth via global excellence and local relevance.

The important aspect stimulating economic growth in a medium and long term perspective is the development of the knowledge base that is directly connected to businesses. One of the conditions is the shift from supply oriented research and development towards demand oriented research and development. Therefore the system of financing research will support the research, development and innovation in the thematic priority areas, in which there is a potential for the utilization of research results in economic and societal practice with the sufficient critical mass.

Partial objectives for accomplishing the strategic objective

a) Increase the share of total expenses for R&D to at least 1.2 % of GDP by 2020.

Low total expenses in R&D in Slovakia negatively affect long-term economic growth.
The aim is to double the total expenses on R&D by 2020 vis-à-vis the year 2011.

b) **Increase the share of private resources for R&D in comparison to public resources to a ratio 2:1 while keeping at least the current share of public resources in total R&D expenses.**

Public expenses for R&D are currently double the private expenses. Motivational environment will be created that stimulates an increase of private sector expenses for R&D.

c) Make the institutional arrangement of R&D base more effective

A current arrangement does not allow effective creation and utilization of knowledge from R&D base. By changing the institutional arrangement and legislation there will be a shift from supply oriented towards demand oriented research and development and towards better functioning of institutions.

Measures

2.1. Fostering excellence of research

The measure supports the integration into the European research area via fostering international excellence and cooperation.

2.2. Development of excellent research while ensuring the necessary infrastructure for research and development

The measure supports building R&D infrastructure in order to create a knowledge base and to train human resources oriented towards the needs of industry and societal practice in the areas of thematic priorities (knowledge diffusion).

2.3. Linking universities, Academy of Sciences, research institutions and partners from the area of industry

The measure will support strategic long-term cooperation projects between enterprises and research and development workplaces in order to create long term partnerships in the areas of thematic priorities.

2.4. Systematic support and stimulation of international cooperation in science and technology

This will be done by strengthening national support, activities of national institutions as well as by motivational funding and co-funding of international activities.

Strategic objective 3 Creating a dynamic, open and inclusive innovative society as one of the preconditions for an increase in the standard of living

Transformation of the economy from production oriented towards knowledge oriented demands the change across the whole society, which enables effective support for the commercionalisation of R&D results and an implementation of various innovation activities.

Partial objectives for accomplishing the strategic objective

a) Creating conditions for enterprises (especially SMEs) to increase their innovation capacities

Innovation performance of companies reflects predominantly the low share of investments into own innovation activities. The current share of innovative enterprises (in house) is 15 %. The aim is to stimulate the businesses to increase their own innovation performances across the whole socio-economic spectrum to 20 %. Simultaneously it is necessary to increase the dynamics of start-up and spin-off businesses creation and create the possibilities of better utilization of financial engineering tools.

b) Increase the share of creative industry in GDP creation

Slovak creative industry has the potential to increase its share in the GDP creation.

c) Increase the share of KIBS in total production of business sector

Slovakia has a low level of knowledge intensive services not only in production but also in linkages with research and development in comparison with EU 27 average. We will increase the share of Slovak republic's work force employed in knowledge oriented activities to 14 %.

d) Support for the implementation of various kinds of innovations into practice for the needs of society

There is an insufficient extent of application and support of eco-innovations and social innovations in Slovakia, including ICT innovations. Systemic supportive tools will be created to increase their applicability in practice with a positive impact on economy and society.

Measures:

3.1. Stimulating KIBS, knowledge-oriented services and creative industry

The measure will be oriented towards the support and development of KIBS as well as knowledge-oriented services in order to increase their share in total production of business sector.

3.2. Supporting research and innovation in environmental areas including adaptation to climate change

The measure supports research and innovative solutions especially in the field of ecology, environmental problems, climate change impacts, lowering emissions, waste usage and environmental burdens solutions in order to create dynamic, open and inclusive innovative society.

3.3. Research and innovation in addressing major societal challenges in Slovakia

The measure supports societal innovation and solving of societal problems especially in the field of inclusion, marginalized groups problems, youth employment and population ageing in order to create open and inclusive innovative society.

3.4. Supporting an open and inclusive society

The measure will support an inclusion of marginalized communities by increasing their employment and by the improvement of conditions in the business sector for their employment and integration in the labor market.

3.5. Supporting dynamic business environment favorable to innovation

The measure aims to create conditions for achieving sustainable economic growth as a basic precondition for business development and for increasing competitiveness of the Slovak Republic on the international scale through financial engineering tools, support for start-ups and spin-off companies and tools supporting the implementation of innovations.

3.6. Protection and utilization of intellectual property

The measure should contribute to a protection and utilization of intellectual property and technological transfer as well as to an increase in the awareness about their protection and commercialization, including the change of legislation regarding the practical needs and past experience.

Strategic objective 4 Improving the quality of human resources for an innovative Slovakia

In a long-term perspective it is impossible to sustain economic growth or employment without superior workforce. Change in the structure and orientation of schools is a basic precondition for long-term competitiveness. A demand for graduates is necessary to link with the market demand in relation to demographic development.

Partial objectives for accomplishing the strategic objective

a) Increase the employability of secondary school and university graduates

The reform of educational system starting from the primary schools in order to harmonize education with the market demand and ensure the flexibility of employees. The improvement in PISA.

b) Improve linkages between educational system and practice

The educational system does not currently reflect the needs of practice to a sufficient extent. It is therefore necessary for schools in collaboration with businesses to take part in preparations of education programmes and enabling mutual linkages and usage of capacities on secondary or university level. It is necessary to motivate enterprises to take part in the education of their future workers.

c) Lifelong learning

The changing society and labor market dynamics necessitates educated people in all age categories. It is therefore necessary to improve the population access to all forms of education (formal, informal, non-formal) during the whole life. This will enable them to include, broaden, and deepen the acquired education, to requalify themselves or fulfill their interests while preserving their information and knowledge.The aim is to elaborate a system of acknowledging the results of non-formal education and informal learning. This includes a legislative solution.

d) Increasing the intersectoral mobility of workers

The important factor for improvement in communication and an increase in cooperation between public and private sector in the area of science, research and innovation is a mutual reciprocal possibility of worker exchanges in order to unify the "mentality".

e) Supporting the creation of international R&I teams

The return of our science and research workers back to Slovakia is one of the possible keys how to create a generation of highly skilled workers in the future. The possibility to cooperate with world-renowned scientists and building of strong teams of global importance should bring new possibilities for increased competitiveness of the Slovak Republic and the whole EU as well.

Measures:

4.1. Improving the quality of secondary education

The measure will ensure the corrections and changes in state educational policy in secondary education, especially vocational schools in order to increase the quality and harmonize the interests of individuals with the needs of society.

4.2. Improving the quality of higher education

The measure will ensure the realization of EUA Audit, legislative changes leading to to the amendment of institutional financing of public universities (especially in the area of technical and natural sciences) and amendments leading to changes in categorization of universities, reflecting the mission of concrete universities in order to increase the employability of graduates.

