Pursuant to Article 8 paragraph 1 of the Law on Scientific and Research Activity ("Official Gazette of the Republic of Serbia", No. 110/05, 50/06 – correction, 18/10 and 112/15) and Article 45 paragraph 1 of the Law on the Government of the Republic of Serbia ("Official Gazette of the Republic of Serbia", No. 55/05, 71/05 – correction, 101/07, 65/08, 16/11, 68/12 – CC, 72/12, 7/14 – CC and 44/14), upon the proposal of the Ministry of Education, Science and Technological Development,

the Government passed the

STRATEGY

ON SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT OF THE REPUBLIC OF SERBIA FOR THE PERIOD 2016 – 2020 – RESEARCH FOR INNOVATION

I. INTRODUCTORY REMARKS

Science and innovation are key factors of competitiveness and sustainable development. The main preconditions for the creation of an innovative society of knowledge are the excellence and relevance of scientific and research results. Excellence is a measure of quality and international visibility of scientific and research results, and the relevance represents the impact of the scientific and research results on the economy and society.

The Strategy on Scientific and Technological Development of the Republic of Serbia for the period 2016 – 2020 – Research for Innovation (hereinafter: the Strategy) is a document which sets out measures and programs for the promotion of excellence in science and targeted research for the development of economy and society as a whole, in the next five years.

Vision of the Strategy

Within five years, science in the Republic of Serbia will be based on a competitive system that supports excellence in science and its relevance to economic development, competitiveness of the Serbian Economy, and development of society as a whole.

Strategy Mission

The establishment of an effective national research system integrated into the European Research Area which leans on the partnerships in the country and abroad, and which contributes to the economic growth, social and cultural progress, raising the standard of living and quality of life.

Institutional and strategic framework of the Strategy is based on the acknowledgement of the role of science, technological development and innovation in the socio-economic and overall development of the country, with a clear emphasis on the quality of education and research staff and competitive research for innovation. The Strategy relies in part on the positive experiences of the Strategy on Scientific and Technological Development of the Republic of Serbia for the period 2010 – 2015, and the current sectoral development strategies and other strategic development documents and policies, and it is associated with regional EU programs and strategies, in particular, in determining the development priorities (Strategy for Education Development in Serbia 2020, Strategy and Policy on Industry Development of the Republic of Serbia 2011 – 2020, Strategy for Support of Development of SMEs, Entrepreneurship and Competitiveness 2015 – 2020, Strategy for Agriculture and Rural

Development 2014 – 2026, Strategy for Information Society Development in the Republic of Serbia until 2020, Strategy on Development of Intellectual Property for the period

2011 – 2015, Strategy for South East Europe 2020 (SEE 2020), Western Balkans Research and Innovation Strategy (WISE), Strategy for the Danube Region, Lisbon Strategy, Horizon 2020, etc. At the same time, the Strategy is a national road map for integration into the European Research Area, since it accepts and sets out measures for achieving priorities and objectives defined in the roadmap of the European Research Area. The essential novelty of this Strategy is that it focuses around the "research for innovation", in the function of economic and overall social development of the country.

In legal terms, the Strategy is in line with the Law on Scientific Research and the Law on Innovation and the bylaws adopted on the basis of those laws, as well as with the Law on Higher Education and other relevant systemic laws and regulations.

Structurally, the text of the Strategy contains the following sections: I. INTRODUCTORY REMARKS; II. ABBREVIATIONS; III. STRATEGIC OBJECTIVES OF THE REPUBLIC OF SERBIA IN SCIENCE AND INNOVATION FOR THE PERIOD 2016 – 2020; IV. GUIDELINES FOR IMPLEMENTATION OF THE STRATEGY; V. ADOPTION OF THE ACTION PLAN FOR STRATEGY IMPLEMENTATION; VI. FINAL PROVISIONS.

Annex I – "SCIENCE AND INNOVATION IN THE REPUBLIC OF SERBIA TODAY" forms an integral part of the Strategy.

II. ABBREVIATIONS

EBRD – European Bank for Reconstruction and Development

EC – European Commission

EU – European Union

ERA – European Research Area

IIR – Integrated and Interdisciplinary Research

IF – Innovation Fund

SRO – Scientific Research Organization

NIS – National Innovation System

OECD – Organization for Economic Cooperation and Development

BR – Basic research

FP7 – Seventh Framework Programme for Research and Technological Development

TD – Technological Development

IPO – Intellectual Property Office

EPO – European Patent Office

TTF – Technology Transfer Facility

SMEs – Small and medium-sized enterprises

III. STRATEGIC OBJECTIVES OF THE REPUBLIC OF SERBIA IN SCIENCE AND INNOVATION FOR THE PERIOD 2016 – 2020

General analysis of the situation in science, technological development and innovation activities in the Republic of Serbia, as well as the analysis of the implementation of the Strategy on Scientific and Technological Development of the Republic of Serbia for the period 2010 – 2015 and its achieved targets and results (Annex 1) shows that the Republic of Serbia has scientific and research potential and that, in times of economic recession and lack of material and financial resources, significant results were achieved in many areas, above all, in the excellence in scientific research and the number of scientific papers published in international journals and establishment of new technological enterprises that improve the position of Serbia in the global economy.

The analysis of the implementation of the Strategy on Scientific and Technological Development of the Republic of Serbia for the period 2010 – 2015 and the achieved results, as well as on the state of science as a whole, is presented in Annex 1 – "SCIENCE AND INNOVATION IN THE REPUBLIC OF SERBIA TODAY", and it contains the following conclusions:

1. The excellence of scientific research and their relevance to the economic and social development of the country and society as a whole are not sufficiently supported through the system of research funding;
2. There are no adequate financial instruments, nor the institutional framework for linking science with industry and the public sector;
3. The system of management of the scientific and innovation system is not sufficiently effective, and there is little coordination of work in the relevant institutions and different stakeholders;
4. There is a lack of adequate human resources in scientific research organizations, industry, public sector, and there are no long-term measures to address this problem;
5. Although there are programs to support international cooperation, science in the Republic of Serbia is not fully integrated into the European Research Area and the insufficient number of scientists participate in international projects.

The economy and society must step into the new field of development, based on science and in an environment that stimulates economic and technological and socio-cultural innovation, so that the Republic of Serbia could improve its competitiveness on the global level.

The overall objective of the Strategy is to improve the efficiency and effectiveness of the scientific research system which will allow:

– the creation of new knowledge, development of new and improvement of the existing technologies, solving complex social and economic problems and the definition of the economic specialization of the country;

– education of high quality research personnel that will be able to use their knowledge and scientific research activities in order to create new values, design and generate economic and overall social development.

In order to achieve the defined vision and mission, this Strategy defines six specific objectives, as follows:

1. Encouraging excellence and relevance of scientific research in the Republic of Serbia;
2. Strengthening the connection between science, economy and society to encourage innovation;

3. Establishing an effective management system for science and innovation in the Republic of Serbia;
4. Ensuring excellence and the availability of human resources for science and economy and social affairs;
5. Improving international cooperation in the field of science and innovation;
6. Increasing investment in research and development through public funding and encouraging the investments of the business sector in research and development.

The task of the ministry responsible for science and technological development (hereinafter: the Ministry) is to prepare and implement a set of measures that will create conditions for the realization of these objectives.

1. Encouraging excellence and relevance of scientific research in the Republic of Serbia

Research in the Republic of Serbia shows high quality and covers broad scientific fields, but they are not sufficiently focused on excellence and the application of research results in practice. For faster social and economic development of the country, it would be necessary to provide significant impact of science, enhancing the excellence and relevance of scientific research.

Measures to achieve this objective are:

1) Strengthening of basic research

Excellence in science is the foundation of an innovative knowledge society, whereby the most significant contribution is provided by the basic – fundamental research. Excellence in all areas of basic research, which are a precondition for overall development, will be supported by directing funds towards more successful research teams that achieve outstanding scientific results, contribute to increasing the international visibility and competitiveness of Serbian science. The primary goal of basic research will remain a systematic search for new knowledge that solve new or existing scientific problems, prove new ideas and develop new theories. In addition, basic research will pursue its essential role in the education of high-quality scientific and technical staff, strengthening international scientific cooperation and participation in the development of new technologies. This research is the result of researcher's curiosity, and it will not be conditional on predefined priorities and topics, and the support for their autonomous development will be implemented by universities, research institutes, Serbian Academy of Sciences and Arts and Matica Srpska.

2) Introduction of targeted basic research

Targeted basic research is introduced, and it is oriented toward solving social challenges and needs of the society for solving specific problems. Therefore, according to the "top down" principle of project financing, this research will take place within the thematic framework determined by the Ministry of Education, Science and Technological Development, in consultation with other relevant ministries.

This type of research will be used to implement coordinated partnership projects between two or more ministries, which will be focused on solving complex problems and significant social challenges, which will contribute to the optimal use of budgetary funds for funding of research and development. Research will be conducted in the field of economic development, market systems and enterprise operation.

In social and human sciences, research of this type will be directed towards the development of cultural, historical and national identity and preservation of the national heritage (Serbian language, national history, spiritual heritage, etc.). In addition, research will be conducted in the field of public policy, education, national security, environment, sustainable development, human and minority rights, health care, the right to use water, energy and improvement of education and other civilization standards in the Serbian society. The projects that have a multidisciplinary approach to research will be supported.

3) Improvement of technical and technological research

In the area of technical and technological sciences, research will be focuses on the development of new and improvement of the existing technologies, products and services. Joint research projects with the industry will be introduced in the area of technical and technological research. Thematic frameworks will be determined through a wide consultation process with the scientific community and industry, in order to define the key areas of research, and in whose implementation will participate joint research teams of science and industry, or economic and other entities will financially support the research of immediate interest. The projects will solve practical problems within thematic areas for predetermined end-users, so that at the same time they reflect the needs of the economy and the possibilities of science.

Special support will be given to joint research projects between science and industry, since direct interaction during the research itself accelerates the development of new products, it helps reach a higher level of technological readiness and it shortens the time needed for their commercialization.

