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Science and Technology Country Report

SERBIA

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1 Introduction

This country report is produced by the "Information Office of the Steering Platform on Research for Western Balkan Countries" and reviews the situation of Science and Technology (S&T) in Serbia.

The report summarises main papers published by the United Nations Educational, Scientific and Cultural Organisation (UNESCO), the South-East European ERA-NET (SEE-ERA.NET), the Austrian "Gesellschaft zur Förderung der Forschung", and several independent scholars on the issue of S&T in Serbia. For the complete table of references please see References in chapter 7, starting on page 263 of this report.

The objective of this study is to enhance our understanding of the national innovation system in Serbia. An overview of the situation in S&T regarding the main stakeholders, input and output indicators, national strategies and priorities and main documents and laws in the field is given below.

The 'system of innovation' approach was taken into account when compiling this report, and covers important factors influencing the development, diffusion and use of innovations, as well as the relations between these factors. It does not place emphasis on individual firms or research organisations, but rather on innovation as an interactive and interdependent process.

Relevant organisations in this respect are firms, higher education institutions, government agencies, etc. interacting to create knowledge and innovation. The macro-level of the system is analysed using indicators such as R&D personnel ratios, R&D expenditure, patent application intensity rates, etc.

The report was compiled in autumn 2006 by the Information Office, by Ms. Elke Dall and Ms. Maruška Bračić, Centre for Social Innovation, Vienna, Austria and reviewed by Ms. Andrea Mayr, Centre for Social Innovation, and Mr. Đuro Kutlača, Mihajlo Pupin Institute, Belgrade, Serbia; Science and Technology Policy Research Centre (Department within the Institute). A brief update was carried out in summer 2007 by Mr. Jure Zrilič, Centre for Social Innovation. The final review in winter 2007/08 was carried out by Mr. Đuro Kutlača, Mihajlo Pupin Institute and Mr. Pero Šipka, Centre for Evaluation in Education and Science. Also the availability of the online sources used was checked again.

1.1 Serbia - A Brief Profile

Unlike the transitional changes in Central and Eastern European Countries, Serbia has undergone a period of economic and political isolation and escalated conflict. The wars, which only ended in 1999, destroyed the country's infrastructure and devastated the environment and the economy, leaving the majority of the population demoralised and impoverished.

Serbia, with a population of 7,463,157 in 2004 (not including data for Kosovo and Metohija), had a total number of 2,068,964 employed persons compared to 895,697 unemployed in 2005 (Statistical Office of the Republic of Serbia, 2006a).

After the fall of president Milošević in 2000 and the re-introduction of a democratic regime in the Federal Republic of Yugoslavia (FRY), the country's suspension from the UN was lifted. Kosovo has been governed by the UN Interim Administration Mission (UNMIK) since June

1999 and in 2003, lawmakers reconstructed the FRY into a loose federation of two republics called Serbia and Montenegro. The constitution of this union included provision allowing each of the republics to hold a referendum on independence after three years. In spring 2006, Montenegro exercised this right and voted for independence enabling it to secede on 3rd June 2006. Subsequently, Serbia declared itself the successor state of the union of Serbia and Montenegro (European Commission, 2006b).

Following discussions, the European Council adopted a conclusion recognising the Republic of Serbia as a legal successor of the state union on 12th June 2006. As a result of strong gains in trade, transportation, financial services and construction, Serbian gross domestic product (GDP), at EUR 2,506 per capita, grew by 6.5% in 2005 (European Commission, 2006b). Major growth drivers were retail trade, telecommunications and transport with the respective rates of 32.9%, 22% and 6.7%. The calculation of GDP and other macroeconomic indicators for the period from 1997 to 2004 was revised by the Statistical Office of the Republic of Serbia. However, according to international standards[1], GDP per capita in 2005 was calculated at EUR 2,836.8; EUR 21,107.9 million using current prices in 2005 (estimates). In 2006, it was estimated that total economic activity, measured by GDP at constant 2002 prices, increased by 5.8% in comparison to the previous year. The greatest increase was noted in the sectors of transport, financial intermediation and construction.

Industrial production grew at a modest 1.3%, while inflation remained in double-digits throughout the year and stood at 17.5% in December 2005, mainly driven by the strong domestic demand, increases in administration costs, the rising cost of fuel imports and the on/off effect of the value-added tax (VAT) introduced in January 2005 (Statistical Office of the Republic of Serbia, 2006a).

In the first quarter of 2007, GDP grew by 8.7% in comparison to the corresponding period of the previous year. Regarding the commercial activities, the growth is noted as follows: the trade sector - 24.1%, the transport sector - 19.4%, the financial intermediation sector - 18.7%, the construction sector - 16.2% and the manufacturing sector - 8.8%. The electricity, gas and water supply sector shows a fall of 5.6%, real estate, renting and business services fall by 1.4% (Statistical Office of the Republic of Serbia, 2007a).

The unemployment rate in Serbia has been increasing in 2004, it was 19.5%, in 2005 reached 21.8% and in 2006, it declined slightly to 21.6%. Labour market conditions in 2007 remained difficult and employment declined by 1.6% year-on-year during the first quarter of 2007. This trend continued during April and May, when employment continued to decline by 1.5% and 1.4% year-on-year, respectively. The official registered unemployment rate remained at a relatively high 19.0% in November 2007, although this rate was shown to be gradually falling (European Commission, 2007a).

According to EU expertise, further reforms in the country are required in order to comply with WTO accession conditions - such reforms include the privatisation of large public enterprises and changes in the foreign trade regime through for example, the adjustment of import rules regulating technical standards and quality and sanitary control of goods entering Serbian territory.

After renewing its membership with the International Monetary Fund (IMF) in December 2000, the former FRY continued to reintegrate into the international community by rejoining the World Bank and the European Bank for Reconstruction and Development (EBRD) in 2001.

[1] In compliance with new international standards and recommendations - the methodology of the System of National Accounts (SNA 93) and the European system of national accounts (ESA 95).

In order to enhance fiscal sustainability and economic growth in Serbia, the World Bank has been active in the Transitional Support Strategy for Serbia and Montenegro. The EBRD has also provided significant support to the country, approving more than 20 new projects and providing major infrastructural loans and investments in support of SMEs. In 2001, an agreement was concluded, rescheduling the country's USD 4.5 billion Paris Club government debt - 66% of the debt was written off - while the London Club of private creditors forgave an additional USD 2.8 billion of debt, 62% of the total owed (European Commission, 2006b).

The European Bank for Reconstruction & Development ranked Serbia top reformer in Central and Eastern Europe for its implementation of structural reforms making investment in Serbia more straightforward. The Government of Serbia is continuing to update and upgrade the business climate and gives full support to international companies realizing their investment ambitions in Serbia (SIEPA, 2006).

The final status of the Serbian province of Kosovo represents another important issue that remains to be resolved. Several thousand peacekeepers from the UN Administration Mission in Kosovo (UNMIK) have administered the region since 1999 and as soon as the required conditions are established, the international community has agreed to begin the process to determine the final status of Kosovo. Under the current regime, UNMIK/Kosovo has an independent institutional structure for science and higher education.

At the time of writing, Kosovo's provisional political institutions have declared Kosovo to be independent from Serbia, a move which has been recognised by a number of foreign states, for example, many EU member states, the US and Japan. It is not possible at this moment to foresee the effect this declaration will have on the S&T processes within Serbia or Kosovo, so the report will continue to give an overview of the situation up to February 2008.

1.2 Relations between Serbia and the EU

The government of Serbia officially declared European integration to be one of the strategic priorities for the country. The European Commission report states that since 2001, Serbia has benefited from the EU policy advice provided through the EU-FRY Consultative Task Force (CTF), later replaced by the Enhanced Permanent Dialogue (EPD), the task of which is to encourage and monitor the reforms based on the European Partnership (adopted by the EU Council in June 2004 and updated in January 2006). EPD structures will remain in place and continue to support the reforms in Serbia until formal contractual relations between Serbia and the EU are established through the Stabilisation and Association Agreement (SAA), which will provide a legal framework for relations during the entire period prior to the possible future accession (European Commission, 2006b).

This process has been prolonged through the European Commission's decision on 3rd May 2006 to block SAA negotiations with Serbia until its obligation to cooperate fully with the International Criminal Tribunal for the former Yugoslavia (ICTY) is fulfilled. Top EU officials held a meeting with the Serbian Prime Minister, Vojislav Koštunica, on 16th October 2006, in order to evaluate the current state of affairs regarding the country's attempts to fulfil the obligations of the ICTY. Following the negative assessment on cooperation given by The Hague's chief prosecutor, Carla del Ponte, the EU decided not to resume SAA negotiations with Serbia.[2] However, the Commission continued to stress its readiness to resume negotiations as soon as full cooperation with the ICTY is achieved. The Council supported the Commission's decision. Following a clear commitment by the country to achieve full cooperation with the

[2] Some changes could occur after parliamentary elections in January 2007.

ICTY, and concrete actions undertaken by the country that have matched this commitment, SAA negotiations with Serbia resumed on 13th June 2007 (FOCUS Information Agency, 2006; European Commission, 2007b).

The SAA should also promote economic and trade relations, with the aim of establishing WTO-compatible free trade after a transitional period. The two agreements will include commitments by Montenegro and by Serbia respectively to progressively align their legislation with that of the Community.

Negotiations for visa facilitation and readmission agreements with Serbia were opened in November 2006. On 18th September 2007 the European Union (EU) and five West Balkan nations (among them Serbia) signed nine agreements on visa facilitation and readmission, which will bring the two sides closer in cooperation in migration and movement of persons. The signature of the agreements is an important political decision toward closer cooperation between the EU and the Western Balkan countries in the sensitive areas of migration and movement of persons (see-science.eu, 2007c).

The EU provides substantial financial assistance to the Western Balkan countries through CARDS (Community Assistance for Reconstruction, Development and Stabilisation), which was replaced by the new Instrument for Pre-Accession Assistance (IPA), starting from January 2007. EU assistance (combining CARDS/IPA, macro-financial and humanitarian assistance) to the whole Serbia and Montenegro has amounted to more than EUR 2.9 billion between 1991 and 2002. A major part of this assistance has been allocated to conflict management, post-conflict reconstruction and stabilisation, paving the way for a closer association with the EU (European Commission, 2006b).

The IPA aims to provide targeted assistance to candidate countries and potential candidate countries with their EU membership application, and entirely replaces CARDS and other pre-accession financial instruments. The programming has five components - Transition Assistance and Institution Building; Regional and Cross-Border Co-operation; Regional Development; Human Resource Development and Rural Development - only the first two of which will apply to potential candidate countries (including Serbia). The IPA will allocate over EUR 11 billion across the 2007-2013 period (see-science.eu, 2006).

Even though science is not among the main objectives of the IPA, support of S&T infra-structure and related activities is envisaged. This significant change is mainly the result of the following dynamics: on the one hand, Serbia's formal request to CARDS for funding S&T related activities, which was supported by EU Member States, and on the other hand the SEE-ERA.NET project, which drew particular attention to the issue of S&T support and pushed the matter to specific contacts with EU officials. Hence, gaining support is mostly in the hands of the West Balkan countries (WBC), which need to demonstrate certain efforts in formulating and submitting requests to the relevant authorities. The SEE-ERA.NET project and especially the Steering Platform, could provide the necessary support in this process, acting as a forum for the exchange of experiences and best practices among the WBCs, as well as through focused and coordinated interventions in respect to the European Commission services and the EU Member States (Bonas, 2006). The European Commission also pledged to support the region in finding synergies between IPA and science in its Communication on the Western Balkans (European Commission, 2008).