4.3. Improving business involvement in education

The measure will support the training centres in businesses, common technical departments of schools and businesses, motivational tools for businesses in order to involve them in vocational training. There will be a support for the improvement of facilities in specialized (vocational) secondary schools and universities in selected programmes and there will also be the involvement of experts from practice in the educational system in order to improve the linkages between educational system and practice.

4.4. Improving the quality of life-long education

The measure focused on the adults in productive age will ensure strengthening of the vocational competencies verification system and the establishment of quality of consultant services verification system.

4.5. Increasing emphasis on education in fields relevant to the RIS3 priority areas

The measure will put forward legislative changes for improving the financing of priority fields; there will be motivational tools to study priority fields (conferences, exhibitions, workshops, etc.) and lastly there will be improved conditions for involvement of young scientists in grant programmes of science and research.

4.6. Supporting the mobility of highly skilled workers

The measure will support the compatibility of qualifications and academic degrees between research and academic sectors and it will also create the conditions for return, imigration or drawing of highly qualified personnel to the SR.

7 POLICY MIX

Vision	Strategic objective	Partial objective		Measure
To drive a structural change of the Slovak economy towards growth based on increasing innovation capability and R&D excellence to promote self-sustaining growth in income, employment and standard of living.	Deepening integration and embeddedness of key major industries increasing local value added through the cooperation of the local supply chains and turning local supply chains into embedded clusters	Create conditions for growth of added value generated at home in total exports by 5 % until 2020 in comparison to the current status.		Development of innovative capacities through cooperation between enterprises and research institutions
		Increasing the number of large companies that become Tier 2 suppliers		Technological upgrade for structural changes in industry
		Improve the linkages of local SMEs with large MNC suppliers.		Support for building research and innovation capacities in Slovak enterprises
	Increased contribution of research to the economic growth via global excellence and local relevance	Increase the share of private resources for R&D in comparison to public resources in a ratio 2:1 while keeping at least the current share of public resources in total R&D expenses		Establishment of indirect motivational tools
		Make institutional arrangement of R&D base more effective		Development of excellent research while ensuring the necessary infrastructure for research and development
				Creation of linkages among universities, Academy of Sciences, research institutions and partners from the area of industry
		Increase the share of total expenses for R&D to at least 1.2 % of GDP by 2020		Fostering excellence of research financed by national sources (knowledge generation)
				Systematic support and stimulation of international cooperation in science and technology
				Protection and utilization of intellectual property
	Creating a dynamic, open and inclusive innovative society as one of the preconditions for an increase in the standard of living	Creating conditions for enterprises (especially SMEs) to increase their innovation capacities		Supporting dynamic business environment favorable to innovation
		Increase the share of creative industry in GDP creation		Stimulating KIBS, knowledge-oriented services and creative industry
		Increase the share of KIBS in total production of business sector		
		Support for the implementation of various kinds of innovations into practice for the needs of society		Supporting research and innovation in environmental areas including adaptation to climate change
				Research and innovation in addressing major societal challenges in Slovakia
				Supporting an open and inclusive society
	Improving the quality of human resources for an innovative Slovakia	Increase the employability of secondary school and university graduates	Lifelong learning	Improving the quality of secondary education
				Improving the quality of higher education
				Strengthening the vocational competencies verification system
				Establishment of the quality of consultant services verification system
				Increasing emphasis on education in fields relevant to the RIS3 priority areas
		Improve linkages between educational system and practice		Improving business involvement in education
		Increasing the intersectoral mobility of workers Supporting the creation of international teams		Supporting the mobility of highly skilled workers

Measure	Activities	Tools	Measurable outputs	Target group	Sponsor
1.1. Development of innovative capacities through cooperation between businesses and research institutions	1.1.1. Creation of consortia for solving multi-disciplinary problems among the priority areas	- research and development projects – short-term, generally one-time projects intended for businesses - cooperation projects with MNC - research, development and innovation projects of mutual cooperation between businesses and R&D infrastructure in Slovakia, also in the form of partnerships (also others, public-private sector) - innovation vouchers - SBIR scheme - clusters - support for cooperation of SMEs (with other SMEs, with research institutions and large enterprises and MNC) in key sectors - support for partnerships between research institutions and businesses - support for (mutual) cooperation of businesses with research institutions and academic sector	Number of supported enterprises, Number of businesses involved in the supply chain for key industry Number of cooperations created between businesses and research institutions Number of new jobs	- companies in supplier chains - universities - research institutes - SAS	Ministry of Economy of the Slovak Republic (ME SR)
	1.1.2. Support for the embeddedness of key major industries through clusters and other forms of networking on a local, regional, national and macroregional level				
1.2. Technological upgrade for structural changes in industry	1.2.1. Support for the structural changes in industry and for increasing technological level of firms	- support for the technology transfer projects - innovation vouchers - financial tools (loans, assurance schemes, venture capital)	Number of supported businesses Number of businesses involved in the supply chain for key industry Number of cooperations created between businesses and research institutions Number of new jobs Number of “saved” jobs Share of businesses implementing technological innovation	- companies in supplier chains - universities - research institutes - SAS	ME SR and the Ministry of Education, Science, Research and Sport of the Slovak Republic (MESRaS SR)
	1.2.2. Support for the mutual cooperation of firms and academic and university research in order to deal with projects with innovation potential	- projects of research, development and innovation in businesses, - legislative changes - the support of partnerships of research institutions and businesses			
	1.2.3. Support for technological centers, including prototype centers, test centers, pilot lines for industrial needs in S3 priority areas	- pilot projects in the setup of technological and prototype centres, test centres, pilot lines - the support of partnerships of research institutions and businesses			

1.3. Support for building research and innovation capacities in Slovak businesses	1.3.1. Building industrial research, development and innovation capacities in businesses	- projects for building R&I capacities in businesses - stimuli - tax incentives - assurance programmes	Number of supported businesses Number of businesses involved in the supply chain for key industry Number of cooperations created between businesses and research institutions Number of new jobs Number of "saved" jobs	- companies in supplier chains (new and existing) - universities - research institutes - SAS	ME SR and MESRaS SR
	1.3.2.Building industrial research, development and innovation capacities with participation of academic and university sector - corporate research centres of businesses	- projects aimed at building the R&I capacities in businesses with the participation of academic sector - stimuli - tax incentives - assurance programes			
	1.3.3.Support for existing industrial, research, development and innovation capacities in companies	- projects for the development of existing R&I capacities in businesses - stimuli - tax incentives - loan and assurance programmes			
1.4 Establishment of indirect motivational tools	1.4.1. Establishment of indirect financial tools	- incentives			Ministry of Finance of the Slovak Republic (MF SR), MESRaS SR, ME SR
2.1. Fostering excellence of research	2.1.1. Change in funding framework to benefit excellent science	- Audit, Benchmarking Legislative changes - Research and development grants	Percentage increase in the budget of the Agency	- authorities (agencies) financing research and development	MESRaS SR, ME SR in cooperation with other central state administration bodies, departments, National Council of the Slovak Republic (NC SR)
	2.1.2. Increase in standards of assessment, funding and administration of projects	-Audit, counselling, benchmarking - support for the project management	Number of revisions and improvements / eliminations of administrative barriers	- authorities (agencies) financing research and development	
	2.1.3. Transformation of Slovak Academy of Sciences (SAS) to public research institution	- Legislative change - Audit, benchmarking	Implemented transformation	- SAS and state institutions for research and development (departmental as well)	
	2.1.4. Support for research profiling of excellent research institutions	- Legislative change - change in the mode of financing in favor of the leading universities in SCIMAGO	Number of universities which will improve rating in SCIMAGO	- public universities, SAS	