4) Improving the system of evaluation of scientific research

The improved system of evaluation shall encourage and promote scientific excellence, as well as the social and economic relevance of research and will be defined with the appreciation of the differences that exist in the areas of science, such as: natural sciences and mathematics and medicine, technical and technological and social and human sciences.

Changes to the system of evaluation of scientific research will include: the introduction of new categories of scientific research results, more precise definition of the value of existing categories and re-categorization of scientific journals.

Scientific excellence and its evaluation are the main assumptions that the knowledge that exists and occurs at the universities and institutes is internationally competitive and that it creates new scientific value, so the results published in the top international journals (journals with high impact factor values) will be especially valued which will improve the parameters of scientific excellence: citation and Hirsch index (of individual researchers, financed projects and the overall scientific research system of the Republic of Serbia).

Evaluation of research in the fields of social and human sciences will support, in addition to publishing results in scientific journals and monographs and the application of the research results in practice, through performed expertise on the international and national level. This will increase the impact of these sciences on society and the development of social innovation.

Evaluation of results in the field of technical and technological sciences will, aside from scientific papers, evaluate patents, new reviewed technical solutions and other results that have practical application, such as the licensing of patents, technology transfer, agreements on the use and development of technology, advisory services, establishment of technology companies, etc.

The evaluation criteria will be a good incentive for researchers and research teams and they will enable the recognition of excellence.

New evaluation procedures will be established (international review, public panels, etc) that will take place in various stages of research independently and with the maximum possible participation of international experts, with the use of good practices and standards developed in the European Research Area (ERA).

The existing databases will be improved and made publicly available, in particular the registry of funded researchers, the registry of funded projects, as well as other registries of importance for research and innovation.

5) Changes in the model of financing scientific research

The system of financing of scientific research will be reformed, in order to improve the system, to ensure stable funding and to ensure that the budget funds are used in an efficient and optimal manner. Changes in the system of financing will include the improvement of existing ways of project financing and development of a new model of financing, and it will be implemented in two phases.

In the first phase, the existing model of project financing will be improved – application in 2016.

A new system of allocation of funds in project financing will be introduced, and the funds intended for the material costs of research will be increased. Of the total funding for projects, at least 20% will be allocated to finance direct material costs of research, which will provide better quality, more extensive and more comprehensive research.

The current model of project financing will be improved through increased competition and introduction of additional criteria that will evaluate: the scope and quality of research, scientific and interdisciplinary cooperation, cooperation with the industry and social activities. In the process of selection of project, their periodic and final assessment will contain a set of quantitative performance indicators. The selection of projects for funding and the monitoring process will be transparent, and the research results will be publicly available to the local and international public. The duration of projects, the criteria for evaluation and selection procedure are stipulated by the law and other relevant bylaws.

In the second phase, from 2016 – 2019, a combined model of financing will be developed "project-institutional funding model", whose implementation should begin in 2019.

The second phase will include the development of the model aligned with the reform of the research system. The ultimate goal of the reform of financing of scientific research is to establish a balanced mix of projects and institutional funding. Institutional funding will have two components: basic, which will provide stable financing; and developmental, which will depend on the degree of fulfillment of the performance parameters. The implementation of this model will follow after a detailed analysis with the adoption of appropriate amendments to laws and bylaws which will regulated the matter of the new model of financing.

6) Establishing the Fund for Research Promotion

The Fund for Research Promotion will be established, with the aim to support the (co-) funding of research, and development and training of research staff. The Fund will support research and development projects aimed at young talented researchers, returnees who have been at renowned research institutions in the world and strengthen the link with the scientific diaspora through the establishment of joint projects and other forms of scientific and technological cooperation. The Fund will be established from the budgetary and donor funds.

The funds required for the Fund to encourage research in the coming period will be planned within the budget limits, given the limited possibilities of the budget balance or the Republic of Serbia and implementation of fiscal consolidation measures.

7) Development of scientific research infrastructure

Providing high-quality research equipment and infrastructure are the main preconditions, not only for good quality scientific research, but also for technological and innovative development as well.

Investments in research and development infrastructure will be implemented through a clear and transparent mechanism to ensure the implementation of strategic objectives and prevent further fragmentation of research infrastructure. The objectives of the project "Research and Development in the Public Sector" will be redefined and efficient and rational use of the loan proceeds (EIB and CEB) will be ensured, as well as new resources that will be provided from the budget, donations or other sources. The Center for Stem Cells, Nanocenter and other centers whose construction started, and which have a research potential and link several research institutions, will be finished and put into operation. Further development will be directed towards the centers of excellence that will be equipped with infrastructure so that they can be an integral part of the European network of centers of excellence.

The existing infrastructure will be assessed, and the register of research equipment will be established, with the specified conditions of use, operational support for the functioning and maintenance. Research equipment will be made available to small and medium-sized enterprises (SMEs) and other users, especially start-ups that participated in the innovation support program.

Strategic plan for the development of scientific infrastructure in the Republic of Serbia will be developed, as well as the access to the use of larger equipment systems at the regional level in the Western Balkans. The procedures for procurement of equipment and the general efficiency of the Project Management Unit will be analyzed and improved.

8) Promotion of science and innovation

Special dimension of development of culture of dialogue between science, technology and society is related to better communication within the research sector with the industry, other ministries, civil sector and society as a whole.

Center for the Promotion of Science, scientific research community, interested business organizations and non-governmental organizations will organize campaigns and actions to promote the development of an innovative knowledge society.

Academic and other scientific organizations will include in their development plans strategies for dissemination of scientific, technological and innovation culture, through the development of communication with mass media, programs for reception of students and teachers during the open days in an institution, etc.

Calls for research projects will include activities related to spreading of the scientific and technological culture. Internet portals of projects will contain notifications that will inform the general public about the benefits of the research conducted.

It is planned to establish regional centers for the promotion of science and interactive science center in Belgrade, as a meeting place for citizens with science and technology, research institutions and industry, and, in particular, talented pupils and students with innovative and new approaches to learning and mastering scientific methodology.

The competition for the best technological innovation will be improved through defining of detailed criteria for selection, evaluation and rewarding of the best annual technological innovation. The competition to select the best technological innovation will include several countries of the Western Balkans, and it will also include, as a follow-up activity, the competition among pupils ("Pupil Innovator") and students ("Student Innovator").

Key performance indicators:*

The excellence of scientific research:

1. The number of papers per year in the *WoS* network per 1000 researchers;
2. The number and share of scientific papers in relation to the total number of papers in high-impact journals (first 10% and 30% of the journals in the field);
3. The number and share of national publications in the 20% of the most cited publications in the field;
4. The number and share of monographs of prominent foreign publishers in relation to the total number of monographs;
5. The number of monographs in national, cultural and historical sciences in Serbian language and the languages of national minorities and ethnic communities;
6. The number and share of Serbian scientists at leading international conferences;
7. The average number of citations per paper without self-citations;
8. The total number of citations without self-citations;
9. The Hirsch index – over a longer period.

The relevance of scientific research:

1. The number of patent applications/patents or other forms of intellectual property (domestic or international);
2. Co-authorship/Invention with researchers from industry or the public sector;
3. Expertise on international or national plan (with the confirmation of the Scientific Committee);
4. Participation in commissioned projects (of domestic or foreign party from the public or donor organizations);
5. The share of projects realized with the participation of the private or public sector;
6. Revenue from the knowledge transfer;
7. The level of private sector investments in the establishment of new technology companies;
8. Revenues generated by the research from international organizations or private sector (national and international).

*A number of indicators of excellence and relevance are shown in other parts of the Strategy

2. Strengthening the link between science, economy and society to encourage innovation

Better connections between scientific research organizations and industry accelerates the development of technological innovation, and a connection between science, art and technology on one side with the new business models and practice on the other side, opens up new opportunities for the development of social innovation. For these reasons, the establishment of these links will be supported, both in the process of creating new intellectual property, and in different stages of development of new

products, services and technologies.

Measures that will be used to achieve this objective are:

1) Encouraging the application of scientific research results

There shall be a mechanism of budget support or co-financed support to those scientific research results that have the potential for commercial use, and which are in an advanced stage of development of products, technologies or services. Priority will be given to those scientific results that have reached a higher level of technological readiness for implementation.

2) Strengthening the work of the Innovation Fund

Improving the links between scientific research organizations and business entities will take place through the work and activities of the Innovation Fund. The activities of the Innovation Fund in encouraging innovative activities through financing of projects of companies and scientific research organizations in the Republic of Serbia will be strengthened by providing funds through the following mechanisms: budget support, through cooperation with international financial institutions, organizations, donors and private sector participation.

3) Further development of the Serbia Innovation Project

The performance of the Innovation Project in the Republic of Serbia confirmed the need for this form of support to continue, as it directly leads to the creation of new intellectual property with a real market value, which is reflected in the successful commercialization of new products, services and technologies, as well as the creation of a significant number of sustainable jobs for people with higher education. Also, these programs provide another model of inclusion of researchers and scientific research organizations in the innovation process and the establishment of international cooperation with partners and clients. The Mini Grants Program will be strengthened, and it is intended for micro and small enterprises in the Republic of Serbia, and this Program contains technological innovation. Additional funds will be provided for the implementation of the Matching Grants Program, incentivizing existing companies in the Republic of Serbia to continue investments in research and development, and to base their further growth and competitiveness in the international market on innovative products, services and technologies.

4) Establishment of joint innovation projects of the private sector and scientific research organizations

One of the primary tasks of restructuring R&D system of the Republic of Serbia and the construction of the national innovation system is to increase the level of involvement of R&D potential in enterprises. One of the support mechanisms for inclusion of part of the R&D potential in the enterprises is realized through joint technological development projects of private companies and scientific research organizations.

A mechanism will be established that will provide incentives for intensive project cooperation between the private sector and scientific research community, in order to create a new market-oriented products, services and technologies that have the potential for commercialization. This funding mechanism will include commercial projects and early development of technology that is still not ready for the market. These projects will be implemented by a consortium composed of at least one Serbian company from the private sector, with the leadership role, and at least one accredited scientific organization as a partner. Co-financing of projects by the beneficiaries will be required, at it will be at least 30% of the total project budget. The project selection process will be competitive, public and conducted with the International Review based on the model used under the Mini and Matching Grants Programs.