2 Contemporary Institutional Landscape

The transition of Serbia and Montenegro's S&T system started following the gradual dissolution of the former FRY, the destruction caused by the war and the subsequent brain drain. The institutional landscape has also been altered during the process. The following chapter tries to map the current main stakeholders in the national innovation system, relevant cooperation and the legal framework defining the system.

2.1 Main S&T Stakeholders Involved in Policy Making in Serbia

The main ministry in Serbia with responsibility for S&T policy and the management, planning and financing of public R&D activities is the Ministry of Science (MSCI)[3]. It also has core and full responsibility for international R&D cooperation[4]. Serbia has no funds or agencies responsible for financing R&D activities - complete financial schemes, payment procedures and the control of infrastructure comes under the responsibility of the MSCI, while higher education policy is managed under the authority of the Ministry of Education. Scientific issues are held under the authority of the Ministry of Science[5]. Following its primary task of co-ordinating science development, based on the knowledge and activation of the existing development potentials and resources in Serbia, the MSCI is also engaged in the realisation of research in the sector of technological development. The aim of this research is to use Serbia's scientific-research potential to solve development problems in various institutions and organisations in the fields of information technology, chemical technology, engineering and software industry, traffic and construction, biotechnology and energy technologies. Realisation of such research should allow direct input of knowledge, helping to achieve faster development within individual economic sectors, as well as creating highly innovative, market-attractive products, improving product quality and competitiveness in international markets, and development of infrastructure (Ministry of Science and Environmental Protection of the Republic of Serbia, 2006).

The formation of the new Serbian government in 2007 created a new division and definition of responsibilities of ministries. According to the new Law on ministries, adopted on 15th May 2007, the new Ministry of Science (now distinct from the Ministry of Environmental Protection) is responsible for:

- System, development and advancement of scientific research activities to support scientific, technological and economic development;
- Definition and implementation of the policy and strategy of S&T development;
- Definition and implementation of the programmes of scientific, technological and developmental research;
- Training and development of researchers;
- Definition and implementation of innovation policy;
- Stimulating entrepreneurship, transferring knowledge and technologies into the industry, development and advancement of the system of innovation;

[3] In the previous government, from 2001 to 2004, it was the Ministry for Science, Technology and Development and from 2004 to 2007 Ministry of Science and Environmental Protection.
[4] Responsibilities for International R&D Cooperation: negotiation with partners and national S&T institutions; contracting the framework for international bilateral and multilateral S&T cooperation; financing of international bilateral and multilateral S&T activities, which are selected and approved by the Ministry (JISA, 2006).
[5] Ministry of Science is divided into 4 departments: Department for Basic Researchers; Department for Technological Development, Transfer of Technologies and Innovation System; Department for International Scientific and Technological Cooperation; Department for Human Resources Development in Sciences.

- Development of the system of S&T information and the programme of S&T infrastructure;
- Research in the field of nuclear energy, security of nuclear objects, etc. (Sipka, 2008)

Other responsibilities in this area are delegated to the Ministry of Telecommunications and Information Society, which is responsible for:

- Definition and implementation of the policy and strategy of building an information society;
- Applying information sciences and Internet;
- Development and functioning of the academic computer network of Serbia

The fact that both the Ministry of Science and the Ministry of Telecommunications and Information Society have closely related responsibilities should be taken into consideration, in order to encourage cooperation rather than overlapping policies (Sipka, 2008).

Respecting the fact that higher education institutions are both educational and scientific institutions, there is also the Council for the Development of University Level Education, responsible for the provision of high-quality education, the implementation of scientific work programmes at higher education institutions and the development of higher education policy (Ministry of Science and Environmental Protection of the Republic of Serbia, 2006). The Council elected the members of the Accreditation and Quality Assurance Commission. The Council and the Commission, the two bodies independent and separate from the executive authorities, started drafting, immediately after their establishment, the norms and standards, to enable the soonest possible accreditation of higher education institutions and curricula according to the Bologna process (Stankovic, 2006).

According to the constitution adopted in 2005, autonomous rights are given to the province of Vojvodina, regarding the definition, finance and management of R&D activities in the province. A Provincial Secretariat for Science and Technological Development has been established which also supports international cooperation, R&D potential and infrastructure and cooperation with industry (Provincial Secretariat for Science and Technological Development Vojvodina).

In Kosovo/UNMIK, the Ministry of Education, Science and Technology in Prishtina supposedly develops both scientific research and the higher education system, as well as promoting a market for innovation and technological development, although no research fund exists (Dall, 2006). The ministry is also responsible for the formulation of an overall strategy for the development of education, science and technology in Kosovo and the promotion of a single, unified, non-discriminatory and inclusive education system. In 2003, the budget allocation for the Higher Education Department amounted to EUR 11.6 million, or 62.4% of the budget of the ministry (MEST Kosovo, 2002).[6]

A Department of Higher Education and Science is in operation within the Ministry of Education, Science and Technology. Its primary goal is planning the development of higher education and science. To achieve this goal it works on plans and documentations of policy, standards and procedures, which provide systematic solutions to the challenges arising in the fields of higher education and scientific research (MEST Kosovo, 2007).

[6] The web page of the Ministry of Education, Science and Technology of Kosovo/UNMIK is http://www.ks-gov.net/masht/DefaultPC.aspx?CaseID=10&LangID=SR&ModID=60

The thematic report for the Information Office by Klaus Schuch (Schuch, 2008) covers the situation in Kosovo/UNMIK in more detail.

Although the Serbian Law on Higher Education states that universities are independent higher institutions, while faculties must be units of a university, the reality is that faculties still enjoy high levels of legal, functional and academic autonomy and because of that it is extremely difficult to introduce coherent reforms even in one university, let alone across a national system (Crosier, 2007). Private faculties are also established as laid out in the Law on Higher Education, on an equal basis with the faculties founded by the Republic of Serbia as regards their rights and their obligations (Stankovic, 2006). Serbia has a much higher proportion of private universities/faculties than the other countries in the region.

An issue has been raised regarding the lack of improvement made in the field of education. While the reforms required by the Bologna Process have begun, more sustainable efforts are needed, in particular to ensure quality and to link the university with the labour market and economic needs. Some progress was made in the endorsement of framework policy documents on vocational education and training (VET). However, further action is needed to implement policies and to strengthen coordination between VET, the other education sectors and the labour market. The development and adoption of a national qualification framework for VET has not advanced. Limited administrative capacities, inadequate definition of competencies and lack of coordination among the responsible institutions are a source of concern, as well as the absence of a clear programme under the new ministry (Sipka, 2008).

Overall, Serbia is relatively advanced in the development of a legislative framework for education and research. However, substantial efforts are still needed to develop the two sectors and to link them to the economic context. The pace of reform of the education sector has been slow. An improved institutional framework and a better-defined programme are needed to ensure further progress.

As regards the main institutions, the University of Belgrade has to be highlighted, as it is the biggest and most important university in Serbia. It incorporates over 30 faculties and 8 institutes, which cover the fields of Physics, Chemistry, Technology, Metallurgy, Molecular Genetics, Genetic Engineering, Applied Nuclear Energy etc. Apart from their research projects, the university personnel carries out, or takes part in, the realisation of a considerable number of projects from the republic's "Programme of Scientific Research" and the "Programme of Technological Development". The scientific research units of the university are currently carrying out quite a number of projects in the fields of general and applied research, as well as some development projects. The university also intensively publishes scientific research results in nearly 300 doctoral theses per annum (University of Belgrade, 2006b).

The Serbian system of higher education incorporates universities founded by the state (the University of Belgrade, the University of Arts Belgrade, the University of Novi Sad, the University of Kragujevac, the University Niš, the University of Novi Pazar, and in Kosovo/UNMIK, the University of Prishtina and the University of Mitrovica[7]), various private universities (the University Braća Karić, the European University, Megatrend University, University Singidunum and University Union, all located in Belgrade; the University of Novi Pazar, located in Novi Pazar; and the University Privredna akademija, located in Novi Sad), as well as some additional faculties (Ministry of Science and Environmental Protection of the Republic of Serbia, 2006; Ministry of Education and Sports of the Republic of Serbia, 2007). In addition, a few more faculties have entered the licensing process. It remains to be seen if

[7] Some Serbs refer to the University of Mitrovica as the University of Prishtina, which in the international context is just used for the Kosovo/UNMIK supervised Albanian-teaching university located in Prishtina (and some affiliated institutes in the countryside).

all these institutions can successfully pass the accreditation procedure, which is in due course at the time of publishing of this report.

Serbia also takes part in the Bologna Process, which has been perceived as a key driver for rebuilding and reinvigorating higher education system, burdened with a heritage from a Yugoslav past. However, the programme implementation is rather slow and difficult to sustain, mainly because of the legacy of Yugoslav self-management and its embodiment in the notion of faculty independence. Despite the efforts that have been put into the reform, the fundamental step of integrating universities into coherent and manageable structures has only been achieved in very few cases (Crosier, 2007).

The Serbian Academy of Sciences and Arts (SASA) was founded in 1886. With its eight departments, it represents the most eminent scientific and art institution in Serbia. In 2005, the Scientific Research Fund of SASA provided and allocated the funds for scientific research, publishing, inter-academic and international cooperation, as well as for the participation of SASA members in scientific meetings, for the acquisition of scientific literature and for other SASA scientific research needs. About 180 projects were conducted and 34 publications, with over 360 participating authors, were published in the SASA editions that same year (SASA, 2006).

A number of Technical Incubators have already been established in Serbia, in spite of the initial delay in the development of Serbian innovation centres. They are (see-science.eu, 2007e):

(a) Technology / Innovation Centres:

- Technology Transfer Centre at the University of Novi Sad (TTC)
- Innovation Centre of Mechanical Faculty at the University of Belgrade
- Novi Sad Innovation Centre (NOSIC)

(b) Technological and Science Parks:

- “Mihajlo Pupin” Institute - S&T Park
- S&T Park Nis
- S&T Park Novi Sad
- Institute Vinca, Belgrade

(c) Business-start-up Centres / Technology Incubators:

- Business Start-up Centre Kragujevac
- ENTRANSE Business Incubator Niš (BIC Niš)
- Business Incubator Knjazevac
- Business Incubator Zrenjanin
- Business Incubator Subotica
- Business Incubator Bor
- Business and Technology Incubator of the Technical Faculties of the University of Belgrade

In Kosovo/UNMIK, the only public higher education institution is the University of Prishtina. It comprises about 2,200 employees (over 360 full-time professors with a Ph.D., and over 220 with a Masters degree, according to statistical data) and 20,000 students studying at 14 faculties and 7 higher education institutions located in various regions. The University

of Prishtina is now a member of the European University Association, as well as other international university cooperation bodies. The university is deficient in science equipment, laboratory materials, books and journals and only functions within the Albanian language stream, except for some particular departments, where other languages are taught (MEST Kosovo, 2002). There has been a strong tendency to establish a higher education institution within the Serbian language stream in northern Kosovo. Currently, there are two separate institutions, both using the name “University of Prishtina”, one of which is conducting education in the Serbian language and is backed by the government of Serbia. In 2004, UNMIK decided to suspend the license of the University of Kosovska Mitrovica and demanded the annulment of Professor Radivoje Papović’s appointment as rector of the university. Subsequently, the EUA called upon its members to discontinue cooperation with the University of Kosovska Mitrovica until the institution is legally reintegrated into the higher education system of Kosovo (EUA, 2004).