	2.1.5. Promoting the public attitude toward science, technology and innovation, popularization of science and technology	- Conferences - Workshops - Exhibitions	Number of realized activities	- public		
2.2. Development of excellent research while ensuring the necessary infrastructure for research and development	2.2.1. Development of existing university science parks and research centres at universities and SAS in relation to RIS3 SK priorities	- projects aimed at developing existing university science parks - projects aimed at developing existing research centres of parks -	Number of new research jobs Number of technological and non-technological R&D outputs applied in practice through innovations Number of patents and licenses based on R&D outputs applied in practice	- public universities and SAS that started with building of university science parks and/or research centres in the previous period with the focus on thematic priority areas		MESRaS SR, ME SR in cooperation with other central state administration bodies
	2.2.2. Support for building national infrastructure for the use of ESFRI structures	- research and development projects for infrastructure development	Number of supported projects Number actual participations of individuals and teams in using the ESFRI infrastructure	- research teams from public universities, SAS, departmental RD&I businesses and other research organizations		
2.3. Linking universities, Academy of Sciences, research institutions and partners from the area of industry	2.3.1. Support for long-term partnerships between companies and research centres	- research and development projects - long-term - technological platforms - common programmes of research and development with the participation of research teams from both sectors – academic and business sector to support the research and development centres	Number common mutual projects Number of new research jobs created Number of patents and licenses based on R&D outputs applied in practice	- consortia and business and research organization, SAS and university groupings, active in the areas of thematic priorities		All relevant RIS3 departments
2.4. Systematic support and stimulation of international cooperation in science and technology	2.4.1. Systemic change of national structures' coordination for Horizon 2020, ERC, ERANET	- audit, benchmarking of effective participation of the SR in international programmes and institutions of research and development	Number of supported projects Number of actual participations of individuals and teams in international cooperation projects in science and technology (especially H2020 and ERC), which used the support or to which the support has contributed Ratio of economic return of Slovak participation in 7. FP and Horizon 2020	- research teams of public universities, SAS, departmental RD&I organisations, businesses and other research organizations searching the cooperation or already cooperating internationally		MESRaS SR, ME SR and other relevant state administration institutions
	2.4.2. Establishment of Liaison Office for Research, Development and Innovation in Brussels	- realization projects				
	2.4.3. Participation of Slovak subjects in international technology platforms	- support for participation				
	2.4.4. Stimulation of cross-border and macroregional cooperation in research, development and innovation	- support of cross-border and transnational projects while using the flexibilities of new EU legislation				
	2.4.5. Stimulation of International Cooperation in Science and	- Legislative changes				

	Technology (ICST) through institutional funding of public universities					
	2.4.6. Support for teams involved in International Cooperation in Science and Technology (ICST)	- programme aiming to supplement the financing the of international scientific and technical cooperation				
3.1. Stimulation of KIBS, knowledge-oriented services and creative industry	3.1.1.Modernization of technologies in creative sectors	- projects - grants - innovation vouchers - start-ups - incubators - financial tools (loans, assurances schemes, venture capital, micro-loans)	Number of supported enterprises Number of new jobs created in creative and knowledge intensive industry Number of saved jobs	- businesses		ME SR and all relevant departments
	3.1.2. Support for implementation of results of creative activities in the business and social practice, support for the creation of prototypes and support of businesses in the area of KIBS					
	3.1.3. Support for the use of digital technologies in creative and non-technological areas					
3.2. Supporting research and innovation in environmental areas including adaptation to climate change	3.2.1. Support for research and innovative solutions in the area of ecology, environmental issues and climate change impacts	- research grants - projects - innovation vouchers - loan programmes - partnerships, clusters	Number of supported enterprises Number of new jobs created in creative and knowledge intensive industry Number of saved jobs	- businesses, universities, research intitutes and SAS, partnerships		ME SR and all relevant departments
	3.2.2. Support for research and innovative solutions in the area of ecology, especially emmission reduction and waste utilization					
	3.2.3. Support for research and innovative solutions focused on solving environmental burdens					
3.3. Research and innovation in addressing major societal challenges in Slovakia	3.3.1. Addressing specific social problems, especially focusing on inclusion, problems of marginalized groups, youth unemployment and ageing population	- research grants - projects - social innovations	Number of supported enterprises Number of new jobs created - Number of saved jobs	- businesses, organizations of public administration and local government, non-governmental organizations		ME SR, MESRaS, Ministry of Interior of the Slovak Republic (MI SR) and all relevant departments
	3.3.2. Support for social innovation of specific social problems					
3.4. Supporting an open and inclusive society	3.4.1. Supporting the employment of risk groups in the labor market	- social innovations - programmes and pilot projects - tax incentives	Number of supported enterprises Number of supported citizens belonging to marginalized groups Number of new jobs Number of saved jobs	- businesses, academic sector, public administration, non-governmental organizations		ME SR, MESRaS, MI SR and other relevant ministries
	3.4.2. Support for the benefits to entrepreneurs employing citizens with disabilities					
3.5. Support for	3.5.1. Support of business activities	- incubators	Number of supported enterprises	- businesses		ME SR