5) Improving the transfer of knowledge and technology

In order to ensure even closer cooperation between scientific research organizations and the private sector, a Technology Transfer Facility will be supported within the Innovation Fund. With the support of international experts, the TTF will link scientific research organizations and university offices for technology transfer with the investors and buyers from the private sector, in order to allow the transfer of intellectual property, from the academic sphere into practical use in the economy. These processes will ensure the creation of value for scientific organizations through new models for the implementation of the existing and newly developed technology, generating revenues from licensing, expanding the range of services that can be provided to the private sector (ordered research, testing, etc.) and further incentivizing of researchers to carry out their primary activities. Financial support will be provided for further development of those projects that show commercial and technological potential, but require additional research in order to raise their level of readiness for commercialization. Also, the operation of the Technology Transfer Facility will enable further strengthening of the capacity of the existing TT offices in universities, which will lead to a better evaluation and greater visibility of the results of applied research in scientific research organizations.

In order to improve the relevance of research in the Republic of Serbia and raising their technological readiness to be as close to the market conditions as possible and to enable their commercialization and application in the economy, the Proof of Concept program will be developed during the second year of implementation of this Strategy. State-owned universities in the Republic of Serbia will develop a Guide for the Implementation of the "PoC" program and it will be piloted in selected research groups, and for these groups additional valuation of intellectual property and the strategy for commercialization will be done under the program.

6) Encouraging the establishment of companies based on the scientific research work ("spin-off")

For the further development and application of scientific research results it is necessary to establish a mechanism for direct support to the establishment of "spin-off" companies from research organizations, which hasn't been supported so far. Incentives to these companies while seeking further forms of investments and development capital represents an advanced form of support to technology transfer, innovative entrepreneurship and applied research and development. In order to create conditions for the development of these companies, it is necessary, first of all, to regulate this area in order to achieve efficient management and commercial exploitation of intellectual property resulting from the publicly-funded scientific research organizations, such as universities, faculties and institutes, and also, to maximize the return effects for the state and development of society. In this process it is necessary to develop financial instruments available for the early development of innovative companies, such as special programs and funds that promote the establishment and rapid development of these companies.

This program will be a complementary measure to the existing instruments and funding programs, by increasing the number of innovative young companies in the Republic of Serbia that could be eligible candidates for further support, growth and development. The establishment and development of spin-off companies will be an important element in retaining young people, because these enterprises (spin-off) usually follow the idea that was generated in the work process of a research institution and they can be the new generator of employment and increasing the share of small companies in the economy.

7) Establishing a public-private partnership

In order to enable the implementation of advanced results and creation of new models of development in the context of the relevance of science and research in the Republic of Serbia, it is necessary to expand the range of available support mechanisms and incentives. Public-private partnerships are a form of cooperation between the public sector and private companies and investors, in order to reduce the risk and increase the potential for the benefit of society as a whole, through the achievement of measurable and precisely defined socio-economic (and other positive outsourced) benefits. Public-private partnerships will increase the contribution of the private sector in the financing of innovation, scientific and technological development and research.

In terms of science, research and innovation, one form of such cooperation has already been initiated in the Republic of Serbia through the Western Balkans Enterprise Development and Innovation Facility (WB EDIF). This program will support the component Enterprise Innovation Fund (ENIF), in order to utilize the synergies of regional integration and regional development initiatives in the field of research and scientific and technological development. The Enterprise Innovation Fund is the first venture capital fund for financing of innovative small and medium enterprises in the initial stage of development. It is necessary to provide continuous support of the state in this mechanism, which will have complementary results with further training of beneficiaries of the Enterprise Innovation Fund to develop and use the funds provided by the EU. The first beneficiaries of the Enterprise Innovation Fund are from the Republic of Serbia and they are already in the process of harmonization of requirements necessary to access this type of support.

8) Science Technology Parks

In the process of early development, support will be provided to the establishment and development of science technology parks in the university centers that will facilitate creation of jobs with high added value and high-quality employment: creation of new jobs/companies based mainly on high technologies, so-called high-tech-intensive companies/jobs; and technology transfer from the source, knowledge base into the business sector.

9) Establishing research and development clusters and competitiveness networks

R&D clusters will be established which will include scientific research organizations, faculties and institutes, business organizations, public enterprises, relevant state institutions, with the aim of performing coordinated research and improve the work within a specific sector within them.

In order to strengthen the cooperation, the networking of research, development and production (large, medium and small) enterprises will be introduced, which is especially important if one bears in mind that the Serbian economy is dominated by small and medium-sized enterprises which find it difficult to mobilize special research resources, which negatively affects their innovative capacity. Using the best practices in the EU, initiatives to form competitiveness clusters will be used that will enable close cooperation between the participants in the chain of value creation within and between sectors, as well as more innovation and high added value.

Key performance indicators:

1. Spending on science from the private sector as % of GDP;
2. The number of registered enterprises based on knowledge and innovation;
3. The number of joint projects of business and science;
4. A new product on the market;
5. The increase of revenue achieved through: the licensing of patents, technology transfer, agreements on the use or development of technology, advisory services, etc. ;
6. The number of implemented researches and services in companies through the application of innovation vouchers;
7. The share of companies with technological innovation (as % of the total number of companies);
8. Revenue from innovative products;
9. The number of "spin-off" companies;
10. Ranking of the Republic of Serbia in the international context: Innovation Union Scoreboard, Global Innovation Index, etc.

3. Establishing a more efficient system of management of science and innovation in the Republic of Serbia

In order for the research and innovative development to be significantly accelerated, it would be necessary for different participants in the process to achieve a certain level of cooperation and compliance at all levels of governance.

Measures to achieve this objective are as follows:

1) Improving the institutional framework

The institutional framework in the area of innovation activities should be improved in order to, inter alia, establish a body at the national level that would: consider and monitor scientific research and innovative development of the Republic of Serbia; identify basic problems of development in the economy and society and propose measures and instruments that would promote the spreading of knowledge networks and organizational application of scientific research results and innovative products, with the aim of creating an efficient, competitive and innovative economy; harmonizing positions around the strategic priorities and directions of economic and overall development of the Republic of Serbia; analyzing and measuring the level of implementation of scientific research results in the development of knowledge and innovation based economy. The law regulating the innovation activities should regulate the activities, operation, composition and appointment of members of the above mentioned body, provided that the member of that body will not receive any remuneration for their work.

2) Establishment of strategic management scientific research organizations

Establishment of strategic management within each scientific research organization will start through (re)defining of their activities, by incorporating the innovations into the work of the high education institutions and institutes. During the first year of implementation of the Strategy, each scientific research institution will develop a program of development in compliance with the Strategy and it will include key performance indicators. The changes to the management system will include redefining the mandates of the University Senate, academic councils of faculties and scientific councils and managing boards of institutes. This will be preceded by corresponding amendments to the laws governing higher education, scientific research and innovation activity.

3) Reforming the network of institutes

For the implementation of scientific and R&D institutes it is necessary to determine the economic and social role of each institute and its activities in the global research and innovation context. Each institute will first carry out a self-evaluation process under a unique methodology in order to analyze:

– organization and management;

– research capacities (in terms of the number of researchers and/or relevance and excellence of their research);

– scientific or market orientation;

– the field of research activities;

– capacity for innovation.

After that, a detailed analysis of the entire network of institutes will follow up which will refer to their activities, expanded or redefined, their continued involvement in the work of the university, pooling of institutes according to their fields of work or further improvement of their independent functioning. The whole process will be done in a transparent manner and in cooperation with the institute's management. The analyzes will be the basis for the development of the model of institutional funding.

4) Policy mix peer review

A policy mix peer review will be conducted with the purpose of improving the system and integration into the European Research Area. This evaluation involves a systematic review and evaluation of performance/functioning of the national system of research and innovation by international experts, in order to improve the content and implementation of the national policies in the area of research and innovation. The evaluation should provide insight into the practice of supporting research and innovation, program portfolios and instruments of incentives and support structures, the organization of financing and institutional structure, as well as the overall environment for research and innovation. Based on the results of the evaluation, recommendations will be defined for the improvement of integrated research and innovation policies. This activity will be carried out during 2016 in communication and coordination with the European Research Area Committee (ERAC).

Key performance indicators:

1. Improving the legislative framework: Strengthening mechanisms of the "knowledge economy";
2. New laws adopted and implemented: the Law on Scientific and Research Activity, the Law on Higher Education, the Law on Innovation Activity: institutions are implementing the laws;
3. The number of conducted analysis of the scientific research organizations, primarily institutes;
4. The number of institutes that have implemented restructuring in accordance with the amended mission.

4. Ensuring excellence and availability of human resources for science and economy and social activities

Knowledge and human resources are the basis of every society. They are a central element of vitality and a condition for social existence. The developed based on the quality of human resources needs to have stronger links of the education and research system with the other sectors, so that the resources that exist and that are generated through high education and research would be used with greater efficiency.

Measures to achieve this objective:

1) Improving the legislative framework for the development of human resources

The availability of higher education will be the basic element of the new act on higher education financing (measure established in the Strategy for Development of Education in Serbia until 2020), which will support the increase in the number of persons with higher education (in the age group 30-34) and increase in the share of students in the field of natural and engineering sciences at all levels of studies (undergraduate, master and doctoral studies).

Bylaws will regulate the incentives and rewards for researchers who achieve outstanding research results, as well as the stay of researchers in leading research laboratories and institutes in the world.

A set of law will be adopted that will remove administrative obstacles related to the visa regime, residence permits and work permits, etc.) for the stay of researchers from abroad.

Legal measures to ensure ethical conduct in scientific research will be improved, especially to combat plagiarism and the organization of transparent competitions for scientific research and teaching positions.