Figure 2.1: Relevant intermediary institutions and research performers of the Serbian STI-system (Kutlaca, 2007b)

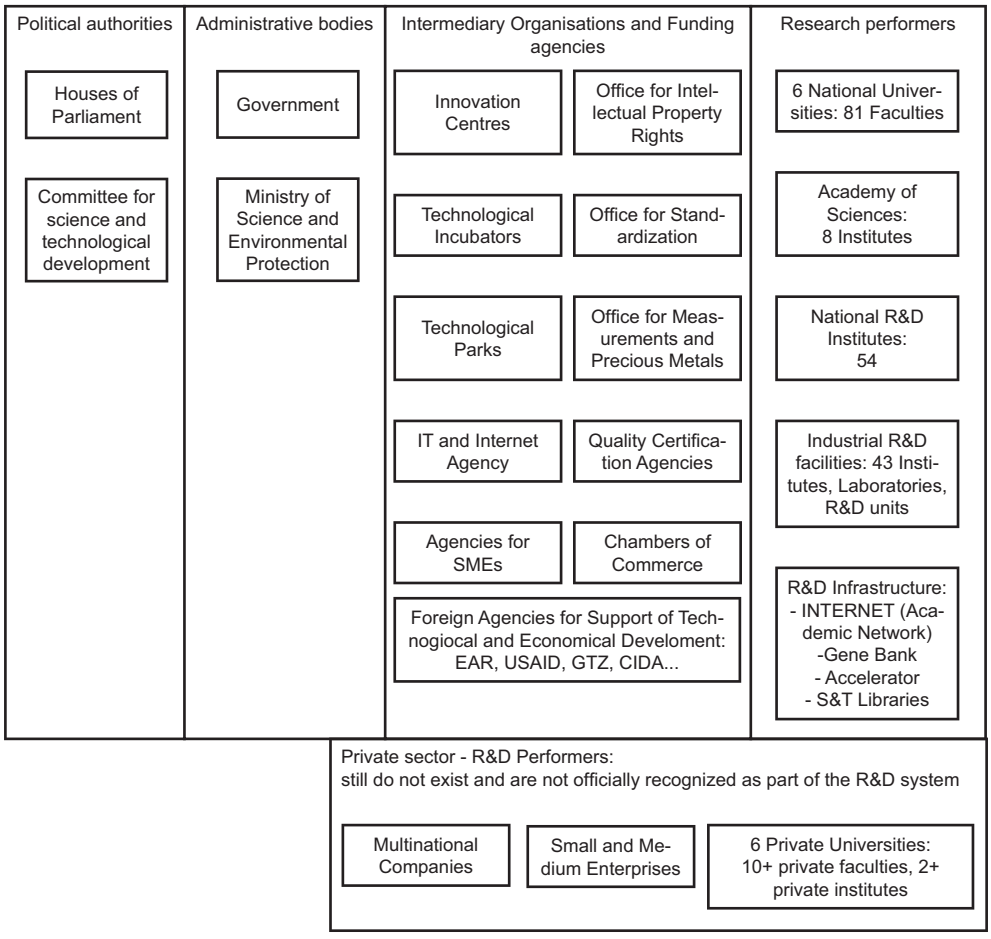


Table 2.1: Main S&T Stakeholders in Serbia (Dall, 2006)[8]

Main ministry in Serbia competent for S&T	- Ministry of Science (MSCI)
Other ministries with importance to the S&T sector	- Ministry of Education - Ministry of Economy and Regional Development - Ministry of Telecommunications and Information Society - Ministry of Health - Ministry of Agriculture, Forestry and Water Management - Ministry of Foreign Affairs - Ministry of Energy and Mining
Other important stakeholders:	- Intellectual Property Office - Council for the Development of University Level Education - Rectors Conference - National Council for RTD
Main research institutions / universities	For a list of research institutions see Annex I - Main R&D institutes in Serbia
	- Serbian Academy of Sciences and Arts (SASA), with 8 departments - University of Belgrade - University of Arts, Belgrade - University of Novi Sad - University of Kragujevac - University of Niš - University of Novi Pazar - Private Universities (University “Braća Karić”, European University, “Megatrend” University, University “Singidunum”, University “Union”, all Belgrade; and University of Novi Pazar, University “Privredna akademija” Novi Sad, University of Novi Pazar etc.) - University of Prishtina (Kosovo/UNMIK) - University of Mitrovica (Kosovo/UNMIK)

2.2 International Cooperation

Serbia has been experiencing constant renewal of international cooperation and support, especially in the last five years. This cooperation has been substantially supported by many international organisations, as well as through the assistance of developed countries in bilateral programmes (also providing significant benefits to the R&D sector). The vast majority of financial support in this respect came from the funds of the Stabilisation and Association Process, the CARDS programme, the Stability Pact for South Eastern Europe, the European Investment Bank, and the European Bank for Reconstruction and Development. The European Union’s Tempus programme has been important in the area of higher education, while Serbia’s participation in the EU Framework Programmes for R&D has also been of particular importance. Concerning multilateral cooperation in the area of science and research, Serbia has closely cooperated with many specialised UN agencies, such as

[8] Adapted by Dall (2006)

UNESCO, UNIDO, UNDP, UNECE[9], while some other international organisations, such as the World Bank and national organisations, such as the USAID, GTZ (Germany), and SIDA (Sweden), etc. have also been important donors and have helped in the area of R&D and innovation (Uvalic, 2006).

Many regional projects have been launched with the objective of promoting regional cooperation in South Eastern Europe. Regional scientific cooperation in Serbia is currently being promoted within several regional organisations: the Central European Initiative, the Adriatic-Ionian Initiative, the Black-Sea Economic Co-operation, the International Centre for Genetic Engineering and Biotechnology and the Stability Pact for South Eastern Europe. Since 27th February 2008, the Stability Pact has been transferred into the new regionally owned cooperation framework, the Regional Cooperation Council. From March 2008, the Council intends to play a key role in consolidating achievements of the Stability Pact to date and in making further progress in the different areas of co-operation. It will also continue to provide a platform for supporting further Euro-Atlantic integration of South Eastern Europe (Stability Pact for South Eastern Europe, 2008).

Serbia is also maintaining active cooperation with the International Atomic Energy Agency (IAEA) and the Joint Research Centre (JRC). The JRC is a department (Directorate-General, DG) of the European Commission providing independent scientific and technological support for EU policy-making. Knowledge and information is gathered using specific application/issue-oriented research within the seven JRC institutes, as well as through close cooperation with over 1,000 public and private organisations in 150 networks within the Member States and applicant countries. The JRC aims to contribute to the goals of the European Research Area and to provide S&T support to EU policies. Its efforts in the ERA focus on five activities: developing scientific reference systems, networking, training and mobility, accessing and using infrastructures, and a dedicated effort to support enlargement (European Commission, 2004).

Regional networks also include initiatives to assist the Western Balkans countries to participate in the EU Framework Programmes for R&D and to integrate in the European Research Area, as defined by the EU-Balkan countries' Action Plan on Science & Technology adopted at the Ministerial Conference in Thessaloniki on 26th-27th June 2003. The "Action Plan", along with the "Shared Vision", defined the priorities of the research cooperation and provided a detailed examination of all possible sources of funding, thus contributing to the economic growth of Balkan countries and aiding their integration into the European Research and Innovation Area (CORDIS, 2003). In June 2004, the Serbian government decided to invest EUR 9 million in R&D infrastructure and the development of technological parks. This was the first time that the significance of RTD as a tool for fostering a knowledge-based economy has been recognised by the highest level of authority in a Western Balkan country (Videnovic, 2006).

Serbia participated in the Sixth Framework Programme (FP6) as an 'INCO country' with co-financing of projects provided by the Ministry for Science and Environmental Protection. In FP6, implemented in the period 2002–2006, scientific workers and researchers took part in a total of 86 projects and received EUR 12 million, as well as access to research that led to projects worth over EUR 170 million (see-science.eu, 2007d). The increased activity and involvement of Serbia in FP6, as well as the current negotiation of Serbian association to the Euratom Programme, does not hide the fact that the country has not yet managed to define an integrated research policy.

[9] Please see the List of Acronyms (chapter 8).

Following the signature of a Memorandum of Understanding, on 13th June 2007 Serbia joined the EU Seventh Framework Programme (FP7) for research and technological development, which will help it participate in EU scientific and research initiatives on equal footing with the Member States. The total programme budget (2007-2013) stands at over EUR 50 billion and participation in the programme enables international scientific cooperation and research, as well as implementation of projects from scientific and technical sciences and humanities (see-science.eu, 2007b).

Positive examples of regional networks include the Inter-Balkan Forum on IST (Information Society Technologies) and the Balkan Physical Union. Various projects based on bilateral inter-governmental agreements have been particularly numerous and further integration is expected as a result of the activities of the South Eastern European ERA-NET (Ministry of Science and Environmental Protection of the Republic of Serbia, 2006; Uvalic, 2006).

ERA-WESTBALKAN is another project focusing on the integration of Western Balkan scientists into the European Research Area, and specifically the Framework Programmes. The project partner is the Ministry for Science. Some other examples of relevant support actions are IS2WEB, SEE-INNOVATION, BAFN, EU-Balkan-FABNET and SCORE, among others.[10]

COST (Co-operation in the field of Scientific and Technical Research) has developed into one of the largest frameworks for research cooperation in Europe and is a valuable mechanism co-ordinating national research activity. According to the latest reports, COST has around 200 actions and involves nearly 30,000 scientists from 34 European member countries and more than 80 participating institutions from 11 non-member countries and non-governmental organisations. Ease of access for institutions from non-member countries also makes COST a very interesting and successful tool for tackling topics of a global nature.

In addition the EUREKA programme has been active in Serbia since 2003 and has since realised 30 projects, with a total value of over RSD 54 million[11] (Zarkovic, 2006). Among the main objectives of EUREKA are to increase productivity, to support cooperation between industry, SMEs, universities and institutes, as well as to develop market-oriented technologies, services and products. Only 30% of the specific project value should come from the budget, while the rest should be contributed by the RTD institutes and private companies.