dynamic business environment favorable to innovation	especially in companies operating in priority sectors 3.5.2. Support for activities aimed at removing legal and administrative barriers to faster development of business 3.5.3. Creating conditions for improved access to start-up capital for new businesses 3.5.4. Increasing the innovation performance of companies 3.5.5. Commercialization of R&I solutions 3.5.6. Internationalization of businesses	- start-up businesses - consultation - education aimed at increasing awareness in the area of innovation and enterpreneurship - innovation vouchers - legislative changes aiming to lower the regulatory burden for business and administrative burden for business - legislative changes aiming to dismantle barriers to development of capital market - financial tools (loans, assurance schemes, venture capital, micro-loans) - support of pro-export activities - exhibitions	Number of saved jobs Number of created start-up a spin-off companies Number of new jobs % SMEs introducing product or process innovations % SMEs introducing marketing or organizational innovations		
3.6. Protection and utilization of intellectual property	3.6.1. Improvement in the protection and utilization of intellectual property and technology transfer 3.6.2. Increasing the awareness in the area of protection and commercialization of intellectual property	- change of legislation related to utilization of the system of intellectual property protection with regard to the needs and practical experience of schools with its current application - educational projects in secondary and higher education institutions - protection of intellectual property projects	Number of trained professionals Number of patents and licenses based on R&D outputs implemented into practice	- businesses, academic sector, universities		ME SR, MESRaS SR, Ministry of Justice of the Slovak Republic (MJ SR), Industrial Property Office of the Slovak Republic, academic sector, universities
4.1. Improving the quality of secondary education	4.1.1. Rationalization of the network of secondary schools, including the harmonization of founders' competencies (including state approval) and the system for financing schools 4.1.2. Strengthening the financing of secondary schools especially in the area of technical and natural sciences in a way that they fulfill the RIS3 mission	- audit - legislative changes - tax incentives to enterpreneurs - support projects Legislative changes aiming to adjust the financing of secondary schools	Number of merged or canceled secondary schools Number of companies directly supporting the vocational schools Number of common technical departments of schools and businesses, or institutions of societal practice Number of students who have benefited from the workplaces supported by businesses	- secondary schools, secondary schools' founders, primary schools		MESRaS SR in cooperation with Self-Governing Regions and the representatives of secondary education
4.2. Improving the quality of higher education	4.2.1. Implementation of measures recommended in the EUA audit report	- Legislative changes	Number of students in fields relevant for RIS3 SK specialization	- universities		MESRaS SR

	4.2.2. Strengthening the financing of excellent public universities especially in the area of technical and natural sciences	- Legislative changes aiming to adjust the institutional financing				
	4.2.3. Change in the categorization of universities in order to reflect the mission of specific universities	- Legislative change				
4.3. Improving business involvement in education	4.3.1. The support for training departments in businesses 4.3.2. Creation of conditions for businesses to professional training through the establishment of specialized (vocational) secondary schools or joint workplaces of schools and businesses 4.3.3. Motivating businesses to cooperate with schools in the area of vocational training 4.3.4. Improving the facilities of vocational schools and universities in technical/research-oriented study programmes. 4.3.5. Involvement of experts from practice into educational process	- Legislative changes - tax incentives to enterpreneurs - support for schools - projects - grants - conferences - exhibitions - workshops - trainings	Number of enterprises directly supporting vocational schools, universities Number of common technical departments of schools and businesses, or institutions of societal practice Number of students who have benefited from the workplaces supported by businesses	- secondary schools - universities - businesses - institutions of societal practice		ME SR and MESRaS SR
4.4. Improving the quality of life-long learning	4.4.1. Strengthening the vocational competencies verification system	Functional network of eligible institutions for verifying the results of vocational competencies.	- An increase in the participation of adults on life-long learning	Adults in the productive age (29 – 65 year old).		MESRaS SR
	4.4.2. Establishment of the quality of consultant services verification system	The set of qualitative standards for administering the consultancy centres in life-long learning.	- Number of consultancy centres connected to the integrated consultation system and number of citizens using the access to such information			
4.5. Increasing emphasis on education in fields relevant to the RIS3 priority areas	4.5.1. Improving the financing of key study fields according to the RIS3 SK priorities 4.5.2. Motivating to study key study fields according to the RIS3 SK priorities 4.5.3. Improving conditions for the involvement of young scientists in participation in grant programmes of science and research	- Legislative changes - grants supporting R&D for young scientists - conferences - exhibitions - workshops - scholarships	An increase in funding of RIS3 SK specialization fields Number of students studying in preferential fields Number of granted preferential scholarships	- primary schools - secondary schools - universities - businesses - institutions of societal practice		ME SR and MESRaS SR and other relevant departments
4.6. Increasing the mobility of highly	4.6.1. Supporting compatibility of qualifications and academic degrees	- long term working placements and internships at home and	- number of mobilities	- professional/scientific workers in businesses,		MESRaS SR

skilled workers	between research and academic sectors and the support of mutual mobility	abroad – reciprocal mobility of employees from businesses and academic sector - exchange placements - legislative changes - reintegration grants		academic and research sector		
	4.6.2. Creation of conditions for the return of highly qualified personnel after completion of internships and working experience abroad back to Slovakia and for drawing highly qualified personnel from abroad to work in the SR					
	4.6.3 Support for immigration of skilled workers					

8 MONITORING AND EVALUATION

One of the key conditions for fulfilling RIS3 intentions for the Slovak Republic [1] is a concentration of all resources of the Slovak Republic (human, material, non-material, financial) in time and space in such a way that by the year 2020 all objectives will be fulfilled. One of the important conditions for implementing the new system of management is effective monitoring, which will provide information about individual activities, identify and map the process of individual activities. It will also provide information about the advancement of partial objectives not only from the perspective of drawing financial sources, but also the eventual effect on the Slovak economy.

The key aspect of RIS3 implementation will be the planned process of activities, which will be mutually interlinked and resourcefully and timely balanced. The integral part of this plan is the monitoring plan as a measurement set which evaluates the process of RIS3 implementation on individual organizational levels. The system of monitoring of the fulfillment of RIS3 objectives and priorities will be adjusted accordingly. The monitoring plan will contain a designation of measurable indicators in respective stages of implementation with deadlines, organizational structure that will administer the monitoring; it will state the responsibility who will review the results of the monitoring and who takes measures and corrections during the process of implementation to achieve the objectives. The plan will not only evaluate the drawing of funds and the qualification for drawing financial resources, but also factually evaluate the method for acomplishing designated RIS3 objectives. Government Council for Science, Technology and Innovation (GCSTI) is an advisory body of the Slovak government and of all materials in the R&I area from all relevant state institutions. In relation to RIS3 it is an executive body for this strategy.

GCSTI Standing Committee (SC GCSTI) as an executive body of the Government Council for Science, Technology and Innovation will be among others responsible for ensuring the monitoring. Supporting monitoring activities for the needs of SC GCSTI is done by the Analytical unit of the Government Office of the Slovak Republic.