2) Improving the program of doctoral studies

A key role in the formation of highly educated staff belongs to the universities. Since the Republic of Serbia still does not have a critical mass of competent experts necessary for a serious economic progress, it is necessary to improve the educational and research capacities of universities by increasing the proportion of: 1) students studying natural sciences and engineering; 2) students of doctoral studies trained to continue their career in other sectors, primarily the economy; 3) teachers who have an internationally recognized research results. To achieve these objectives, it will be necessary to improve the model of financing of higher education, support the performance and quality of education and the effectiveness of research and internationalization. It is essential for universities to take action, according to the Strategy of Development of Education in the Republic of Serbia until 2020 and the Action Plan, for the reform of doctoral studies, to implement the principles and elements of innovative doctoral studies. Improvement of doctoral studies should be aligned with the priority research and the needs for the development of the country.

Mechanisms will be established for the financial support to institutions that organize doctoral academic studies, while personal support will be provided to students of doctoral studies during their studies. The support will include elements related to educational and research activities, mobility, but also the acquisition of transferable and other skills that are of interest for further career development in research and innovation and in other sectors.

In those areas with exceptional research environment (excellent equipment, research results and staff that is internationally recognized) doctoral schools will be formed, with the aim of attracting students from the region and other international students.

3) Involvement of young researchers in projects

The best students, after completing master academic studies, and successful students of doctoral studies will be included in the projects of general interest, new project cycle, after a conducted public call for projects.

Particular incentives will be devoted to the return of young researchers who have doctorates from foreign universities and they will be able to be involved in research projects within the general interest program.

Also, the financing of projects that would be led by younger researchers with the academic or teaching title will be supported.

4) Strengthening the cooperation with the diaspora

Special measures will be undertaken to include renowned scientists from the diaspora into the education and scientific system, through their participation in doctoral studies, then the undergraduate studies, their involvement in the management, advisory bodies and committees, as well as in the process of the review of national projects and the financing of start-ups, including the ones that are the beneficiaries of the innovation support program. Improving the scientific infrastructure and improvement of project funding will incentivize their participation in national projects from the program of general interest and the management of those project, if they want to come back and continue their scientific career in the Republic of Serbia, in order to pass on their knowledge and experiences from eminent laboratories and institutions around the world.

A single database of Serbian scientists and professors around the world will be formed, while the establishment of associations of academic diaspora will be encouraged in those countries where the diaspora is numerous. The actions which mark the anniversaries related to the famous scientists of Serbian origin will also be supported.

5) Improving the mobility of researchers

It is extremely important that the universities and institutes engage foreign students, researchers and experts, through international public competitions. Educational and scientific capacities of the Republic of Serbia can be dramatically increased by introducing structural measures to encourage cooperation between universities and institutes. Through the reform of the network of institutes, state-owned universities will include a number of institutes in their composition and thus strengthen their research and innovative potential. Elections to the scientific research and teaching titles will be harmonized, which will allow unhindered mobility of teaching and research staff.

It is extremely important that the universities and institutes engage foreign students, researchers and experts, through international public competitions. The aim is to establish a completely open research space, based on the excellence of researchers, which encourages the general mobility. The mobility policy will be based on the measures that ensure the funding of mobility and access to infrastructure. The “Mobility for Better Learning” Strategy will be accepted, and a strategy that will include the mobility of international and national students, teachers and researchers will be adopted. In order to be able to implement these objectives, it is necessary to remove legal barriers and other obstacles for the open procedure of employment of researchers in the public sector in research organizations. It is necessary to define new structures and approach to career development of researchers. Processes and procedures for the recruitment of researchers must be aligned with the Researcher’s Charter and the Code of Conduct of researchers. Foreign students will be able to get effective granting of their student visas and resolution of other issues relevant for their life in the Republic of Serbia (health care, accommodation, food, etc.).

Improving mobility between science and economy will be an integral part of systemic measures for greater cooperation on joint development and innovation projects, with the aim of resolving the current problems and tasks in the economy and society as a whole and creating new products and services.

6) Improving gender and minority equality in science and innovation

Gender and minority equality will be improved at all levels of decision-making and gender budgeting will be implemented in accordance with the Gender Budgeting Guidelines at the national level in the Republic of Serbia.

Key performance indicators:

1. The number of researchers per million inhabitants;
2. The number of researchers in the total number of employed inhabitants;
3. The number of young researchers that are students of doctoral studies;
4. The number of young people who have obtained their Ph.D.;
5. The number of researchers from the diaspora participating in national programs;
6. The number of PhDs in the non-academic sector;
7. The number of researchers that are involved in technology and other innovative companies;
8. The number of researchers who have achieved mobility in the country;
9. The number of researchers who have achieved mobility abroad;
10. The number of foreign students in doctoral and other academic studies in the Republic of Serbia;
11. The number of foreign researchers who are (co)financed from the budget;
12. Percent gender representation on different levels of decision-making and the share of women in the total number of researchers.

5. Enhancing international cooperation in the field of science and innovation

International cooperation will work on achieving the desired goals and addressing current challenges: to become an equal member of the European Research Area, to attract additional sources of financing from abroad, to successfully carry out the negotiation procedure until the end (Chapter 25), to provide excellence through collaboration with leading scientific research organizations abroad, to enable incoming and outgoing mobility, to involve more intensively the sector of small and medium-sized enterprises, etc.

Further integration into the European Research Area will support the intensification of existing and introduction of new measures and inclusion of the priorities from the roadmap of the European Research Area in the creation of the national roadmap.

Measures to achieve this objective:

1) Establishing of a coordination body for international cooperation

For better coordination, policy implementation in this area and raising the level of participation, an advisory body will be established – the Committee for International Cooperation which would include experts appointed in the program boards, boards of the ERA and other relevant bodies at international level (ERAWATCH, COST, EUREKA). The activities of the Committee would not be limited only to Horizon 2020, but to other forms of international cooperation.

2) Strengthening participation in the European Framework Program for Science and Innovation Horizon 2020:

– the Capacity Building Program for the participation of the Republic of Serbia in Horizon 2020 will be passed and it will include all aspects for researchers and research teams, business and social organizations, in the activities of Horizon 2020. The mobility programs will be supported through incentives, especially the mobility of young people, as well as the support for more intensive participation in the most prestigious part of the program related to the exceptional science, and implemented by the European Research Council;

– an intensive support campaign for researchers and other participants in the program will continue, using the established mechanisms, such as: info days, workshops, technical support, consultations with the national focal points, consultations, etc;

– a permanent representative of the Republic of Serbia in Brussels will be appointed, in order to be at the source of information, and a link between the creators of research policy and the Commission, and with those who work on the policy implementation;

– the network of national focal points will be strengthened in terms of additional training, acquiring skills and professionalization, with the ultimate goal of setting up a separate body to support the participants in the Horizon 2020 program;

– a mechanism to support the small and medium-sized enterprises, and large companies that want to participate in Horizon 2020 program will be developed in cooperation with the Ministry of Economy and the Serbian Chamber of Commerce and Industry;

– the possibility of accessing Euratom program will be considered;

– cooperation with the Joint Research Center of the EC will be expanded, especially in the development of smart specialization strategy, exchange of information, access to databases, support to the process of accession to the EU and others.

3) Strengthening regional cooperation in the Western Balkans and the Danube region

– the active role within the Danube strategy/region will continue, especially in terms coordination in the Priority Area 7 "Knowledge Society", and in this regard steps will be made towards better use of existing funds for research, opening new research, joint programming, stepping up international cooperation with the Joint Research Center, the Danube Rectors' Conference, better use of existing research infrastructure in the region, increased mobility of researchers, etc.;

– programs and mechanisms of cooperation within the region of the Western Balkans will be developed through the Western Balkans Research and Innovation Center (WISE) and through other existing (EDIF/ENIF) and future initiatives. This includes the creation of funds to support the activities provisioned by the Western Balkans Regional R&D Strategy for Innovation (announcing calls, investing in research, innovation, youth mobility, technology transfer, etc.). In addition, the cooperation with international research organizations in Trieste, within the Adriatic-Ionian region, the Black Sea region, etc. will be further developed.

4) Ensuring access to international research infrastructure

In accordance with the strategic research directions, the work on further involvement of the Republic of Serbia into European consortia of research infrastructure *ERIC* will be intensified, with the aim of opening up research infrastructure of the Republic of Serbia to the foreign researchers. The roadmap of research infrastructure will define and enable the construction of the necessary infrastructure installations which would be open to both domestic and foreign researchers, but also for to the companies that would be in line with the roadmap of the European Strategy Forum on Research Infrastructures, ESFRI.

In order to avoid fragmentation of research in the European context and its double or multiple funding from different countries, there will be a more intensive involvement in various forms of joint programming, either through public-public partnership (ERANETCofund, Article 185 Initiatives, Joint Programming Initiatives), or through public-private partnership (Joint Technology Initiatives, Article 187).

Key performance indicators:

1. Adopted Program for Capacity Raising for the participation of the Republic of Serbia in Horizon 2020;
2. A Committee for International Cooperation is established;
3. Appointed representative in Brussels as well as the professional network of national focal points;

4. Chapter 25 closed;
5. The number of projects in HORIZON 2020 involving teams from the Republic of Serbia;
6. The number of applications for projects HORIZON 2020 involving teams from the Republic of Serbia in relation to the total number of researchers;
7. The number of projects with coordination compared to the total number of projects in which the Republic of Serbia is participating in HORIZON 2020;
8. The number of companies that took part in Horizon 2020 projects;
9. The number of companies that run projects in Horizon 2020;
10. The number of Serbian consortium involved in the Horizon 2020 projects;
11. The number of Serbian consortium that run projects in Horizon 2020;
12. The share of publications with foreign researchers as co-authors;
13. The share of research and development financing from foreign sources;
14. The number of incoming and outgoing mobility which was accomplished through international exchange programs;
15. The number of jointly programmed research programs at the regional and global level.

6. Increasing investments in research and development through improved public financing and encouraging business sector investments into research and development

The project of building the European Research Area is the central element of the Lisbon Strategy of the EU, and innovation activities are the key to implementation. Three percent of gross domestic product should represent the total investment into research and it is an invitation to the governments, and the business sector to increase the intensity of financing for research and development, with the adequate tax policy. The EU's program "Horizon 2020" predicts that until the end of 2020, the total investment in research and innovation should amount to 3% GDP, of which 1% should come from public sources, i.e. the budget.