Higher education institutions maintain bilateral connections with a number of foreign university associations, support participation in TEMPUS and the CEEPUS (Central European Exchange Programme for University Studies). There are also programmes and various international competitions that award funds to scientific research, the development of the education system and the acquisition of material resources for the advancement of the higher education teaching process. Furthermore, higher education institutions, particularly the University of Belgrade, have regular contacts and cooperate with trade associations, as well as student exchange associations, for the purpose of studying and participating in summer practice programmes (University of Belgrade, 2006a). Serbian academic institutions are also continuing to maintain strong international cooperation by signing bilateral agreements with a number of foreign universities, covering every continent and joining the European Universities Association (EUA), the Balkan Universities Network, the Danube Rectors' Conference (DRC), the Network of Universities and Research Centres of the Adriatic-Ionian Region (UNIADRION), the Agency of the Francophonic Universities, the Educational Committee of the Council of Europe, UNESCO and other organisations that contribute to the development of education, science and culture (University of Belgrade, 2006a).

[10] Information on the Serbian partners, including Ministries, involved in these projects can be found on their websites.
[11] Around EUR 700,000 (www.oanda.com/convert/classic).

The Organisation for Black Sea Economic Cooperation (BSEC) initiative and the Regional Co-operation Council (RCC) are further opportunities to build partnerships and cooperation. The BSEC signed a Declaration on Cooperation in Higher Education and University Research in September 2005, to exchange and share examples of good practice and experiences in this field (Fila, 2005). One of the key activities of the Stability Pact for South Eastern Europe that will hopefully be adopted and supported by its successor, the RCC, is the area of "Fostering and Building Human Capital" (i.e. the field of education and research). Since May 2007, a Memorandum of Understanding (MoU) was signed between the Ministers responsible for Education, Science and Research in South Eastern Europe, acknowledging the importance of education, higher education, science and research for the future of this region. However, to date, Serbia is the only country that has not signed this MoU. The intentions of this MoU and a subsequent Declaration of Intent (DoI) to strengthen and deepen Cooperation in Education, Science and Research (signing in August 2007) have contributed to the Proposal for the establishment of a Task Force Fostering and Building Human Capital (to be authorised by April 2008 (Cvijic, 2008)).

Current bilateral S&T cooperation in Serbia and in the other South Eastern European countries owes a great deal to the Central European Initiative (CEI). The initiative was set up in 1990, and has gradually extended to incorporate 18 members from Central, Eastern and South Eastern Europe, bringing them closer together and assisting in their transition to stable democracies and market economies as well as in their preparation for EU membership. The priorities of the CEI are divided into three principal areas: economic, human and institutional development (CEI, 2006). As a result, the progress made in S&T cooperation has been used as a starting point for identifying partners for FP6, FP7, COST (Co-operation in the field of Scientific and Technical Research) and EUREKA (the Pan-European network for market-oriented, industrial R&D). Bilateral agreements are signed between Serbia and France, Germany, Greece, Hungary, Romania, Slovak Republic, Slovenia, Norway and Switzerland. With several other countries, protocols are existing or agreements under negotiation: Belgium, Bulgaria, Czech Republic, Italy, Israel and Turkey (see-science.eu, 2007a).

Serbia also participates in the Swiss SCOPES Programme for Eastern Europe by Swiss National Science Foundation (SNSF). On 12th February 2007, Serbia and Switzerland signed the Memorandum of Understanding (MoU) on the Technical Cooperation in the field of sciences - SCOPES today. The MoU allows the realisation of 15 new joint research projects in the scientific cooperation between Switzerland and Serbia, in a total amount of almost half a million CHF. This shall enable scientists from the two countries to undertake together original research of high quality. The projects refer on nuclear physics, ecology, health, geology, chemistry, etc. This cooperation implies knowledge and expertise transfer between a host of reputed Swiss scientific institutions and Serbian counterparts. These will in turn strengthen international networking of Serbian research teams and increase the attractiveness and competitiveness of Serbia's scientific institutions (Swiss Cooperation Office in Serbia, 2007).

USAID adopted a "Strategy Statement" for Serbia (2006-2011) in December 2005. The strategy guides its programmes and activities, addressing Serbia's development needs in line with US government foreign policy objectives. The main strategic objectives are to ensure democratic governance of the market economy, to encourage enterprise growth in high potential sectors and to reduce political risk (USAID, 2005).

The WUS (World University Service) of Austria, a non-profit making organisation established in Graz in 1983, has developed a regional focus on South Eastern Europe since 1994. In the Western Balkans, it has successfully realised various projects; for example, CEP (Centre of Excellence Projects), NIP (Networking Infrastructure Projects), Training Courses on Project

Management and International Cooperation, Internet and Computer Training Programme. Serbia also benefits from ongoing World University Service (WUS) projects - Course Development Programme Plus, Brain Gain Programme, Counselling and Information Centres, and others (WUS Austria, 2006).

3 The Input Side of the National Innovation Systems

Regarding the input indicators for the S&T system, some questions (for example, the amount spent in terms of the gross domestic product (GDP), volumes and growth rates) need to be addressed. Here a distinction is made between private and public investment. R&D investment can be considered as an indirect measure of a country's innovation capacity (Fischer, 2006).

The current economic situation in the Western Balkan countries still poses significant constraints on national policies in R&D. Most countries of the region are at less than 30% of the EU-25 GDP per capita average, hardly reaching 60-80% of their 1989 GDP. Restrictive fiscal and monetary policies, necessary for attaining macroeconomic stabilisation, allow for limited public expenditure and have generally contributed to low investment rates, also experienced in the R&D sector. Financial assistance received from abroad is significant but not always provided on a continuous basis (Uvalic, 2006).

In order to provide an understandable, accurate and least conflicting statistical insight, some particularities need to be explained. There are strong inconsistencies between statistics released by the Ministry of Science and Environmental Protection (which has been renamed to Ministry of Science) and the Statistical Office of the Republic of Serbia. Statistics on Serbian R&D activities calculated by the MSEP/MSCI are mostly based on data from organisations supported and financed by the ministry, while statistics on R&D activities in Serbia built by the Statistical Office of the Republic of Serbia are calculated using the collection and interpretation methodology and statistical practice inherited from the previous regime (during the 1980s and 1990s). Under this methodology, R&D data is collected from all organisations registered under the Science Law and from all other organisations, which are willing to supply their data concerning R&D activities. However, it must be stressed that neither of these two methodologies is based on the Frascati manual nor on the OECD/EU based statistical methodologies and practices concerning R&D activities in one country. Therefore, researchers within the Science and Technology Policy Research Centre of the Mihajlo Pupin Institute have organised their own R&D statistics based on official data, collected and published by the Statistical Office of the Republic of Serbia, and than re-calculated, using the methodology proposed in the Frascati manual. Nevertheless, a significant proportion of R&D data is still absent from the official statistics, particularly in the private sector (for example, the software industry). This problem has not been resolved by the new Science Law, but could be overcome with the Innovation Law if both private, and state companies, would register their activities under this law (this is a precondition for the application of R&D activities which could be co-financed by the Ministry of Science and Environmental Protection - now Ministry of Science). Still, major changes in R&D statistics are expected to be announced by the Statistical Office of the Republic of Serbia, within the framework of the national innovation system, and under full cooperation and understanding between officials and professionals from this office and responsible ministries (Kutlača, 2007a).

The latest official source (Statistical Office of the Republic of Serbia, 2006c) published in 2006, contains R&D data for 2004, which as described above, was re-calculated by the Science and Technology Policy Research Centre of the Mihajlo Pupin Institute. The results are given in the tables below (Kutlača, 2007a).

3.1 Development of Financial Resources Allocated to R&D

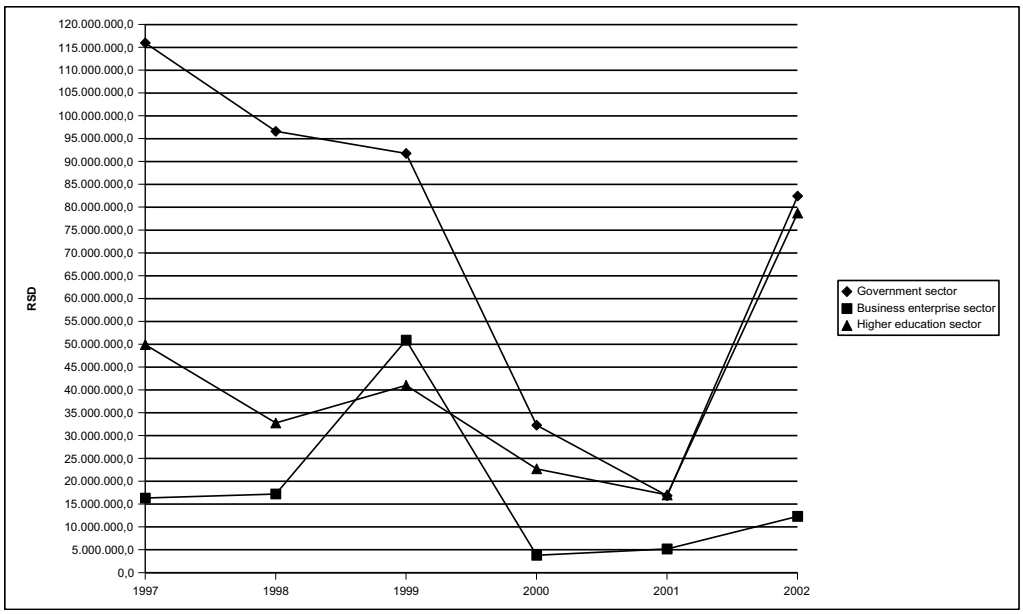
In general, the dynamics of expenditure provide an important indicator of knowledge creation and absorption, of which there are very special characteristics to be observed in Serbia. However, it is important to bear in mind the aforementioned problems concerning these statistics.

Table 3.1: General Expenditure on R&D (Kutlača, 2007a)[12]

	1997	2000	2001	2002	2003	2004
GERD (in thousands, RSD)	1,081,991	3,710,114	2,636,486	10,198,181	6,361,680	4,418,784
as % of GDP	1.27	1.18	0.48	1.45	0.79	0.50

In line with expectations, whereupon Central and Eastern European countries have registered a general cut in science expenditures in the early stages of the transition process, the Serbian level of investments in R&D has decreased rather than increased in recent years. However, these numbers still call for the alert and rapid coordinated policy action towards affirmation of local talent and support of national innovation, which is a normal response for countries in this stage of transition.

Figure 3.1: Dynamics of Expenditure for R&D per sector



[12] Source: State Statistical Office according to Kutlača

3.2 Government Sector Expenditure on R&D

In Serbia, government expenditure on R&D in 2005 represented only 0.32% of the GDP, but this figure is a remarkable increase compared to only a few years before, having more than tripled since 2000 (Zarkovic, 2006). According to the Statistical Yearbooks of Serbia, the government allocated in total USD 58.7 million[13] in 2000, USD 39.9 million[14] in 2001 and USD 173.4 million[15] in 2002 (Kutlača, 2005b).

Political determination to improve the situation was expressed by the former Serbian Minister of Science and Environmental Protection, Aleksandar Popović. Minister Popović explained the objectives of the "National Investment Plan" and the criteria for defining investment priorities regarding scientific research[16]: according to Popović, although the MSEP was extremely dissatisfied with the 0.4% of GDP that the government was allocating to science and research, it also displayed significant improvements in this respect. Following the objectives laid out in the "National Investment Plan" and the increased budget outside the investment plan, the budget for science and research should soon reach 0.6% of GDP, which would represent a significant increase compared to the 0.2% of GDP allocated in 2001, when the government was starting the sector reform (Popović, 2006). Inside the EU-27, the aim is to achieve an investment rate of 3% GDP for science and research by the year 2010 (1% of which is supposed to come from the budget and the other 2% from private funding and donations).