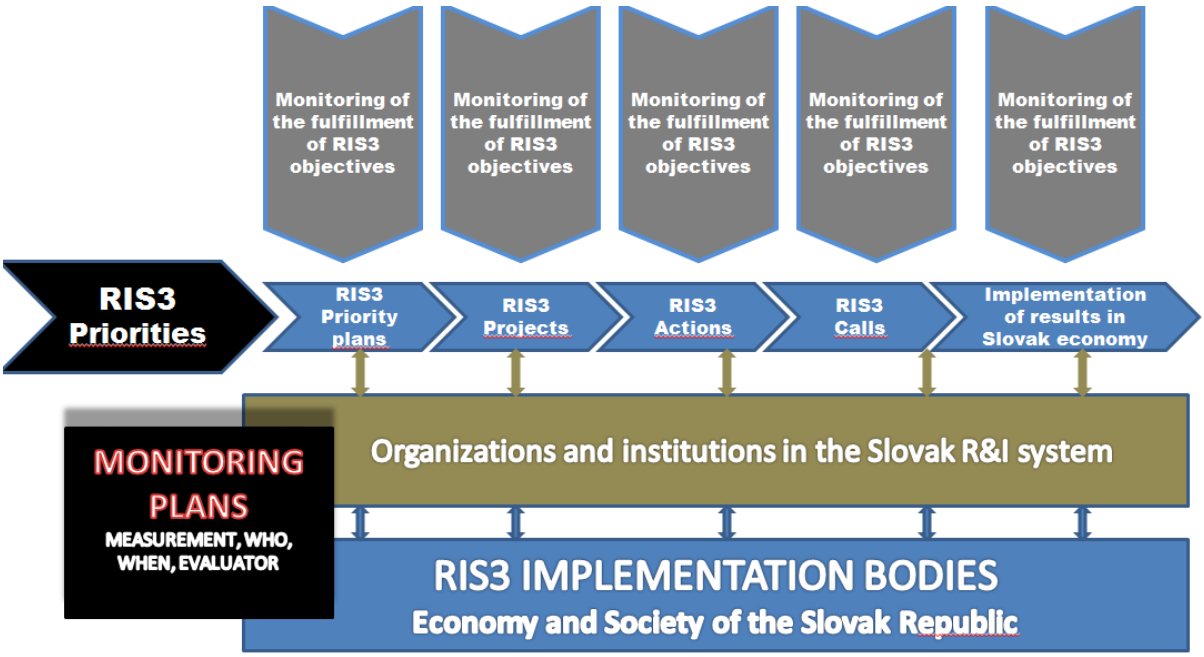
The monitoring system of RIS3 implementation includes:

- Responsibility for methodical activities (preparation of methodological documents that establish horizontal framework for RIS3 implementation)
- Periodical reporting for the needs of GCSTI, Government of the SR, European Commission and other subjects involved in RIS3 implementation. Reporting contains reports about the state of RIS3 realization and about the contribution of measures towards the fulfillment of RIS3 objectives, as well as the contribution of the strategy to the fulfillment of the Partnership Agreement of the SR for the years 2014 – 2020,
- Formulation of suggestions for measures in case the RIS3 SK implementation does not lead to the results in a timely manner and in an intended scope
- The obligation of administrators of projects with public funding sources during the project approval to submit the separate monitoring plan of the state of project implementation and its organizational and material provision

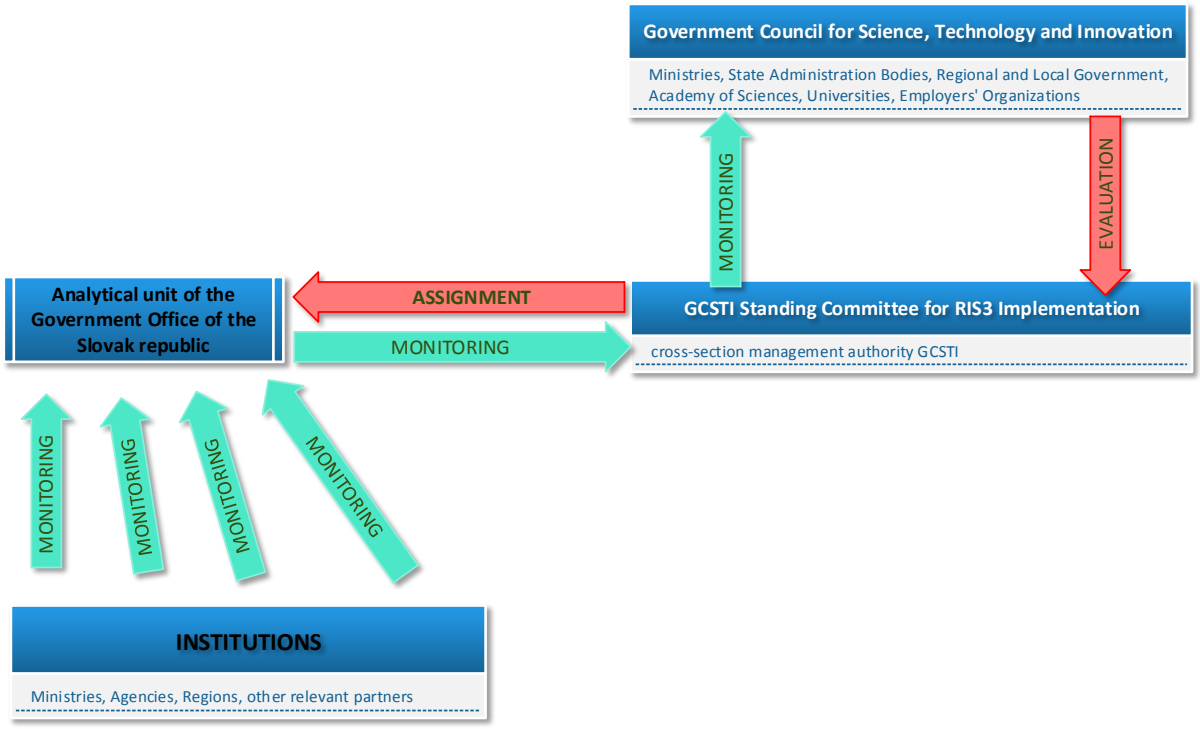
Implementation of RIS3 SK monitoring on the executive level:

- GCSTI Standing Committee is responsible for monitoring
- Analytical Unit of the Government Office of the Slovak Republic in cooperation with central state administration bodies (especially the Ministry of Economy of the Slovak Republic and the Ministry of Education, Science, Research and Sport of the Slovak Republic) monitors relevant measurable output, result and impact indicators, tools and measures for RIS3,
- based on data from central state administration bodies, Statistical Office, other sources, annual and final reports, etc. the Analytical Unit of the Government Office of the Slovak Republic summarizes the available data and in relation to strategy as a whole processes it into implementation report on annual basis and into final RIS3 report

Picture 4 *Scheme for the incorporation of the monitoring process into all processes of RIS3 implementation*



Picture 5 *Institutional structure of RIS3 monitoring*



9 CONCLUSION

The next steps in the time period November 2013 – January 2014 will focus on the explanation of intentions of the actual version of the RIS3 document approved by the government to all relevant partners while ensuring the partnership principle and *quadruple helix* model. This is a condition for adopting the strategy since many comments asserted within the framework of the interministerial review process or GCSTI meetings were a direct contradiction to the requirements of the EC expressed in the written report of the experts and in the informal EC stance.