The Republic of Serbia defined its policies in line with the EU accession and on that path it has mobilized all the available capacities for compliance, and alignment with the prescribed European standards, both in term of legislation, as well as the fulfillment of other European standards and requirements. The first chapter in the negotiation process were opened in 2015, and this and the opening of other chapters in the negotiation process is expected this year and the following years.

If the Republic of Serbia wants to become part of the European Research Area until 2020, there has to be gradual increase of investments into research, development and innovation in order to achieve the objective set in the EU's "Horizon 2020" program, in the future time. Whether the achievement of this strategic goal, in the negotiation process, will be achieved in 2020 or later, that the total investment in science, technological development and innovation from all sources is 3% GDP, and from the budget 1% of GDP, will depend in the following years, primarily on significant economic growth and available funds in the budget of the Republic of Serbia.

Further progress of the research and innovation system, and therefore the economic and overall development of the Republic of Serbia, in real terms, is not possible without increased material investments in science and research. The projection is that by 2020 the investments from the budget will be on the level of 0,6% of GDP, and in line with the available resources of the budget of the Republic of Serbia, and the total investment from all sources of financing will reach 1,5% GDP, in order to achieve the vision of the Republic of Serbia supporting the excellence in science, relevant research and innovative system that affects economic and social development of the country.

The Strategy implementation, as well as the projected rates of budget allocations for science, research and innovation in the following years, will depend on the available resources in the budget of the Republic of Serbia and will be planned on an annual basis within the defined budget ceiling.

Measures to achieve this objective:

1) Increasing investments in research and development from public sources

Analysis of budget investments in science and research has shown that these funds are insufficient, they are not sufficiently targeted and the effective coordination of their use is not achieved, so it is necessary to provide the following in order to improve the system:

– long-term and stable increase of investments in research and development from pubic sources, so that the research system of the Republic of Serbia can develop and be internationally competitive. Additional funds for research and development should not replace insufficient investments from the national sources;

– focusing budgetary allocations for research and development, primarily to researchers and research projects, and then, to procurement and maintenance of research equipment, at to a much lesser extent, to the construction of new facilities.

– increase of investments in tangible assets for research, which is the main precondition for achieving excellent, relevant and results that are applicable in practice;

– use of budget funds for setting up and improving the work of organizations to provide infrastructural support to innovation activity;

– allocation of budgetary resources for research in projects that will be implemented by other ministries, independently or together with the Ministry;

– investments of public enterprises or state institutions in research and development directly or through joint projects with universities or institutes;

– investments of local or provincial self-governments in dedicated projects through public tenders, from own sources of revenue;

– implementation of criteria of excellence and relevance that will reduce the number of adopted project proposals from the budget resources to about 70-80%.

2) Increasing the business sector investments into research and development

Analysis of gross domestic product intended for research and development shows that these funds are still low, and unlike most EU countries in which the percentage of allocations grows, the Republic of Serbia that percentage is either stagnating or declining. To overcome this situation, it is necessary to refocus the spending towards the research and innovation in small and medium-sized enterprises. The incentives that were effective in other EU countries should be applied in the Republic of Serbia, which will strengthen the role of the economy in research and development through: tax incentives, customs incentives, specific exemptions (VAT and tax exemption on the portion invested in science), specific lines of credit financing for development of new products and services, etc.

3) Investments in research and development from other national and international sources

In line with the measures that were successful in other EU countries, investments in R&D will be stimulated, and the framework for the development of donor activities in the support of R&D will be established, as well as the legal framework for the establishment of venture capital funds.

The funds will be provided for the preparation of international research projects and joint participation of state universities and faculties, institutes and economy in international projects will be incentivized.

Key performance indicators:

1. Total spending on research and development as % of GDP;
2. Budget allocations for research and development as % of GDP;
3. % of GDP for research and development in the business sector;
4. % of GDP for research and development in higher education;
5. % of GDP for research and development in the public sector;
6. % of GDP for research and development in the nonprofit sector;
7. Budget allocations for research and development within the budget allocations of all other ministries (the amount as % of GDP).

IV. GUIDELINES FOR IMPLEMENTATION OF THE STRATEGY

Previous practice has shown that the definition of a clear policy is as important as ensuring the conditions for its implementation in practice. A key prerequisite for the implementation process is the establishment of functional cooperation between ministries and other relevant bodies and institutions, as well as between the public and private sectors. The success of the Research for Innovation Strategy will depend on understanding and political support at the highest level, as well as on ensuring stable and relevant system of financing. For the successful implementation of the Strategy, it is necessary to provide the consensus of government bodies, scientific research organizations and relevant organizations and institutions, with the provision of financial mechanisms for institutional and material support for innovation and technology transfer, as well as better coordination at the regional, national and European level.

In addition to state bodies, direct or indirect participants in the Strategy implementation process are: Serbian Academy of Sciences and Arts, Matica srpska, National Council for Scientific and Technological Development, the Committee for Accreditation of Scientific Research Organizations, the Committee for Acquiring Scientific Titles, Scientific Committees, the Committee for Ethics in Science, the National Council for Higher Education, institutes, institutions of higher education (universities and faculties), centers of excellence, the Innovation Fund, Project Implementation Unit for the project Research and Development in the Public Sector, Center for the Promotion of Science, Association of Institutes of Serbia, Conference of Universities of Serbia (KONUS), Science Center Petnica, republic and regional talent centers, scientific and professional associations, research and development centers, innovation centers, business and technology incubators, science technology parks, business and technology incubators, public enterprises, small and medium-sized enterprises, Chamber of Commerce of Serbia and regional chambers of commerce, financial institutions and other business and NGO organizations, institutions and bodies that are included in this process as users of the services.

V. ADOPTION OF THE ACTION PLAN FOR STRATEGY IMPLEMENTATION

Measures and activities, with deadlines, tasks and authorities and organizations responsible for the implementation of the Strategy will be determined by the Action Plan for Strategy implementation.

The Government will pass the action plan for the Strategy implementation within six months from the date of adoption of the Strategy.

VI. FINAL PROVISION

This Strategy will be published in the "Official Gazette of the Republic of Serbia".

05 Number: 660-1384/2016-1
In Belgrade, March 3, 2016

GOVERNMENT

The accuracy of the transcript verified by GENERAL SECRETARY

Novak Nedic

PRESIDENT

Aleksandar Vucic

ANNEX 1

SCIENCE AND INNOVATION IN SERBIA TODAY

In the assessment of the state of science in the Republic of Serbia, one should bear in mind that the implementation of the Strategy on Scientific and Technological Development of the Republic of Serbia for the period 2010 – 2015 was ongoing in conditions of severe economic crisis, in the country and on the global level. Despite numerous difficulties which our society and the country were facing in the past, science in Serbia has kept its critical mass, and in some segments it has strengthened and recorded growth and success at international level. The purpose of this part of the Strategy is to identify key issues of science and innovation in the Republic of Serbia today, through an analysis based on facts. In addition, the aim is to identify the strengths , weaknesses, opportunities and threats within the existing system through the so-called SWOT analysis.

The analysis of the research and innovation system is based on the data of the Republic Statistical Office (annual reports and press releases), the report of the National Council for Scientific and Technological Development (for all years from 2010 – 2014), annual reports of the Serbian Academy of Sciences and Arts (for all years from 2010 – 2014 on the implementation of the Strategy, European Research Area Facts and Figures 2014 SERBIA, on the analysis made by the team of experts of the World Bank, as well as based on the conclusions and assessments of the current situation from the events organized by the Ministry of Education, Science and Technological Development in cooperation with the Serbian Academy of Sciences and Arts and the Serbian Chamber of Commerce and Industry.

KEY ISSUES

1. The excellence of scientific research and their relevance for economic and social development of the country and society as a whole are not sufficiently supported through the system of research funding

In recent years, the Republic of Serbia has improved its scientific research potential, which is illustrated by the fact that the Republic of Serbia, in the total world production of scientific works, accounts for 0.3% and is ranked 46th on the list of over 140 countries (SCImago Journal&Country Ранк), and the University of Belgrade is ranked on the "Shanghai List" of the world's best universities between 300 and 400 positions.

Analysis of achieved results

This analysis includes the results of scientific research work on the projects of the current project cycle for the period 2011 – 2015 under the program of general interest: 1) the Program of basic research (BR); 2) the Program of research in the field of technological development (TD) and 3) the Program of co-financing Integrated and Interdisciplinary research (IIR).

The analysis of achieved results was carried out on the basis of regular annual reports that scientific committees prepared every year for the funded projects based on the conducted research. The analysis of the performance of scientific production used the bibliometric indicators, defined by the database Web of Science (WoS-Thomson Reuters) which covers the largest number of the most important journals in most field of science. In the field of humanities and social sciences, this analysis could not include the results from the local journals and research production included in monographic works, so instead the Serbian Citation Index – SCI was used which covers the journals of domestic publishers referred in the COBSON system of the National Library of Serbia. The total number of scientific papers, as well as the percentage of papers in leading international journals are shown in Figure 1.

Figure 1. Scientific papers indexed in the database WoS - Web of Science (Thomson Reuters), 1а) the number of scientific papers in the project cycle 2006-2010 and 2011-2015; 1б) the percentage of papers in the database WoS by programs BR, IIR and TD; 1в) the percentage of papers in top international journals (journals that belong to the top 30% journals in their field with the highest impact factor values) in the programs of BR, IIR and TD (2011-2014); 1г) the percentage of papers in leading international journals in the field of BR programs.

Based on the analysis of the results achieved in the previous project cycle, the following conclusions can be provided:

1) The scientific research results are dominated by research papers

– of the total number of results achieved, 88% are research papers published in international or national journals with peer-review. Out of the total number of scientific papers 40% are the papers published in the journals indexed by the WoS database, and 60% are scientific papers published in national journals;

– the number of scientific papers published in the journals indexed by the WoS database (figure 1a.) increased almost twice compared to the previous project cycle 2006-2010. The annual number of these papers per thousand inhabitants is 0,76 (the European average is 0,85 -2010), or an average of 390 papers per thousand budget funded researchers;

– in top international journals – journals that belong to the 30% of journals in their field with the highest values of the two-year impact factor, and 36% of the total number of scientific papers from the Republic of Serbia that were indexed in the WoS were published.