Table 3.2: Government Expenditure on R&D (GOVERD) (Kutlača, 2007a)[17]

	1997	2000	2001	2002	2003	2004
GOVERD (in thousands, RSD)	685,254	2,037,133	1,137,447	4,846,908	3,834,326	2,207,892
as % of GDP	0.80	0.65	0.21	0.69	0.47	0.25

The Serbian Ministry for Science and Environmental Protection dedicated the largest part of its budget to R&D programmes, more than 84% of the total in 2004. Regarding the distribution of funds among the different programmes, in 2004 more than 50% of Serbian R&D budget was allocated to the Basic Research Programme, 30% to the Technology Development Programme, and another 8% to the R&D Facility and Infrastructure Upgrade Programme. The remaining programmes received a much smaller relative share of the budget (Uvalic, 2006).

3.3 Business Sector Expenditure on R&D

The contribution of the business enterprise sector is evaluated by looking at the level and dynamics of the business sector's R&D expenditure at the aggregate country level. R&D activities in the business enterprise sector are particularly essential for the innovative output and competitive dynamics of a country.

During the 1990s, the government "Programme for Technology Development" provided the main financial and moral support for innovative activity in industry. Since sanctions prohibited international technology trade, the "in-house" innovative activity was the main source of new technologies and activities (Kutlača, 1998b).

[13] EUR 62.3 million (31.12.2000, www.oanda.com/converter/classic)
[14] EUR 44 million (31.12.2001, www.oanda.com/converter/classic)
[15] EUR 165.4 million (31.12.2002, www.oanda.com/converter/classic)
[16] 04.08.2006, Interview in daily newspaper "DANAS".
[17] Source: State Statistical Office according to Kutlača

The relative importance of the business sector's R&D efforts is indicated by the level of business expenditure on R&D (BERD) as a share of GDP. The relative importance of BERD in total economic activity in the region of South Eastern Europe (0.24% in 2003 as calculated by Fischer (2006), which includes Bulgaria and Romania, but not BiH and Albania, due to the lack of data), lags considerably behind that of the EU-15 (1.26% in the year 2000). In Serbia, the level of BERD expenditure as a percentage of GDP was only 0.06% in 2001, 0.10% in 2002, declining again in 2004 to 0.07%.

The input of the business sector in R&D activities in comparison to overall R&D activities reveals the relative importance of profit-oriented knowledge creation and absorption. In Serbia, a very low proportion of total R&D (around 7% in 2002) was spent on business research, thus reflecting a relatively low level of business sector knowledge investment in comparison with the knowledge invested by the government and higher education sectors (Fischer, 2006). In 1999, the Statistical Office of the Republic of Serbia recorded a particular increase in expenditure that then sharply declined in 2000 and only slowly recovered. Thus, data for 1999 is also given in the following table.

Table 3.3: Business Sector Expenditure on R&D (BERD) (Kutlača, 2007a)[18]

	1997	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
BERD (in thousands, RSD)	96,384	593,114	238,728	348,730	723,535	884,922	643,309
as % of GDP	0.11	0.39	0.08	0.06	0.10	0.11	0.07

Compared to the EU-15 (4.3%, 1995-2000), BERD increased relatively slowly in South Eastern Europe[19] (growth rate 2.3%, 1997-2003). Figures for Serbia demonstrate negative dynamics, with a low level of business R&D activity, resulting in sub-optimal absorptive capacities preventing firms from taking advantage of the R&D activities undertaken elsewhere (Fischer, 2006).

3.4 Higher Education Sector Expenditure on R&D

Higher education institutions research represents one of the key activities within the higher education sector affecting national innovation systems, providing scientific and technological knowledge that is disseminated in and utilised by the economy. However, as primary suppliers of fundamental research, universities do not only contribute to the economy through the direct provision of applicable results, but also through the diffusion and adoption of skills and techniques and through professional networks and other forms of communication channels created by academic research (Fischer, 2006).

According to statistical data compiled by Đuro Kutlača, the expenditure in the higher education sector, research institutes and other organisations with research units in 2002 was USD 78.9 million[20] (more than triple the expenditure 2000), which represented 0.66% of GDP in 2002.

[18] Source: State Statistical Office according to Kutlača
[19] Fischer has included Bulgaria and Romania in this calculation but not Albania and BiH - due to the lack of data.
[20] Around EUR 77 million (31.12.2002, www.oanda.com/converter/classic).

Table 3.4: Higher Education Sector Expenditure on R&D (HERD)[21]

	1997	2000	2001	2002	2003	2004
HERD (in thousands, RSD)	294,905	1,434,253	1,150,309	4,627,738	1,642,432	1,567,583
as % of GDP	0.35	0.45	0.21	0.66	0.20	0.18

3.5 R&D Infrastructure

In her survey on the National Systems of Research and Development in the Western Balkan Countries (compiled for the purposes of the SEE-ERA.NET Consortium), Milica Uvalić established that the research infrastructure in Serbia severely deteriorated during the 1990s, as very little investment was made in modernising existing technical equipment in research institutions. The only exception was in the information technology sector where individual computer use increased, but the degree of information networking does not qualify as sufficient. Although the recovery of the R&D sector started in 2001, the severe consequences of neglecting the sector throughout the 1990s are still evident. Within the Ministry of Telecommunications and Information Society, the Department for Information Society co-ordinates and encourages activities concerning e-management and the internet. Various initiatives, including the preparation of a policy and strategy for the creation and development of the Information Society (the strategy was adopted in October 2006, Official Gazette RS, No.87/06) have been launched in order to involve Serbia in the e-Society and e-Europe initiatives and programmes. In addition, some regulations in the process of informatisation, the internet, and the Electronic Business Law have been adopted and contracts between the government and ICT companies have been implemented.

Even more recently, in the area of information society services, the new Ministry of Telecommunications and Information Society has attached priority to accelerating the legislative agenda. Serbia still has to adopt new laws on information society covering e-government, e-commerce, and protection of personal data. The role of IT in the government's communication and services to citizens (e-government) is currently limited. Serbia is moderately advanced in this area (Sipka, 2008).

An important body in this field was the Information Technology and Internet Development Agency (ITIDA). The ITIDA has been founded in 2001 because the Serbian government placed a strategic orientation on Information and Communication Technology (ICT) in order to overcome the existing gap in and to unite all the authorities in the field of IT and the internet in one coordinated body. It consisted of a working body of about ten ICT experts, as well as assisting technical staff. The Agency was the fundamental source of contact and work coordination between international and local donors, Serbian government and final beneficiaries of ITIDA's programmes. ITIDA planned very ambitious programmes, which have been realised just in parts. Because of conflicts in jurisdiction between ITIDA and then existing Ministry of Science, Technology and Development, ITIDA activities are practically suspended since 2003 (JISA, 2006).

Before dividing into two separate entities, the MSEP had already signed contracts with Microsoft and Oracle, and the Academic Network of Serbia has become a constituent part of the GEANT Network, a pan-European research and education network which provides high-bandwidth data connectivity between the national research and education networks throughout Europe, now also providing connections between all educational and research

[21] Source: State Statistical Office according to Kutlača

institutions in the 18 cities in Serbia (Uvalic, 2006). The infrastructure in Serbian faculties and research institutions comprises several local computer networks and special-purpose computer purchases. Since the Optical Academic Network has been formed, the MSEP/MSCI is planning to finance local computer networking and Optical Academic Network connectivity, and to purchase special-purpose computers for research institutions (Uvalic, 2006).

In 2007, the Statistical Office of the Republic of Serbia conducted the survey "Use of ICTs by businesses, by companies, households and individuals in Serbia" (no data for Kosovo and Metohija is available), using EUROSTAT methodology and covering statistically national representative samples (1000 companies, 2000 households, 2000 individuals, organized in three sub samples: Belgrade, Central Serbia, Vojvodina). The main findings were (Statistical Office of the Republic of Serbia, 2007b):

- 97.8% of households in Serbia own a TV set, 33.8% own a cable TV;
- 73.6% of households in Serbia own a mobile telephone;
- 34% of households in Serbia own a computer (the rate of PC penetration being the highest in Belgrade, where it reaches 45.4%, followed by Vojvodina with 34.4% and in Central Serbia only 26.3%)
- distribution of PCs in households strongly depends on economic situation - 74.9% of households with an average monthly income higher than 600 EUR own a computer, 54.1% of households with an average monthly income between 300 and 600 EUR own a computer, and only 20.5% of households with an average monthly income less than 300 EUR own a computer;
- 26.3% of households in Serbia have an internet connection (39.1% in Belgrade, 29.2% in Vojvodina, 16.56% in Central Serbia; 35% in urban Serbia and 13.7% in rural Serbia);
- more than 4,400,000 inhabitants in Serbia (76.8% of population) use a mobile telephone;
- more than 1,700,000 inhabitants in Serbia used the internet in the last three months;
- more than 850,000 inhabitants in Serbia used the internet every day;
- more than 230,000 inhabitants used e-government electronic services;
- more than 135,000 inhabitants used the internet last year for e-shopping.

Regarding the informatisation of libraries, the largest part of information acquisition is carried out through *KoBSON* (Consortium for Co-ordinated Acquisition), which comprises representatives from all important scientific libraries in Serbia (the National Library of Serbia; Matica Srpska Library, Novi Sad; University Library of Belgrade Svetozar Marković; University Library of Niš Nikola Tesla; University Library of Kragujevac; Library of SASA - Belgrade; and representatives of the Community of University Libraries and Community of Libraries of Serbia). The main objectives of KoBSON are the acquisition of scientific information, the use of electronic publishing and the promotion of access to electronic information. The overall subscription system is financed by the government. About 111 institutions in Belgrade and an additional 64 in other Serbian towns were registered with access to the KoBSON website in 2005 (Uvalic, 2006).

Any modern information society that supports knowledge-based development needs a contemporary bibliographic information system and a system to provide information about research activities. Since 2003 Serbia has been a member of COBISS (Co-operative on-line bibliographic system and services), established by the Slovenian Institute of Information Sciences (IZUM) in 1991. In January 2006, 380 libraries were using COBISS software for the automation of their activities (293 Slovenian, 44 Serbian, 21 Macedonian, 13 BiH and 9

Montenegrin libraries). IZUM is pursuing the development of the third generation of applicative software (COBISS3), initiated in 1997, using a new technological platform (COBISS.SR, 2006).

Furthermore, the National Library of Serbia (NBS) became a full partner in the project called The European Library, which is carried out under the authorities of the Conference of the European National Librarians and the European Commission. The Commission aims to achieve not just a single database, but rather integrated access to the digitalised material of Europe's cultural institutions through a single multilingual entry point. A recent report by the INASP (International Network for the Availability of Scientific Publications, entitled Accessing and Disseminating Scientific Information in South Eastern Europe), undertaken in 2006 for the purposes of UNESCO-ROSTE, has analysed the existing infrastructure in the Western Balkan countries in detail, particularly the situation regarding connectivity, e-journals, libraries, and e-publishing. The report has confirmed great variety among individual countries in the Western Balkans in each of these areas of scientific information dissemination. According to the INASP findings, researchers in Serbia enjoy good connectivity and wide access to international journals and databases. The INASP suggested various areas for activity, for example, Accessing International Journals, Online Journal Service, Open Access Publishing, Open Access Archiving, Library Strengthening, Regional Co-operation, Communicating Science, which allowed for some significant accomplishments to be achieved in acquiring and publishing national science outputs in full-text format (INASP, 2006).