A compelling task is to ensure reflecting the RIS3 into the updated draft of the Partnership Agreement of the SR for the years 2014 – 2020 and its elaboration in relevant operational ESIF programmes for the years 2014 – 2020. Another free-standing compelling task is elaborating the strategy into action plans in the next 24 months.

In line with the EC recommendations it is necessary to involve all relevant RIS3 stakeholders in processes and working groups for the preparation of operational programmes in such a way, that the mutual interconnection of documents will be ensured.

RIS3 is not a static document – it is a tool for the permanent serious internal learning process and a tool for the improvement of the system and mechanisms in the whole 2014 – 2020 programming period. The reason of this processual evolutional model is a desire to have an effective, economical and efficient implementation of investments in R&I in the SR with the objective of ensuring the contribution towards fulfilling Europe 2020 Strategy. In this context and also based on EC regulation it is necessary to elaborate in chronological intervals the thematic action plans. Two-year horizon of action plan's operation is suggested, while in line with the monitoring system annual follow-up evaluation will be realized, including the update of the document or action plans.

The first action plan – „Action plan for the RIS3 implementation for the years 2014 – 2016" will contain the most important thematic areas and activities necessitating the successful RIS3 implementation and taking into account the conditions for fulfilling the ex ante conditionality for thematic objective 1. Strengthening research, technological development and innovation, especially:

- elaboration of operational programmes – especially OP R&I, OP Human Resources, but also Integrated regional OP, OP Integrated Infrastructure, OP Effective public administration, OP Quality of environment – in line with RIS3, including the update of the set of indicators for the OP and RIS3 in connection with the definitive versions of all relevant OPs,

- elaboration of financial frameworks with indicative allocations according to measures, sources of financing and types of financial Instruments,

- basic legislative changes necessary to achieve RIS3 objectives (for example Act No. 575/2001 Coll. on the organization of government and central government administration, Act No. 172/2005 Coll. on the state R&D support mechanism, Act No. 185/2009 Coll. on R&D incentives, Act No. 595/2003 Coll. on revenue taxes – introduction of tax reliefs for R&D, Act No. 133/2002 Coll. on Slovak Academy of Sciences, Act No. 528/2008 Coll. on aid and support granted from European Communities Funds, Act No. 131/2002 Coll. on universities, Act No. 184/2009 Coll. on vocational education and preparation as amended by later legislation, Act. No. 596/2003 on public administration in municipal education as amended by later legislation, Act No. 540/2001 Coll. on state statistics, etc.) so the amended versions of Acts facilitate and enable a fulfillment of the strategy's objectives in line with the vision and proposed policy mix,

- the plan of institutional changes for the application of public RIS3 governance model in order to eliminate fragmentation, including the update of related necessary legislative rules,

- SK Roadmap for building ESFRI infrastructure, which will identify the actual national infrastructure facilities suitable for the connection to ESFRI, including the critical analysis (which R&D centres, competence centres and

centres of excellence are sustainable in a long-term, have the potential for improvement and can become a part of ESFRI projects). In particular the importance will be given to the possibility of interlinkages between RIS3 in the priority industries and participation in ESFRI initiatives.

- elaboration of the AP 2014-2016 as a compact starting plan for RIS3 implementation with concrete chronological milestones for the values of indicators binded with objectives in such a way that it would be possible to chronologically evaluate the realization and purposefullness of RIS3, i.e. the fullfillment of the EU 2020 Strategy objectives.

10 ANNEXES

- SWOT Analysis: according to strategic objectives, according to thematic areas

- Abbreviations

Strategic objectives	A. Strengths	B. Opportunities	C. Weaknesses	D. Threats
I. Deepening integration and embeddedness of key major industries increasing local value added through the cooperation of the local supply chains and turning local supply chains into embedded clusters	I.A.1. Key industrial sectors represented by MNC (automotive, electrotechnical, metallurgical, chemical) **I.A.2.** Competitive technological level and production level in export sectors **I.A.3.** Increasing interest of businesses and industrial clusters in rebuilding of industrial R&I structures (entities) **I.A.4.** Increasing share of information services in export services	**I.B.1.** Broadening the connection of domestic sub-suppliers to global supplier MNC chains **I.B.2.** Creation of linkages between MNCs' R&I and domestic business R&I framework **I.B.3.** Concentration of R&I centres on the limited number of RIS3 priority areas **I.B.4.** Deepening the dialogue between academic and industry sectors **I.B.5.** Potential for using land reserves and strategic domestic natural resources (water, timber, magnesite) in an innovative economy **I.B.6.** Support for the conversion to green technologies, materials and products due to legislation and undesirable ecological changes	**I.C.1.** Insufficient share of own (Slovak) R&I activities in export sectors in Slovakia **I.C.2**. Absence of corporate industrial research In Slovakia **I.C.3.** Insufficient integration of domestic businesses into sub-supplier chains for MNCs **I.C.4.** Undercapitalisation of businesses associated with low innovation performance, especially SMEs **I.C.5.** Marginal application of revolving schemes including venture capital for R&I support. Absence of the system for the application of venture capital **I.C.6**. Low own added value of production of domestic businesses	**I.D.1.** The shift of investors into territories with different comparative advantages in comparison to the SR (EU) **I.D.2.** Insufficient investments in products and technologies based on knowledge also due to insufficient links between MNC and local R&I infrastructure. **I.D.3.** Reluctance of businesses to invest in R&I in Slovakia

II. Increased contribution of research to the economic growth via global excellence and local relevance.	**II.A.1.** Good results in selected scientific and technological disciplines, with concentrated research teams and workplaces (materials and nanotechnologies, information and communication technologies, biomedicine and biotechnologies, industrial technologies, energetics and energy, environment and agriculture, social sciencies and humanities)	**II.B.1.** New "EU Industrial Strategy (Industry 2020)" heading towards the revitalization of European industry **II.B.2**. Dismantling the barriers to cooperation (increasing coherence) through quadripartity (quadruplehelix) as a basic governance principle of R&I **II.B.3.** The support of R&I projects within Visegrad Four countries and the EU Strategy for the Danube Region and interlinking within ERA also by utilizing the Centrope region potential (Bratislava-Brno-Vienna) **II.B.4.** Better use of community programmes, especially Horizon 2020 and the system of ESFRI programmes and projects **II.B.5**. Use of European technological platforms by integrating national technological platforms into their activities **II.B.6.** Broader use of Slovak republic's knowledge in carbon-free energetics including the level of security that is accepted by society **II.B.7.** Insufficiently used agriculture and water resources management potential	**II.C.1.** Absence of the complex R&I strategy and its implementation **II.C.2**. Excessive number of broadly defined priorities of state policy in the area of science **II.C.3.** Fragmentation of resources for building R&I infrastructure on a national level (state budgest, structural funds) **II.C.4**. Extensively built R&I infrastructure **II.C.5.** Barriers for companies to access the infrastructure of public R&I workplaces **II.C.6.** Administrative barriers to implementation of projects financed from structural EU funds into practice **II.C.7.** Low level of cooperation between academic sector and industry **II.C.8.** Low share of national resources allocated to financing R&I **II.C.9.** Low involvement of Slovak bodies in 7. framework programme (FP7) **II.C.10.** Insufficient competitiveness of Slovak R&I organizations within EU	**II.D.1.** Limitation of desirable financial support for the R&I system in the Bratislava region