– Citations of papers originating from the Republic of Serbia is on the rise, but it is still lagging behind the European average;

– Dominant results in the field of social sciences and humanities are the papers published in the national journals (60%), monographic works that make up 30%, and only 10% are the papers published in international journals. The number of papers published in international journals has not significantly grown during the implementation of the current project cycle.

2) Research excellence depends on the area of research

– The distribution of papers published in top international journals is not uniform, nor by programs (figure 1в), nor by areas within the program (shown for the program BR – figure 1г). The highest percentage of published papers in top international journals is realized within the Program of basic research (BR) - 43%, and the highest share of papers in leading international journals is in physics 69%;
– In the Program of Integrated and Interdisciplinary research (IIR), the percentage of papers in leading international journals is 36%, with the largest field of New materials and nanomaterials 59%.;
– In the Program of research in the field of technological development (TD), of the total number of scientific papers indexed in the WoS, 26% was published in the leading international journals.

3) The number of results that may be of interest for the economy is low

– Of the total number of achieved results (patents and technical solutions) they account for 3,3%;
– 2300 results of scientific research works are technical solutions, 733 are patents, strains, variety or race, construction or architectural work on the international or national level. Most of these results were achieved through (TD) projects (70%), 23% in (IIR) projects, and only 7% in (BR) programs;
– Electronics, telecommunications and information technologies are the most successful areas in the number and commercialization of achieved technical solutions. Of the total number of new technical solutions, 38% are the results in this area, out of which 90% has already been commercialized on the national or international market;
– biotechnology and agriculture are the most successful areas in the number of patents. Of the total number of patents in technological development projects, 57% belong to this area;
– a significant number of areas within the program (TD) and program (IIR) provide insufficient contribution to the implementation of new technical solutions or patents;
– some areas of technological development participate in the research financed through budget funds through projects of other ministries, such as the area of agriculture and environmental protection, energy, transport, urban planning and construction, defense, etc. The results of the research are mostly studies, research expertise or other required results.

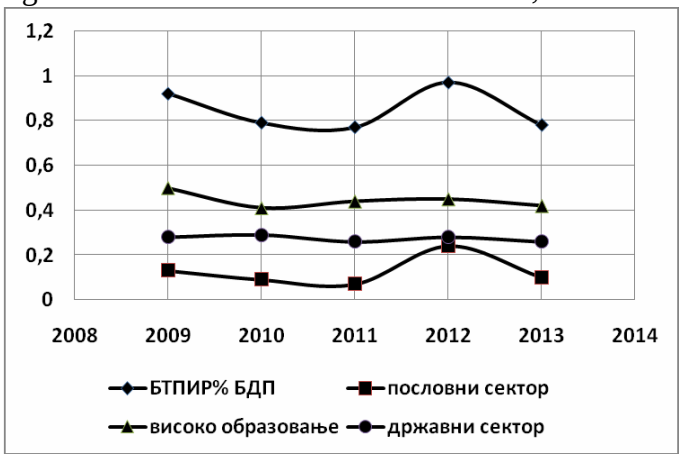
Based on the conducted analysis, the conclusion is that the research activities are mainly focuses on the production of scientific papers. Despite the extensive production, there is still a significant number of results with no international visibility, since the papers are published in national journals or publications from scientific conferences. Although some areas reached an enviable excellence, it is not sufficiently present in the entire research system. What is obvious is that the element of the research orientation are underrepresented. The presented data, however, clearly show that the Republic of Serbia has significant scientific and research potential, but this potential is insufficiently transferred into new products and services on the market.

Financing of scientific research

The excellence of scientific research, and their relevance for the economic development of the country and society in general are not sufficiently supported through the current system of financing. The total investment in science and research, from the budget and from other sources, are insufficient.

According to the data of the Republic Statistical Office, the total share of spending for research and development in the gross domestic product of the Republic of Serbia is below 1% (Figure 2) and it is still well below the EU-27 average which is 2.06 % (Eurostat).

Research in the Republic of Serbia are concentrated in the public sector, universities and institutes. The distribution of funding sources for research and development in 2013. Shows that the share of funding from the state budget is 59,5% (Figure 1). The funds that the scientific research organizations realize on the market are 25,1% which is well below the EU average of 63%.



Sources of financing (RSO -	%
Own sources	25,1
Budget funds for research and development	59,5
Business sector	7,5
Nonprofit organizations	0,1
International sources	7,8

Figure 2. Total allocation for research as percentage of gross domestic product (source data from the RSO).

Direct budget support to research

Budget funds intended for research and development (BFI as % of GDP), according to the Strategy (2010-2015) were supposed to continuously grow and reach 0,9% in 2014, while in 2015 they should have reached 1,05% of GDP, which was not realized. Over the past few years, BFI as % of GDP were below 0,5 % (they vary in the range of 0,36% - 0,46%, (Figure 3). The system of budget financing includes 16 programs of general interest for the Republic of Serbia, which are defined by the Law on Scientific and Research Activity, and which are project funded after conducted public calls/invitations and selection, under predefined rules. The largest part of the budget funds (68,4%) is distributed for research programs that are financed through projects. During a public call for project financing that was conducted in 2010, the percentage of projects accepted for financing was 87,5%. High percentage of granted projects is the results of the system of research funding, but also the fulfillment of one strategic objective, that the project should include as many, mainly, young researchers. The funds allocated to research projects were primarily for this reason directed into the work of researchers (around 57% of total funds). The share of the funds allocated for material costs of research was extremely low, only 3,2% of the total amount, which has significantly affected the scope and the quality of research, and hence the excellence and the application of results achieved. In addition, the low level of resources dedicated to the direct costs of research has, as it can be seen from the results shown in Figure 1a, reflected in the reduction of the number of papers published after 2012.

There is an obvious lack of funds needed to cover the material costs of research, and without the increase of these funds it is not possible to increase nor improve the excellence and relevance of research, especially in experimental research. The lack of funds is significantly reflected on the possibility of commercialization of research that requires testing and prototype development.

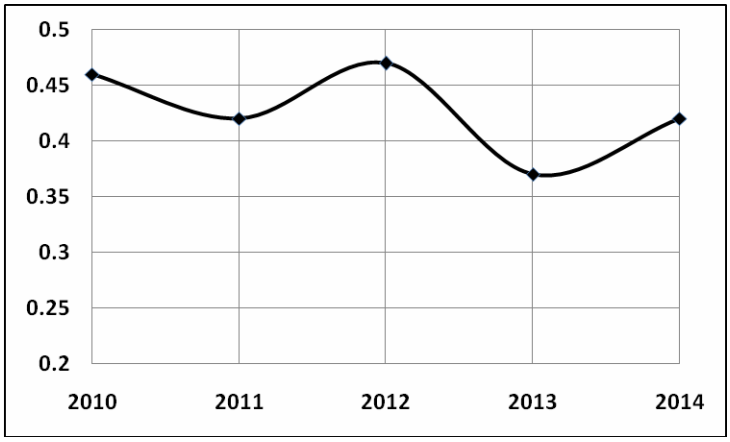


Figure 3. The movement of budgetary funds earmarked for science and research as % of GDP

Distribution of budget funds in 2014		%
Total for implementation of research programs (BR, TD, IIR)		68,4
The work of researchers	56,9%	
Overhead costs of research	8,3 %	
Material costs of research	3,2%	
Project Research and Development in the Public Sector		16,8
All other programs and subsidized institutions		14,8

Investments in research and development infrastructure

Direct budget support for research is implemented through the project "Research and Development in the Public Sector" which began in 2011. This support includes a number of investments for the revitalization of research and development in the public sector in the Republic of Serbia, including the modernization of the existing research capacities and infrastructure, creation of new research centers, building apartments for young researchers and modernization of academic computer network. The projects under this project are financed from the credits of the European Investment Bank (EIB) and the Council of Europe Development Bank (CEB), the Instrument for Pre-Accession Assistance of the European Union and the resources from the budget of the Republic of Serbia. Important infrastructural facilities have been completed: technology parks "Belgrade" and "Novi Sad Phase 1", central building of the University of Novi Sad and apartments for young researchers Block 32 in New Belgrade, facilities for Science center Petnica and Natural History Museum Svilajnac.

One of the most important sub-projects implemented within this project is the procurement of capital equipment for the needs of scientific and research organizations. Research teams received approval (project cycle 2011–2015) to procure 3.070 pieces of capital equipment in the total value of EUR 53,2 million. So far, the scientific research organizations have receive and put into operation the total of 803 pieces of research equipment in the value of EUR 24 million, and one part of equipment will be purchased and delivered during 2016. However, the total resources of this project will not be used and they will not be used in a way that it was planned.

The presented data on research results and the amount of financing clearly show that the Republic of Serbia has significant research and scientific potential since, even in times of economic recession and lack of funds, it has achieved significant results, but that the financing of science and technological development at the current level is insufficient. The low level of resources devoted to research makes it difficult to provide excellence and greater application of the achieved results in practice, and therefore the greater impact of science on economic and social development of the

country.

Higher investments from all sources of financing would be necessary in order to intensify research and innovation.

2. There are no adequate financial instruments, nor the institutional framework for linking science with industry and the public sector

The participation of the business sector in funding research in the Republic of Serbia is only 7.5%, while in the OECD countries the business sector finances 60,8% of all expenses for research and development.

The relationship of science and economy in the Republic of Serbia is characterized by:

– Inadequate human resources for research and innovation in the business sector,

– Small number of financial instruments to support research and innovation in the economy,

– Insufficiently developed institutional and legal framework to support research and innovation in the economy.