3.6 Human Resources in R&D

The quality of the science system in Serbia is generally considered much higher than the level of economy would suggest, possibly because of the satisfactory supply of human capital. The education system, although not generally modernised and consequently facing difficulties in providing highly qualified graduates on a large scale, is capable of supplying a large scientific elite to keep up the status of the science sector. However, the continuous brain drain poses a severe threat to science in Serbia. Driving forces behind the brain drain are the deteriorated economic living conditions and the lack of state-of-the-art infrastructure and funds, constituting serious obstacles for research, as well as restrictive visa regulations that hinder scientific exchange and temporary employment abroad.

Human resources play a key role when it comes to knowledge production and, subsequently, economic and technological development. Availability and quality of human resources (being both producers and diffusers of knowledge) in S&T, forms a crucial element on the path towards a knowledge society (Fischer, 2006). It is obvious though that the recent trend regarding the human resources in the Western Balkan countries has been extremely variable. In some countries, the number of researchers and scientists has been increasing (for example, in Albania or Croatia), while in others (for example, in the FYR of Macedonia or Serbia) this number has been stagnating or declining (Uvalic, 2006). In 2003, Serbia[22] reported 3.5 researchers per 1,000 of the labour force, which was on par with some of the EU-15 countries (e.g. Greece or Portugal), but still well below the EU-15 average (5.4 researchers per 1,000 labour force) (Fischer, 2006).

According to the Statistical Office of the Republic of Serbia, the total number of researchers in Serbia since 1990 has been more or less constant. There were about 12,000 researchers in 2004, or 52% of the total number of personnel employed in science and research activities (Statistical Office of the Republic of Serbia, 2006b).

[22] The data is for Serbia and Montenegro.

Table 3.5: R&D Personnel (Kutlača, 2007a)[23]

Year	1999	2000	2001	2002	2003	2004
Total number of employees	24,198	23,117	19,415	21,291	22,054	22, 485
Total number of employees - FTE	17,752	16,595	13,586	14,879	15,558	15,651
Number of researchers	12,163	11,969	10,071	10,855	11,353	11,637
Number of researchers - FTE	6,647	6,406	5,085	5,364	5,642	5,617
Number of Research Organisations	203	189	150	156	165	163
Number of researchers per 1,000 labour force	3.4	3.4	2.8	3.1	3.2	3.2
Researchers (in % of total R&D personnel)	50%	52%	52%	51%	51%	52%
Supporting staff (in % of total R&D personnel)	23%	24%	23%	22%	21%	22%
Others (in % of total R&D personnel)	26%	25%	25%	27%	27%	27%

Of the total R&D personnel in 2002, 35% were engaged in the government sector, 59 % in the higher education sector and 6 % in the business sector. Regarding the distribution by scientific field, most of the R&D personnel work in the engineering and technology sector (32.6 % in 2002); while the rest are more or less evenly distributed amongst other scientific fields (Kutlača, 2005b).

Compared to OECD data, it becomes evident that there are very few researchers in the business enterprise sector and a vast majority in the higher education sector, mostly employed by the main public universities.

Table 3.6: R&D Personnel, (Kutlača, 2007a)[23]

Distribution of researchers by sectors, OECD and Serbia, year 2001			
	Business Enterprise Sector	Government Sector	Higher Education Sector
OECD	64.60	8.80	26.40
Serbia	6.37	18.80	74.83

Data for 2002 presented by official sources and quoted by Uvalic in her study, also confirms that over 80% of researchers in 2002 were employed by the main public universities, around 14% worked at research institutes, mostly (67% of the total) in the field of natural sciences. An almost negligible percentage of researchers were employed in industrial institutes and private research organisations. Regarding the distribution by scientific field, more than 50% of researchers registered by the Ministry of Science and Environmental Protection (now Ministry of Science), work in the Basic Research Programme, around 30% in the National Programme on Energy Efficiency, and about 10% in the National Programme on Biotechnology and Agro-industry. Within the largest sector, the Basic Research Programme, the greatest percentage of researchers work in the area of Medicine, followed by the Social Sciences and Chemistry (Uvalic, 2006).

Human resource potentials in the S&T sector can also be increased by producing more Science and Engineering (S&E) graduates. Degrees in the S&E fields of study formally qualify their holders for employment as researchers, scientists and engineers. Serbia[24] has the highest proportion of students in S&E within the region (43.2%). However, a negative growth rate of 1.2% has been recorded in the period between 1997 and 2001 (Fischer, 2006).

[23] OECD - MSTI, provided by Kutlača
[24] The data is for Serbia and Montenegro.

Fischer concluded that the results from his survey suggest that the future outlook is optimistic, especially due to the fact that a greater percentage of young people are becoming more highly qualified, offering a potential relief to the shortages created by the transition towards a knowledge-based economy (Fischer, 2006).

As regards the brain drain problem, Serbia has established a Ministry of Diaspora, which runs initiatives directed at scientists living abroad. In 2007, the Ministry initiated a project aimed at the creation of a database of all researchers working outside Serbia, with 5000 researchers expected to be on the list. If this database succeeds, it will provide great potential and resources in this area. As regards brain-drain, Serbia also established a Ministry of Diaspora which sets initiatives towards the scientists living abroad.

A joint UNESCO/Hewlett Packard (HP) project on piloting solutions for alleviating regional brain drain was implemented in 2003 in several Southeast European countries. By providing resources, including technological and financial facilities, to various universities, the initiative has enabled young scientists from the region to work within the framework of joint research projects with their fellow-nationals living abroad. The project has provided grid technology to various universities from Albania, BiH, Croatia, FYR of Macedonia, Serbia and Montenegro. At the University of Belgrade, for example, several young engineers remained in the country to develop experiments using the grid computing technology. Moreover, at the regional level, regular project meetings have also acted as a stimulus for transcending boundaries. Not only has the project strengthened scientific and educational capacities at the national level, it has re-established dialogue among young researchers from the region after years of broken communication. The networks created with UNSECO/HP support function autonomously, with the objective of sharing innovative experiences to help researchers from the region consolidate local capacities and undertake research beyond borders, without leaving their home countries permanently (Preda, 2007).

4 The Output Side of the National Innovation Systems

The output of an innovation system is manifested through the new knowledge, new products and processes that are produced. Whereas indicators such as the Gross Expenditure on Research and Development (GERD) and the number of researchers provide a measure of the resources potentially allocated to innovation, this chapter focuses on the results of the innovation processes and their output indicators such as patents and scientific papers.

4.1 Patenting Activities in Serbia

Among other approaches, innovative output can also be measured by patent data, the most important advantage of which is the wealth of the information supplied. A patent file granted by the European Patent Office (EPO) provides data on the invention, which is protected by the patent through the title, abstract and technological classification. Furthermore, patent data provide the only output measure available for almost all countries in the world, including the Western Balkans countries (Hörlesberger, 2006).

European inventors today have a choice between two alternatives when seeking patent protection for their inventions: the European Patent Office (EPO) and national patent offices. The EPO was set up to provide patent protection through a single procedure, defining the granting of patents in some or all of the contracting states of the European Patent Convention (EPC). The procedure for obtaining a patent at the EPO consists of two phases and sometimes a third phase dealing with possible objections. In contrast to national patents that are valid in

only one country, a European patent gives its proprietor equivalent rights to a national patent in each member state (EPO, 2006).

Moreover, European patents may also be effective in some countries that have not yet acceded to the EPC, including Serbia. Serbia and Montenegro have held a so-called "extension state" status at the EPO since 1st November 2004. This means that although the State Union recognises European patents, it is not formally a member of the organisation (EPO, 2006). As the legal successor to the former State Union of Serbia and Montenegro, Serbia retained this status, while the position of the territory of Montenegro has yet to be confirmed. The Patent Cooperation Treaty (PCT) provides a unified procedure for filing patent applications.

A second barrier to patenting is the cost associated with a patent application. Studies estimate that the cost of an application and the 10-year maintenance of a patent at the EPO are approximately EUR 32,000 (Roland Berger Market Research, 2004). Applications to national patent offices, may be comparatively, less expensive (applications to local patent offices in the Western Balkans in particular can be expected to incur a considerably lower cost than an application to the EPO) (Hörlesberger, 2006).

On the other hand, in transition economies, improvements in production and organisation and imitation of technology with minor improvements and adaptations for local use are more important but are not usually sufficient to be patented. Therefore domestic patenting data in these countries does not capture a significant share of relevant domestic technological activities (Da Motta e Albuquerque, 2000). Furthermore, the patenting activity in some countries in the EPO is too small and cannot be used as a proxy for RTDI activity within the country (Kutlača, 2004).

Serbia has its own Intellectual Property Office (IPO). The patent law adopted in 1995 significantly altered the practice of protection of invention in the country: Since then employee inventors have not been allowed to apply for patent rights without their firm's permission. Since 2004, the IP Office has ratified and applied a Cooperation and Extension Agreement with the EPO, which envisaged technical, legal and administrative cooperation for the purpose of infrastructure development for the efficient patent system in the Republic of Serbia (Intellectual Property Office of the Republic of Serbia, 2006a). New patent laws have adopted recommendations by WIPO (World Intellectual Property Organisation) and EPO concerning the protection of pharmaceutical products, which had been the subject of negotiations between former Yugoslavia and these organisations. This patent law is in process of change, adopting new regulations, particularly in the field of protection of software. It is questioned if the IPRO for Serbia has a sufficient number of trained personnel in order to fulfil its substantially changed role, scale and scope of activities (Kutlača, 2004).

In 2003, there were in total 62,873 patents granted by the EPO, 31,027 of which were granted to EU countries. Austria, a country comparable in size to Serbia, was granted 765 patents in 2003, while Serbia registered only 4 granted patents[25] (Hörlesberger, 2006).

For the purposes of her survey, Marianne Hörlesberger used the data on the total number of patents granted between 1996 and 2004 (Hörlesberger, 2006). The six technological fields that are analysed are mechanical engineering, chemicals and pharmaceuticals, process engineering, electricity and electronics, instruments and consumer goods. According to Hörlesberger, the technological specialisation of Serbia[26] is similar to that of Romania. 38% of all patents granted at the EPO were in the field of chemicals and pharmaceuticals, followed

[25] Data refers to the year 2003 and is for Serbia and Montenegro.
[26] The author used data for Serbia and Montenegro.

by mechanical engineering as the second most important field with 18% (this share was significantly lower than it was for the EU-25). Shares of instruments (16%) and consumer goods and civil engineering (11%) were slightly larger than the respective shares for the EU-25. Electronics also had a significant share (10%), but process engineering (5%) lagged behind (Hörlesberger, 2006).