III. Creating a dynamic, open and inclusive innovative society	**III.A.1.** Dynamic growth of ICT usage in all business processes	**III.B.1.** Development of social innovations and creative industry **III.B.2.** Entry of national innovative firms into global markets **III.B.3.** The support for the creation and development of innovative spin-off and start-up businesses **III.B.4.** Utilizing the potential of networking (enterprises, R&I structures) **III.B.5.** Motivate the businesses to support the innovations and technological transfers by financial tools (innovation vouchers, venture capital funds). **III.B.6.** Utilizing the potential of services and products in the area of ICT in the context of Digital agenda 2020	**III.C.1.** Dysfunctional national innovation system **III.C.2.** Barriers to utilizing the protection of intellectual property rights **III.C.3.** Ineffective use of resources for the transfer of knowledge and technologies into practice **III.C.4.** Absence of indirect tools and motivational environment for the R&I support **III.C.5.** Low law enforcement **III.C.6.** Absence of legislation stimulating the acquisition of innovative products	**III.D.1.** Autonomous functioning of sectors of education, R&I and business practice, which results into different understanding of R&I

IV. Improving the quality of human resources for an innovative Slovakia	**IV.A.1. The quality of human resources in the competitive production sectors stemming from the tradition**	**IV.B.1.** Renewal of the tradition of vocational and technical education **IV.B.2.** Creation of the suitable environment for the return of the Slovak citizens employed in foreign R&I organisations **IV.B.3.** The support for inflow of foreign R&I workers and foreign students to Slovakia **IV.B.4.** Involvement of young R&I workers in solving practical business problems	**IV.C.1.** Educational system is not linked to the practical needs, especially in the area of technical and natural sciences **IV.C.2.** Absence of the system and the support of business education and development of creativity in the educational process **IV.C.3.** Low number of efficient R&I employees focused on the practical utilization of the results	**IV.D.1.** Changing population structure with increasing share of population with insufficient quality of education and low professional skills - analysis of human resources (demographic development) **IV.D.2.** Persisting educational orientation towards the areas that do not correspond with the needs of the economic practice and knowledge society - to be included into analysis **IV.D.3.** Deteriorating composition of graduates in the educational process. Missing graduates especially in technical and natural sciences - to be included into analysis **IV.D.4.** Persisting brain drain of talents abroad – look into analytical concepts **IV.D.5.** Imbalance of employees' age structure – to be included into analysis

Thematic areas	External		Internal	
	Opportunities	Threats	Weaknesses	Strengths
Economic environment	IB1, IIB1, IIIB2, IIIB4, IVB1	ID1, ID3, IVD1, IVD2, IVD3	IC3, IC4, IC6, IIIC5, IVC1, IVC2	IA1,IA2, IA4, IVA1
Science	IB3, IVB2, IVB3	IID1, IVD4, IVD5	IC2, IIC2, IIC3, IIC4, IIIC2	IIA1
Innovation environment	IB2, IB4, IB5, IB6, IIB2, IIB6, IIB7, IIIB1, IIIB3, IIIB5, IIIB6 , IVB4	ID2, IIID1	IC1, IC5, IIC1, IIC5, IIC6, IIC7, IIC8, IIIC1, IIIC3, IIIC4, IIIC6, IVC3	IA3, IIIA1, IVA2
ERA	IIB3, IIB4, IIB5		IIC9, IIC10	

Thematic areas	External		Internal	
	Opportunities	Threats	Weaknesses	Strengths
Economic environment	I.B.1. Broadening the connection of domestic sub-suppliers to global supplier MNC chains	I.D.1. The shift of investors into territories with different comparative advantages in comparison to the SR (EU)	I.C.3. Insufficient integration of domestic businesses into sub-supplier chains for MNCs	I.A.1. Key industrial sectors represented by MNC (automotive, electrotechnical, metallurgical, chemical) and with existing localized sub-supplier businesses
	II.B.1. New "EU Industrial Strategy (Industry 2020)" heading towards the revitalization of European industry	I.D.3. Reluctance of businesses to invest in R&I in Slovakia	I.C.4. Undercapitalisation of businesses associated with low innovation performance, especially SMEs	I.A.2. Competitive technological and productive level in export sectors
	III.B.2. Entry of national innovative firms into global markets	IV.D.1. Changing population structure with increasing share of population with insufficient quality of education and low professional skills	I.C.6. Low own added value of production of domestic businesses	I.A.4. Increasing share of information services in export services
	III.B.4.Utilizing the potential of networking (enterprises, R&I framework)	IV.D.2. Persisting educational orientation towards the areas that do not correspond with the needs of the economic practice and knowledge society	III.C.5. Low law enforcement	IV.A.1. The quality of human resources in the competitive production sectors stemming from the tradition
	IV.B.1. Renewal of the tradition of vocational and technical education	IV.D.3. Deteriorating composition of graduates in the educational process. Missing graduates especially in technical and natural sciences.	IV.C.1. Absence of linkages between the educational system and the practical needs, especially in the area of technical and natural sciences	
			IV.C.2. Absence of the system and the support of business education and development of creativity in the educational process	
Science	I.B.3. Concentration of R&I centres on the limited number of RIS3 priority areas	II.D.1. Limitation of desirable financial support for the R&I system in the Bratislava region	I.C.2. Absence of the business industrial research in Slovakia	II.A.1. Good results in selected scientific and technological disciplines, with concentrated research teams and workplaces (materials and nanotechnologies, information and communication technologies, biomedicine and biotechnologies, industrial technologies, energetics and energy, environment and agriculture, social sciencies and humanities)
	IV.B.2. Creation of the suitable environment for the return of the Slovak citizens employed in foreign R&I organizations	IV.D.4. Ongoing outflow of talented people abroad	II.C.2. Excessive number of broadly defined priorities of state policy in the area of science	