1) Inadequate human resources for research and innovation in the business sector

An extremely small percentage of researchers in the Republic of Serbia is engaged in the private sector. In the Republic of Serbia in 2013, there was 75,2% of researchers in higher education, 21,4% in scientific institutes, and only 3,3% in the business sector (the data of the RSO). In OECD countries, that structure in 2012 was as follows: 32,2% researchers in higher education, 7,8% in the government sector, and 59,9% in the business sector. The situation is similar in the EU countries where the number of researchers in the business sector in 2011 was almost 37% of the total number of researchers.

2) Small number of financial instruments to support research and innovation in the economy

In Serbia, there are no financial instruments and mechanisms or programs for stimulating demand for innovation, for example, there are no tax incentives for companies that implement activities of research and innovation, as well as credit support for innovation projects of companies.

The following instruments of (co)financing of research and innovation in economy are applied in the Republic of Serbia through:

– Serbia Innovation Project implemented by the Innovation Fund aimed at private micro and small enterprises in the early stages of development that possess technological innovation. Through four public calls conducted in the period from 2012 to 2014, the financing of 53 projects was approved, in the amount of EUR 6 million, within the Mini and Matching Grants Program. More than 300 jobs for employees with higher education was supported, including 65 PhDs, with the involvement of over 20 scientific and research organizations. In the implementation so far, this project has shown positive results which is clearly visible in the Figure 4.а. where the data on revenue growth and export of companies that were the beneficiaries of these projects are given.

– The Program of knowledge and technology transfer and the incentives to the application of the results of scientific research work conducted by the Ministry provides support to finance innovation projects in organizations registered for performing innovative activities which represent the finalization of the most successful technological research to their market commercialization. In the period 2011 – 2014, the total of 217 projects of registered innovation organizations was financed. Also, the co-financing of 25 projects of physical entities/innovators was financed through this project in the implementation of innovative activities. The Figure 4.б. shows the growth of total revenues of innovative organizations that are registered in the Registry of Innovation Activity in the period 2011 – 2014, and which were supported by the Ministry through the financing of innovation projects.

– The introduction of quality systems as an innovation into the organization of business operations

is implemented through the financial support provided by the Ministry of Economy.

– Innovation vouchers that represent the system of state aid to small and medium-sized enterprises and aimed at the development of cooperation between research organizations and small and medium-sized enterprises, are implemented by the Ministry of Economy.

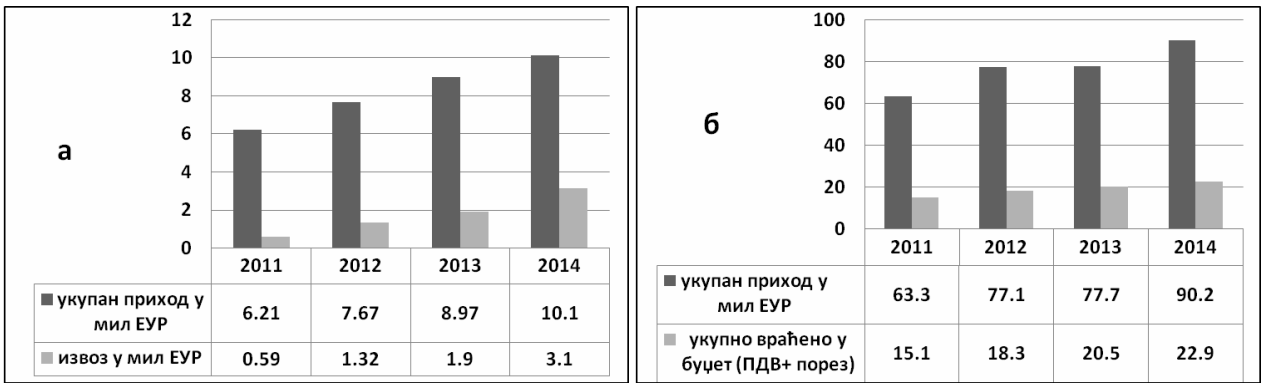


Figure 4. Revenues of innovative companies: а) In the Innovation Project, б) Registered in the Registry of Innovation Activities

3) Underdeveloped institutional and legal framework to support research and innovation in the economy

The establishment of "spin-off" companies by researchers employed in scientific research organizations is not regulated by current laws – the Law on Higher Education and the Law on Innovation Activity. In addition, positive regulation does not regulate the financing through venture capital funds.

Despite a number of new institutions that were founded in Belgrade, Novi Sad, Nis and Kragujevac in the past five years (eight business-technical incubators, four science technology parks and four TT centers), there is still lack of infrastructural support for innovation in the Republic of Serbia. However, these organization for support to innovation activity often do not have enough capacity, human or financial, to fulfill their mission. A large number of business-technological incubators was established with the aim of supporting "spin-off" and "start-up" companies, but these are often donor initiatives that do not provide long-term and sustainable financing.

3. The system of management in science and innovation is not sufficiently effective, and there is little coordination of relevant institutions and various stakeholders

Research and innovation in the Republic of Serbia are an integral part of most strategic documents adopted in the previous years, and therefore, they are related to the activity of a number of ministries. Although substantial responsibility for the development of science and innovation is in the domain of all the ministries, the main tasks in this field have been entrusted to the Ministry of Education, Science and Technological Development. According to the Law on Ministries, the Ministry performs the public administration tasks that, among other things, refer to: system, development and advancement of scientific research in the function of scientific, technological and economic development; proposing and implementation of policy and strategy for scientific and technological development; defining and implementation of the scientific, technological and development research; training of personnel for scientific research activities; proposing and implementation of innovation policy; incentivizing techno-entrepreneurship, knowledge and technology transfer and technologies in the economy and development and improvement of the innovation system in the Republic of Serbia.

Due to a large number of institutions that are essential for the development of science and innovation and due to the lack of coordination among these institutions, the total budget resources to support this area are not being used effectively and optimally.

In addition, no proper mechanisms were established within the research system that would ensure that the research results find their way to a competitive product or service:

– Research system is organized according to the Law on Scientific and Research Activity, and the innovation system according to the Law on Innovation Activity. Innovation organizations are involved in the implementation of scientific research programs of general interest, and scientific research organizations are not recognized as an integral part of the innovation system;

– The largest number of research organizations do not have a strategic approach to managing research and directing research towards innovation. Organizational and management structure of universities and faculties recognize two components of their activities, education and research, but not innovation. Organization and management of innovation is not an integral part of the activities of the majority of institutes, even those that generate a significant portion of revenues on the market;

– Management of the scientific research work in the system exclusively relates to project financing. Scientific committees implement the policy of monitoring research work of researchers and the results achieved in the projects, but not innovative activities.

In order for the innovative process to be accelerated, it is necessary for the different actors in this process, at all level of management, to achieve the necessary level of cooperation and coherence.

4. Lack of adequate human resources in scientific research organizations, economy and public sector, and there are no long-term measures to address this issue

In 2013, the Republic Statistical Office recorded that there is a total of 21.044 employees in the field of research and development, which is 2,8 employees per thousand inhabitants. This is well below the European average, where the number is more than five (Eurostat). The number of women in this area is 10.793 or 51% of the total number of employees which is significantly above the European average, where this percentage is slightly above 25%. Among the total number of employees, there are 14.643 researchers, which is 2,0 researchers per thousand inhabitants. This average is well below the European average of three researchers per one thousand inhabitants.

Of this, 59% or 8.620 of researchers have PhDs. Only 3% of researchers is located in the non-financial sector which includes businesses and organizations whose primary activity is the production of goods and services and their sale. The distribution of researchers by sectors is shown in Figure 5.

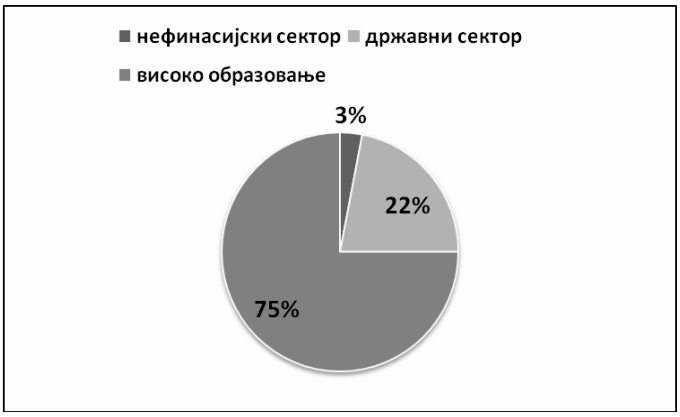


Figure 5. Distribution of the number of researchers: a) by sectors

Of the total number of researchers, around 85% are engaged in the funded projects (state sector and higher education). One of the priorites of the Strategy for the Development of Research System in the period 2010 – 2015 was to increase the total number of researchers, which included, above all, the involvement of young researchers and fellows in projects and increasing the total number of researchers with PhDs. The total number of researchers engaged in projects that were financed in 2014 was 13.323, of which 7.970 (62%) are PhDs. The growth index in the number of researchers, according to the data of the RSO (2010 - 2013) was 115%, while the growth index for the researchers in the projects of the Ministry was 140%, and the growth index in the number of PhDs in the period 2010 – 2014 was 154%. Distribution of the number of researchers at registered scientific research organizations (SRO) is given in Figure 6.

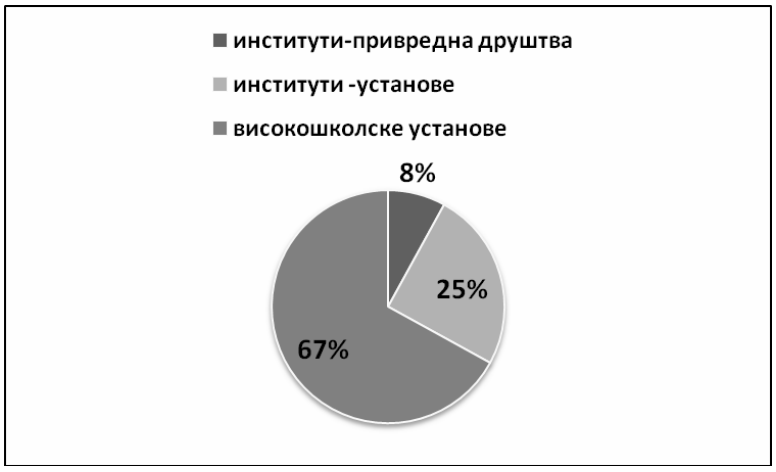


Figure 6. Distribution of the number of researchers engaged in the projects of the Ministry by types of SRO

Between 2010 and 2015, the distribution of researchers by age in comparison to the period before 2010 has changed and improved. There is a significantly higher number of researchers under the age of 40 (Figure 7), and the number of PhDs under the age of 40 has increased (Figure 8).