A thorough analysis of the cumulative aspects of technology learning based on national patenting data is given in a survey of national patenting between 1921 and 1995 in Serbia (Kutlača, 1998a). It shows over decades the persistently high share of resident patents in the field of mechanical engineering and agriculture eventually proving the country's competitiveness in these two sectors, as well as the country's technological dependence in the chemical industry, with the highest share of non-resident patents over the entire analysed period (Kutlača, 2004). Patent intensity (ratio of average number of patent applications to the average population size between 1997 and 2003) shows that Serbia, with a ratio of 0.06 lags considerably behind the ratio of the EU-25 (10.39) (Hörlesberger, 2006).

It is indeed disputed whether the use of registered patents is a proper measurement of the country's output activity. Kutlača argues that it is only partly applicable in the case of transition countries, like Serbia. He bases this opinion on the insufficient legal framework regulating the IP sector, which exists in line with international standards, even though it is not fully operational and lacks human resources, computer and technical equipment and the documentation needed for the patent registration process. Thus, the small number of registered patents is mainly due to long procedures caused by the non-existence of the aforementioned conditions. Kutlača argues that it is therefore more reasonable to use the number of patent applications rather than the number of registered patents (see Table 4.1) for the purposes of the survey (Kutlača, 2004).

Table 4.1: Patenting Activity in Serbia 1994-2004, Patent Applications and Registered Patents (Intellectual Property Office of the Republic of Serbia)[27]

Patent Applications	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Residents	574	584	477	372	415	274	324	362	359	381	473
Non-residents	214	230	237	141	203	449	524	573	657	658	694
Patent Applications - Total	788	814	714	513	618	723	848	935	1016	1039	1167
Registered patents	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Residents	156	161	96	70	112	59	3	31	73	91	65
Non-residents	518	350	186	133	137	49	0	11	58	93	110
Registered patents - Total	674	511	282	203	249	108	3	42	131	184	175
Ratio: Registered patents / Patent applications %	86%	63%	39%	40%	40%	15%	0%	4%	13%	18%	15%

The number of registered patents in Serbia has considerably varied in recent years. Pre-2000, Serbia had been registering very different results through patenting activity, at times demonstrating a sharp decline with only 3 patents granted in 2000 (Hörlesberger, 2006). It is important to stress that only a small percentage of patent applications are actually granted - in 2004, the 175 patents granted represented only around 15% of the total number of applications (see table above).

4.2 Publication Activity in Serbia

Another possibility for measuring innovative output is in bibliographic data, such as scientific

[27] Provided by Kutlaca (2007a)

publications or new product announcements in technical journals. Information on scientific publications at the country level is readily available through indexes such as the Science Citation Index. However, according to Hörlesberger, publications tell us more about the capabilities of the science system than about the ability of countries to create new products and services (Hörlesberger, 2006).

Uvalić emphasises a number of problems specific to the Western Balkans countries regarding scientific output measured through bibliometric methodologies. During the 1990s, the region was isolated and inward-oriented, thus some of the Western Balkan countries were not covered by major databases during this decade, clearly raising the possibility of under-estimation of their scientific output. Many national scientific journals in these countries are still not included in international databases. Furthermore, scientists have suffered from the lack of opportunity to publish in internationally recognised journals, partly due to limited international contacts and limited participation at international conferences (and not necessarily because of low quality output) (Uvalic, 2006).

Serbia seems to be under-way to surmount these difficulties. Publishing activity in the country has recovered in recent years. As a result, national performance as measured by number of articles published in ISI Web of Science (WoS) citation indexes (SCI, SSCI and A&HCI) were rising steadily from 2000 onwards, recapturing the touch with the performance of neighbouring countries in 2006.

Publishing an article in locally published journals (LPJs) is, however, still the predominant form of communicating results. Due to their hyperinflation during in the period of country isolation, the Ministry of Science, Technology and Development decided in 2003 to submit all periodicals to bibliometric analysis and assessment. This ended with a permanent programme of their monitoring and evaluation performed on a regular basis by the Centre for Evaluation in Education and Science (CEON/CEES). All published journal issues are taken from the newly established Repository of National Library of Serbia, and are thus to be followed up by looking at indicators of their impact and quality. The results are published yearly in the form of an interactive web report, the CEON/CEES Bibliometric Journal Report(CEON/CEES, 2007).The purpose of this programme is to classify journals according to their quality, in order to use the results for evaluation purposes. The purpose is also to improve the general quality of the journals, as well as to select and support the best among them in their efforts to achieve international recognition. Journals that meet a set of predefined criteria are included in SCIndeks, the Serbian Citation Index[28]. SCIndeks refers to approximately 350 LPJs, more than 100 available in full text format (Sipka, 2008).

Occasionally, CEON/CEES performs comparative analyses of publishing activity in the country, based on bibliometric data. Conclusions of the results are advanced to the Ministry of Science for eventual use in (re)shaping national publication policy. In the latest such analysis covering a four-year period of journal monitoring some favourable trends were registered (CEON/CEES, 2007):

- sharp raise in visibility and availability of LPJs in a relatively short period;
- better representation of LPJs in top international databases, with more than a dozen admitted for indexing in WoS in Scopus;
- rise of the international impact of LPJs, as measured by the number of citations in WoS indexes;
- slight reorientation of authors to publishing in international (WoS) journals instead of LPJs;

[28] See www.scindeks.nbs.bg.ac.yu

- internationalisation of LPJs, with more than 3,000 papers published yearly by international authors, coming mostly from the regional countries, including the FYR of Macedonia, Bulgaria and Slovenia.

At the same time, the number of active periodicals was found to be still too large, discovering in many cases redundancy, careless editing, disrespect for international publishing standards, irregular issues publication, etc., calling for more selective approach in journals support by the MSCI (Sipka, 2008).

The revival of publication activity in Serbia can be ascribed in part to a huge improvement in availability of up-to-date international periodical literature. The largest part of the acquisition of foreign S&T information in Serbia is carried out centrally, through KoBSON (Consortium for Coordinated Acquisition). Through KoBSON international databases containing both periodicals and books in electronic form are provided (KoBSON, 2007). This activity led by the Centre for Scientific Information of the National Library (CSI NLS) is fully supported by the Ministry of Science.

Another factor contributing to the transformation of S&T publishing in Serbia is acceptance of Open Access. The model was previously promoted through various activities of CSI NLS and CEON/CEES, the most important being two international conferences/workshops held in Belgrade in 2003 and 2005. The gatherings were well attended by publishers and journal editors, which ended in Open Access to become a dominant model of periodical publishing in Serbia. Only sporadic LPJs publishers turned out not to be willing to join the initiative in 2007.

Publishing in general is a part of S&T sector where, thanks to the new technologies, the largest and most visible changes were introduced in the previous decade. Availability and connectivity of both international and domestic resources of scholarly information reached the international level. Several ongoing projects are expected to bring further developments in this area (Sipka, 2008).

5 National R&D Strategies and Legal Framework

The key challenge for all Western Balkan countries is to carry out the transition to a market economy and to create stable and favourable conditions for economic growth. Against this background, innovation policy has to enlarge its scope from its current focus on research to a broad productivity agenda (Dall, 2006). As stated by Slavo Radošević, innovation policy as such has only recently re-emerged in the Western Balkans, after having been reduced to a secondary role during the transition process. “In order to be effective, innovation policies in the CEECs should recognise the structural weaknesses of their individual innovation systems. This will require a search for country-specific solutions, as opposed to the rather imitative mode that has so far prevailed” (Radosevic, 2005). Investment in R&D and high-tech orientation are regarded as the dominant theme in innovation policy (Dall, 2006).

Analysing the innovation policies applied in Serbia, i.e. the official public documents that influence the policies on technical change, scientific development, innovation support, and so on, is the next step in acquiring knowledge about the existing national strategies and programmes. The legal framework and the strategies adopted will be presented in this chapter. The aim is to learn about the implementation of science policy, taking into account scientific and research priority, the policy aspects of the education system, the development of information and communication technologies, intellectual property protection, tax regimes, etc.

5.1 Legal Framework for the National S&T System

A legal framework is indispensable in the organisation of R&D institutes and the development of innovation infrastructure and programmes that provide grants to research organisations and innovative companies. Most frequently, laws are prepared separately for the areas of S&T and higher education, although legislation in Serbia is still undergoing a process of transition. New laws are under public debate, with ministerial regulations and governmental decisions also playing important roles in their passing. Legislation has profited and will continue to profit from stabilisation and association processes (Dall, 2006).

Table 5.1: Important Laws in the Legal S&T Framework (Dall, 2006)

Law on the Scientific and Research Activity	Defines scientific activity, specifies programmes and regulates the financing and managing of state-owned R&D institutions and possibilities for their privatisation. A newer version has been in place since December 2005.
Law on Higher Education	Adopted in September 2005. Fully implements the Bologna Declaration.
Law on the Innovative Activity	Adopted in 2005, this law defines the innovation activity and regulates its organisation, infra-structural support, programmes, financing, IP rights deriving from such activity etc.
Laws on IP Protection: Patents Law, Copyrights and Related Rights Law, Trademark Law, Legal Protection of Designs Law, Protection of Integrated Circuit Topographies Law, Geographical Indications Law	The Assembly of Serbia and Montenegro adopted these laws in 2004 in order to harmonise regulations with WTO requirements and the TRIPS agreement. The adopted laws are also in line with the international con-ventions joined since the latest major revision of laws dealing with such matters, as well as with the related European Union regulations.

The Law on Scientific-Research Activity defines the scope of scientific activities in Serbia, specifying the definition of state-owned R&D institutions, financing and managing these institutions and possibilities for their privatisation. Furthermore, it specifies the programmes for which the ministry provides grants. The law was adopted in 1993, and reviewed and updated in December 2005.

In accordance with the Bologna Declaration, the Law on Higher Education emphasises the fundamental goals, as follows (Fila, 2005):

- Establishment of the system of comparable and easily understandable academic titles;
- Establishment of credit (points) system - ECTS (European Credit Transfer System);
- The Diploma Supplement;
- Two-step system and recognition of studying period
- Quality assurance through accreditation of faculties, licenses for professors and periodic quality assessment.

The implementation of the Bologna process in Serbia is overseen by the Committee for the Monitoring of Implementation of the Law on Higher Education, which consists of representatives from the state and private universities, as well as by the students' representatives and representatives of the Ministry of Education (Stankovic, 2006).

An important novelty, introduced by both laws (on Science and Higher Education) was the mandatory process of accreditation (for all R&D and higher education institutions). The process had a time limitation and is repetitive (every organisation must be re-accredited after several years, as defined in these two laws). During the process of accreditation, a number of issues are evaluated (personnel, equipment, infrastructure, programmes, references etc.) and compared with pre-defined standards. The accreditation of the research organisations was finished on schedule in 2007 and the procedure for higher education institutions is ending. Before the end of 2008, the number of R&D and higher education institutions which comply with the newly introduced standards and criteria for the qualified performance will be known (Kutlača, 2007a). Now the emphasis has to be put on monitoring and evaluating R&D entities and processes.