	IV.B.3. The support for inflow of foreign R&I workers and foreign students to Slovakia	**IV.D.5. Imbalance of employees' age structure**	**II.C.3. Fragmentation of resources for building R&I infrastructure on a national level (state budgest, structural funds)**	
			II.C.4. Extensively built R&I infrastructure	
			III.C.2. Barriers to utilizing the system for protection of intellectual property rights	
Innovation environment	**I.B.2. Creation of linkages between MNCs' R&I and domestic business R&I framework**	**I.D.2. Insufficient investments into products and technologies based on knowledge partly due to absence of MNCs' linkages with local R&I infrastructure**	**I.C.1. Insufficient share of own (Slovak) R&I activities in export sectors in Slovakia**	**I.A.3. Increasing interest of businesses and industrial clusters in rebuilding of industrial R&I structures (entities)**
	I.B.4. Deepening the trialogue between academic, business and public sectors	**III.D.1. Autonomous functioning of sectors of education, R&I and business practice, which results into different understanding of R&I**	**I.C.5. Marginal application of revolving schemes including venture capital for R&I support. Absence of the system for the application of venture capital**	**III.A.1. Dynamic growth of ICT usage in all business processes**
	I.B.5. Potential for using land reserves and strategic domestic natural resources (water, timber, magnesite) in an innovative economy		**II.C.1. Absence of the complex R&I strategy and its implementation**	**IV.A.2. Disciplined, motivational and adaptable human resources**
	I.B.6. Support for the conversion to green technologies, materials and products due to legislation and undesirable ecological changes		**II.C.5. Barriers for companies to access the infrastructure of public R&I workplaces**	
	II.B.2. Dismantling the barriers to cooperation (increasing coherence) through quadripartity (quadruplehelix) as a basic governance principle of R&I		**II.C.6. Administrative barriers to implementation of projects financed from structural EU funds into practice**	
	II.B.6. Broader use of Slovak republic's knowledge in carbon-free energetics including the level of security that is accepted by society		**II.C.7. Low level of cooperation between the academic sector and industry**	
	II.B.7. Insufficiently used agriculture and water resources management potential		**II.C.8. Low share of national funds that finance R&I**	
	III.B.1. Development of social innovations and creative industry		**III.C.1. Dysfunctional national innovation system**	

	III.B.3. The support for the creation and development of innovative spin-off and start-up businesses		**III.C.3. Ineffective use of sources for transferring of knowledge and technologies into practice**	
	III.B.5. The existence of financial tools for the motivation of business subjects to support the innovations and technological transfers (innovation vouchers, venture capital funds)		**III.C.4. Absence of indirect tools and motivational environment for the R&I support**	
	III.B.6. Utilizing the potential of services and products in the area of ICT in the context of Digital agenda 2020.		**III.C.6. Absence of legislation stimulating the acquisition of innovative products**	
	IV.B.4. Involving the young R&I workers into solving practical business problems		**IV.C.3. Low number of productive R&I workers that are focused on practical application of results**	
ERA	**II.B.3. The support of R&I projects within Visegrad Four countries and the EU Strategy for the Danube Region and interlinking within ERA also by utilizing the Centrope region potential (Bratislava-Brno-Vienna)**		**II.C.9. Low involvement of Slovak subjects in 7. Framework Programme (FP7)**	
	II.B.4. Better use of community programmes, especially Horizon 2020 and the system of ESFRI programmes and projects		**II.C.10. Insufficient competitiveness of Slovak R&I organizations within EU**	
	II.B.5. Use of European technological platforms by integrating national technological platforms into their activities			

List of abbreviations

EU FP7	Seventh Framework Programme of the European Union
SRDA	Slovak Research and Development Agency
ASFEÚ	The Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic for the Structural Funds of EU
CE	Centre of Excellence
CIP	Competitiveness and Innovation Framework Programme
EC	European Commission
ELIXIR	European Life-sciences Infrastructure for Biological Information
EPOS-ERIC	Infrastructure for the study of tectonics and dynamics of Earth surface
ERA	European Research Area
ESFRI	European Strategy Forum on Research Infrastructures
ESRF	European Synchrotron Radiation Facility
ESSurvey	European Social Survey
ESIF	European Structural and Investment Funds for the period 2014 - 2020
ETP	European Technological Platform
EU	European Union
EURATOM	The European Atomic Energy Community
European XFEL	European X-ray Free Electron Laser
FAIR	Device for Anti-proton and Ion Research
GDP	Gross Domestic Product
ICT	Information and Communication Technologies
ILL 20/20	Innovation of the tool of european neutrons and spectroscopy
IS SR	Innovation Strategy of the Slovak Republic for the period 2007 – 2013
IUS	Innovation Union Scoreboard
JHR	Jules Horowitz Reactor
CC	Competence Centre
LIFEWATCH-ERIC	The E-Science and Technology European Research Infrastructure Consortium for Biodiversity and Ecosystem Research
MTCRD SR	Ministry of Transportation, Construction and Regional Development of the Slovak Republic
ME SR	Ministry of Economy of the Slovak Republic
MHTM	Medium-High Technology Manufactures
MIRRI	Microbial Resource Research Infrastructure
MC SR	Ministry of Culture of the Slovak Republic
MLTM	Medium-Low Technology Manufactures
MNC	Multinational Companies
MD SR	Ministry of Defence of the Slovak Republic
MAaRD SR	Ministry of Agriculture and Rural Development of the Slovak Republic
SME	Small and Medium Enterprises
MESRaS SR	Ministry of Education, Science, Research and Sport of the Slovak Republic
MI SR	Ministry of Interior of the Slovak Republic
ISTC	International Scientific and Technological Cooperation
MYRRHA	Multi-purpose hybrid research reactor for high-tech applications
MH SR	Ministry of Health of the Slovak Republic
NACE	Statistical classification of economic activities in the European Community
NADSME	National Agency for the Development of Small and Medium Enterprises
NFC	Non-returnable financial contribution
NSRF	National Strategic and Reference Framework
OECD	Organisation of Economic Cooperation and Development
OP	Operational Programme
OP CaEG	Operational Programme Competitiveness and Economic Growth
OP E	Operational Programme Education
OP R&D	Operational Programme Research and Development

PRACE	A Partnership for Advanced Computing in Europe
FDI	Foreign Direct Investment
RCA	revealed comparative advantage
RIC	Regional Innovation Centre
RIS3	Research and Innovation Strategy for Smart Specialisation of the Slovak Republic
GCSTI	Government Council for Science, Technology and Innovation
SACR	Slovak Agency for Tourism Development
SARIO	Slovak Investment and Trade Development Agency
SAV	Slovak Academy of Sciences
SBIR	The Small Business Innovation Research Programme
SIEA	Slovak Innovation and Energy Agency
SOŠ	Vocational school
SOÚ	Vocational schol with an industrial specialisation
CS	central Slovakia
SC GCSTI RIS3	Standing Committee of the Government Council for Science, Technology and Innovation for RIS3 Implementation
SADF	Slovak Assurance and Development Fund
TFP	total factor productivity
UH	University hospitals
USP	University Science Park
SCU	Slovak Clusters Union
CSAB	Central state administration bodies
GO SR	Government Office of the Slovak Republic
V3	Vysegrad Four countries except the SR (the Czech Republic, Poland, Hungary)
V4	Vysegrad Four countries
R&I	Research and innovation
R&D	Research and development
U	universities
SGR	Self-Governing Region
RDC	Research and Development Centre
WEF	World Economic Forum
WS	western Slovakia