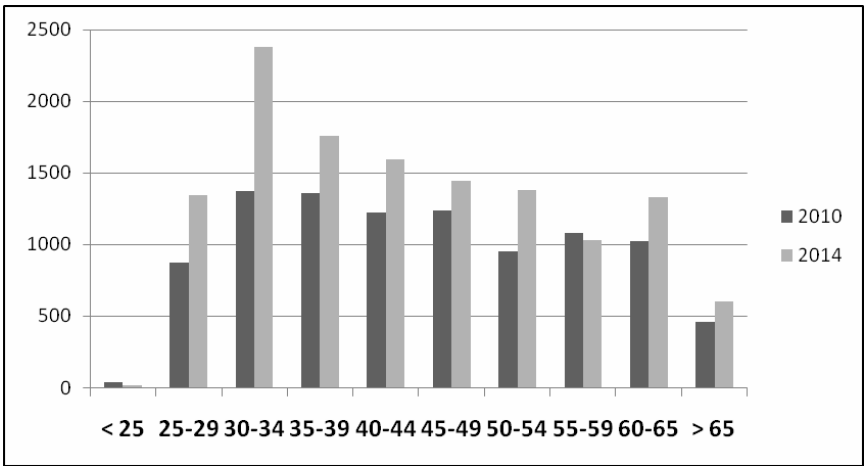


Figure 7. Distribution of the number of researchers by age

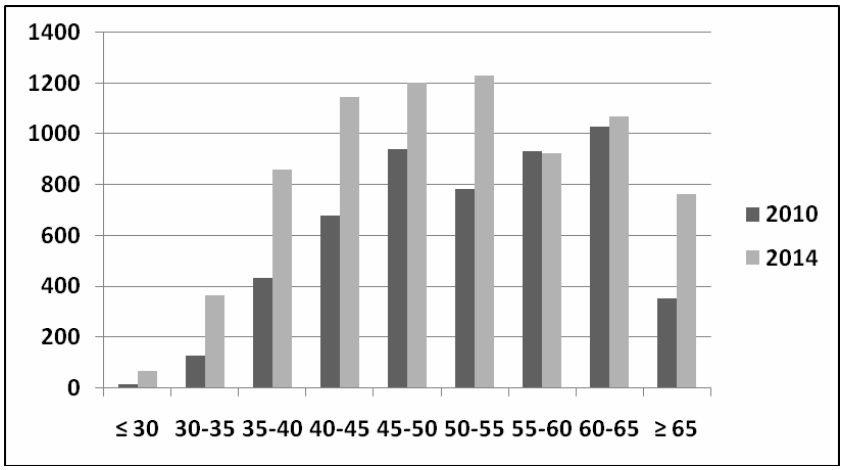


Figure 8. Distribution of the number of PhDs by age

Mobility is a very important segment in the process of development of each researcher. Consequently, the mobility of researchers is an important step in improving human capacity in our research area, and it plays an important role in the desired rapid development of science in our country. The mobility of researchers can be geographical or cross-sectoral. Geographic mobility is realized within the country or through transfer from one country to another and it can be incoming or outgoing.

Incoming mobility refers to the conditions under which foreign researchers could come, live and work in the Republic of Serbia and return to their own country or a third country and continue their career. For incoming mobility there is a number of substantive and administrative obstacles: 1) there is no basis for the financing of foreign researchers from the budget of the Republic of Serbia; 2) lack of integration of universities has a negative impact on incoming mobility due to: the lack of any effort to improve the existing capacities in order to improve international cooperation, lack of a unified procedure for the recognition of diplomas, the absence of a system of collecting information on international cooperation of faculties; 3) the stay of foreign researchers is not regulated from the legal aspect; 4) there is not system of "research visa", so the same procedures are applied to researchers, very lengthy and complicated, as to any other foreigner.

Outgoing mobility refers to departure of researchers to other institution or other country and their return to the same or to some other institution. When it comes to outgoing mobility, the main problem are visas for certain countries and regulating the returning mobility, i.e reintegration of a returnee researcher.

The absence of an efficient mechanism of reintegration is one of the main causes of the harmful effect of "brain drain". A large number of researchers from the Republic of Serbia is located abroad (diaspora). Unfortunately, the link with the diaspora is weak and there are no official data (database) on the number of our researchers and their areas of activity abroad. Also, there are no precise data on the number of researchers who were educated abroad. In the previous five years, the Ministry has funded 102 post-doctoral studies and around 4.000 participations in conferences in the country and abroad. Taking into account the total number of researchers in the Republic of Serbia, this is not enough and there must be a way to improve this situation.

A special type of mobility of researchers is the intersectoral mobility. It deals with the problem of movement of researchers from academia to industry and vice versa. This type of mobility in our country practically doesn't exist.

The analysis of the current situation provides specific requests: to increase the number of researchers in the system, to increase the number of students on doctoral academic studies, to support young researchers to stay in the country, to improve (modernize programs) doctoral academic studies, to increase the mobility of researchers in the country and abroad, to use the potential of the diaspora, to provide greater cooperation with the industry, to increase the number of researchers in the nonacademic sector.

5. Although there are programs to support international cooperation, science in the Republic of Serbia is not fully integrated into the European Research Area and the insufficient number of researchers participate in international projects

Researchers from our country already participate in numerous programs of international cooperation. A significant volume of international cooperation is shown through the fact that in more than 35% of the scientific papers indexed in the WoS, at least one of the authors is a foreign author.

In the EC Framework Program 7 (FP7), in the period from 2007 – 2013, 319 institutions in the Republic of Serbia (of which 51 companies) participated in the implementation of 236 projects. From that number, the Republic of Serbia has been the coordinator of 42 projects. The areas in which our researchers were the most successful are information and communication technologies, food, agriculture, fishery and biotechnology, as well as environmental protection, including climate changes. The total value of contracted and completed projects is more than EUR 64 million. The Government of the Republic of Serbia and the European Union signed an agreement on the participation of the Republic of Serbia in the Horizon 2020 program. According to the statistical data from October 2015, the financing of 75 projects with participation of 103 institutions from our country (out of which 28 partners from the industry) has been approved. The agreed budget for the approved projects amounted to EUR 16.2 million. During the first year of the program implementation, for the first time a researcher from the Republic of Serbia received a grant from the European Research Council intended for exceptional research ideas/projects that push the boundaries of research.

In addition, the Republic of Serbia participates in Eureka projects , COST actions (246), NATO program "Science in the service of peace and security" (22 projects), it cooperates with the European Organizations for Nuclear Research (CERN) and with the research center Dubna in the Russian Federation.

Republic of Serbia actively participates in all relevant regional initiatives:

– EU Strategy for the Danube Region - EUSDR, as the coordinator of the Priority Area 7 ("Knowledge Society");

– Central European Initiative (CEI) through participation in several programs: Know-how Exchange program, cooperative activites, as well as in the platform CEI–PRAISE Programme to Promote Research and Innovation through Centres of Scientific Excellence and Advanced Research Groups in Member Countries;

– The Republic of Serbia is a co-founder of the Western Balkans Research and Innovation Center – (WISE) with its headquarters in Split.

In the context of the accession of the Republic of Serbia to the European Union, bilateral explanatory screenings for Chapter 25 "Science and Research" took place. The following items were presented: legal framework of the Republic of Serbia in this area, cooperation in the field of research and innovation, participation in the EU programs and other activities. It was agreed that the EU acqui will be accepted in this area. The readiness of the Republic of Serbia to accept and implement the recommendations of the roadmap of the European Research Area has been expressed.

Despite these results, the possibilities for further improvement are numerous. The areas in which our country has been less successful so far is the participation in the most prestigious part of the Framework Program of the European Union, in the funding of excellent science through the projects of the European Research Council, then, in the programs of mobility of researchers, as well as in the programs that required participation of the SMEs sector. Additional weaknesses identified in the previous period related to the problems of financing our experts nominated to various expert committees of the European Union, insufficient level of coordination in articulating the interests of our scientific community, relatively small number of researchers who are involved in international cooperation, the inability of national focal points to be exclusively dedicated to the activities related to Horizon 2020 due to the necessity to be involved in other activities of the Ministry, as well as the lack of body that would provide ongoing technical and other support to our researchers who participate in international programs.

SWOT analysis within the current scientific and innovation system of the Republic of Serbia – strengths, weaknesses, opportunities and threats

The analysis of the results clearly shows that the Republic of Serbia has significant potential in the field of science and research, which can be the basis of further economic and social progress of the country. The highlights of the SWOT analysis of research and innovation system are:

Strengths	Opportunities
– significant increase in the number of scientific papers indexed in the WoS; – significant level of research excellence (physics, new materials and nanomaterials) and the application of research results (IT, biotechnology and agriculture); – increase in the number of researchers; – share of scientific papers resulting from international cooperation (35%); – the Innovation Fund is established.	– readiness of the research community to initiate changes; – defined program for HR development in science and innovation; – infrastructural support to innovation is established: the Innovation Fund, science technology parks, TT offices; – membership in HORIZON 2020.
Weaknesses	Threats
– low level of total (below 1% of GDP) and budget investments (below 0,5% of GDP) in research and innovation; – the absence of strategic management;	– departure of highly educated people from the country; – low level of economic development; – lack of research equipment;

– small number of researchers in the economy; – lack of mechanisms for cooperation between science and industry; – small number of patents and technical solutions.	– low level of intersectoral coordination in the financing of research; – insufficient recognition of the need to build a national innovation system by institutions at all levels.