A basic Law on Innovative Activity was introduced in December 2005, providing principles, aims and organisational criteria for scientific and technological applicability with the objective of supporting the creation of new and improved products, technologies, processes and services as key elements in the country's future development process. According to the Innovation Activity Law, in force since the beginning of 2006, the Ministry of Science has established a Register of Innovation Activity (SBRA-Great-IST, 2007) .

Further progress has also been made with Serbia's intellectual property legislation. In 2004, the Assembly of Serbia and Montenegro adopted five new laws that deal with intellectual property: the Patents Law (July 2004), the Copyrights and Related Rights Law, the Trademark Law, the Legal Protection of Designs Law and the Protection of Integrated Circuit Topographies Law (all December 2004). These laws were adopted with the aim of fully harmonising with the requirements of the WTO and the Trade Related Aspects of Intellectual Property Rights (TRIPS) agreement, as well as in accordance with related EU regulations. Furthermore, in order to align businesses in the IT sector closer to the standards of the EU and to aid the quick development of the Information Society, the following laws have been adopted: the Electronic Signature Law, the Protection of Personal Data Law, the Protection of Consumers Law, the Access to Information Law, and the Amended Criminal Code (SIEPA, 2006).

The main institution dealing with intellectual property in Serbia is the Intellectual Property Office of Serbia. It deals with matters relating to intellectual property rights (patents, trademarks, industrial models and samples, geographic appellations of origin and integrated circuit topography), copyrights and related rights. From September 1999 up to 31st December 2006, the Intellectual Property Office received 2,748 applications for the depositing of copyright works and related rights works. In 2006, 681 copies of copyright works were deposited, which represents the increase of 35% in comparison to 2005, when 519 copies of works were deposited (Intellectual Property Office of the Republic of Serbia, 2006).

Despite the obvious efforts being made, it must be stressed that the enforcement of the laws dealing with intellectual property is causing many difficulties in practice. Due to disharmony, limited competence and inadequate coordination between the authorities responsible for the enforcement of laws (courts, public prosecutors, police, customs, market inspectors etc.), the protection of intellectual property rights is not efficient enough at present (Yusurvey, 2006).

5.2 Main Documents Reflecting National Strategies for Research, Development and Innovation

Innovation is sometimes a topic subordinated to science or research policy or even to development policy. Most S&T policies in Western Balkan countries encourage sustainable support for basic research at universities and research institutes, for the development of human resources and for cooperation in the framework of the European Union's programmes for RTD and joint research programmes with the European Science Foundation or bilateral agreements. In technology policy, emphasis is placed on linking research institutions as sources of knowledge with industry and SMEs and on encouraging the establishment and functioning of the intermediary institutions, although their success in practice is currently still being questioned (Kobal, 2005).

To date, there is still no S&T policy and strategy in the form of an official, single and comprehensive document (Sipka, 2008). The situation has been alleviated but not completely solved since the government of Serbia adopted its ambitious National Investment Plan, with the objective of improving conditions for scientific research. Bearing in mind the basic starting conditions, the government is nevertheless confident of its success in achieving the objectives stretched out in the National Investment Plan. It intends to allocate financial sources for the procurement of capital equipment for chemical, physical and biological sciences, astronomy and information technology departments. In other cases, instead of purchasing new equipment, the government will finance the upgrades of existing laboratories and equipment. According to the National Investment Plan, the investment is worth millions of euro. The investment projection for the government was made by the Ministry of Science and Environmental Protection (now the Ministry of Science). All procurements will be carried out through public tenders, except in some well-defined cases. In order to reduce the price as much as possible, the Ministry has also announced an intention to try international tenders, whenever the legal groundwork for such possibility exists. The government is also planning to begin building the first stage of the technological park 'Radmilovac', dedicated to agricultural sciences and biosciences. The plan is to start building an infrastructure that could combine scientific theory and its application in one place. The government has chosen agricultural science because the country has not only had scientific success in this area, but also success in the corresponding market. Thus, the ministry is convinced that the agricultural sciences should be particularly encouraged, especially since half of the country's scientific "export" involves this field. The government's optimistic forecast is based on a history of success and skilled staff and experts who can transform scientific results into marketing success (Popović, 2006).

Table 5.2: National Investment Plan (National Investment Plan, 2007)

National Investment Plan - R&D sector			**000 EUR**
Year	**2006**	**2007**	**Total**
Equipment	6,290	10,710	17,000
Support for up to 50 innovations per year	925	1,575	2,500
Innovation infrastructure	962	1,638	2,600
Setting-up centralised R&D databases	2,923	4,977	7,900
Total	**11,100**	**18,900**	**30,000**

In October 2006, the government adopted a Strategy for the Development of the Information Society in Serbia (Official Gazette RS, No.87/06) with the objective of promoting the use and development of information and communication technologies (ICT) in all its upcoming development strategies, especially due to the great impact of ICT on the national economy

and global competitiveness. The strategy will aim to improve the general situation in the ICT sector, define the competences, build a partnership between the private and public sectors, and facilitate the participation of key actors, including NGOs. Furthermore, the strategy will direct the insufficient existing financial sources towards the use of ICT for national priorities and help improve the dynamics for additional investments, promote the changes in society, and provide for local initiative activities. The strategy should also re-direct the national innovation system in order to satisfy fundamental and long-term technological conditions and shed light on the overall co-ordination, providing additional investment for the use of ICT. The strategy is divided into ten chapters, outlining the initiatives, priorities and goals of the strategy, and covering the institutional and legislative framework for the development of an information society with an informational infrastructure, e-administration, e-education and e-health. Furthermore, it encompasses a plan for the development of the business sector in terms of information and communication technologies (Government of the Republic of Serbia, 2005).

Aleksandar Popović, former Minister, has expressed his disappointment regarding the government's failed action called "1,000 Serbian Technologies", which in 2005 aimed to make intelligence Serbia's leading export brand. The action was launched with the objective of promoting and marketing Serbia's scientific and technological achievements through a well-designed uniform database, which would allow the government to access foreign markets with the assistance of Serbian embassies abroad, foreign embassies in Serbia and the Serbian Chamber of Commerce. However, after the government launched the project by setting up a web-portal, the scientists failed to correspond with due activity. With the exception of the Mihajlo Pupin Institute, which demonstrated serious will for cooperation, others did not follow the example and the project was eventually terminated. At the time of writing this report, the government was considering its revival, convinced that the successful completion of such a project could significantly contribute to the export of Serbian S&T achievements to foreign markets (Popović, 2006). The government of Serbia believes that the "National Investment Plan" will considerably change the conditions for practicing science in the country as well as improving the conditions for scientific research.

In 2005, as a further strategy for boosting innovation, the government launched a competition for the best technological innovation. According to the latest data from the Ministry of Science, 346 innovations and 900 participants were registered in the first year, 257 innovations and 919 participants (or 471 teams) were registered in 2006, and 274 innovations in 2007 (Sipka, 2008).

In the field of education, there is a strategy document entitled "The Serbian Higher Education Reform". The document was drafted by the Ministry of Education and Sports in 2001 and deals with the reform of the education sector in Serbia (Ministry of Education and Sports of the Republic of Serbia, 2001). Furthermore, the government adopted a strategy for the development of SMEs and entrepreneurship in the period between 2003-2008, with the objective of increasing the total number of SMEs and creating new jobs. In this document, the Ministry of Economy also recognises the need to develop institutional frameworks and a favourable business and investment climate (Government of the Republic of Serbia, 2003).

Another recent document is the "National Innovation Strategy" - co-ordinated by the Ministry of Science and the Ministry of Economy, and assisted by the Support to the Enterprise and Development Entrepreneurship Programme (EDEP). EDEP is now in the process of promoting and disseminating the National Innovation Strategy and the results of the National Innovation Audit (EDEP, 2007).

In Kosovo/UNMIK, the Ministry of Education, Science and Technology drew up a Strategy for the Development of Higher Education for the period 2005 to 2015. The aim is to develop an efficient higher education system, providing high-quality education and research. In the first phase (2005-2009), the ministry decided to focus on completing the legislative documentation, drafting and implementing the development policies, and increasing support funds. Priorities in the second phase (2010-2015) will revolve around the development of the institutional capacities, intellectual capacities and piloting innovations. Various problems, such as the lack of national policies and programmes and incomplete legislation for scientific research, the lack of defined priorities, the lack of administrative and intellectual capacity as well as the lack of interdisciplinary approaches and standards, the ongoing brain-drain, and the absence of a mechanism for protecting both intellectual property and industrial rights, have been identified and assessed. Performance indicators, such as the provision of a legal package and programmes for scientific development, the number of scientific research projects that contribute to the solving of societal problems, the existence of postgraduate study systems organised in accordance with the objectives of the Bologna Process, the number of publications, the allocation of funds to scientific research and the establishment of an institutional infrastructure for scientific work, have also been defined (MEST Kosovo, 2004).

5.3 Main Fields of Intervention and Research Priorities

Serious long-term structural problems that affect the S&T sector need to be discussed in order to assure further development. Amongst these structural problems are budgetary constraints and public debt, a generally low level of development, widespread unemployment and poverty and massive migrations, pointing to the need for industrial restructuring in largely agricultural-based, de-industrialised economies (Uvalic, 2005). Due to the overall lack of resources, prioritisation is of utmost importance, research orientation needs to be steered towards the economic and social needs of the present in order to make provisions for the future. International programmes need to support foresight studies and the process of prioritisation, as simply focusing on the RTD Framework Programme or imitating the strategies of other countries will not bring the desired results (Uvalic, 2006).

Priority setting in the S&T sector is intended to facilitate the efficient performance of certain identified S&T fields by providing a predictable allocation of critical-size funds. The need to define the thematic S&T disciplines and fields has to be recognised by the official policy makers. The specific research priorities include the Information and Communication Technologies, Life Sciences, Research on Agribusiness and Biotechnology, Genomic research, Environmental and Materials research, and research on renewable energies and sustainable development as well as water management, transport, aerospace research, humanities and social sciences, and research in SMEs (Uvalic, 2006). Significant achievements have been made in terms of institution and strategy development. However, some papers remain generally superficial and many statements have more to do with paying lip service than real policy implementation and related operations and identifying an analysis of real performance aimed at locating competitive advantages in S&T. Furthermore, the level of aggregation often seems too broad and thus, goal-oriented interventions will be difficult to identify and are unlikely to generate the expected benefit. Much remains to be done, including the implementation of national foresight studies in order to support the prioritisation process. It would be worth considering a complementary regional comparative foresight exercise to assist the diverse national attempts (Uvalic, 2006).

The general aim of R&D development activities in Serbia is to provide optimal research conditions and encourage the research community to contribute to the economic growth of

the country (Uvalic, 2006). One of the main priorities of the Ministry of Science is to increase the government's expenditure on R&D (Popović, 2006). Furthermore, the government's aim is to improve the project proposal evaluation (peer review according to international standards), improving the status of researchers, building up R&D infrastructure through provision of research laboratories, academic networks and libraries, and enhancing international cooperation through the increased participation in the European Union's RTD Framework Programmes and by concluding additional bilateral cooperation agreements (Ministry of Science and Environmental Protection of the Republic of Serbia, 2005). In view of this, several measures are being either launched or planned - including the promotion of entrepreneurship in technological development (incubators, start-ups, spin-offs, demonstration/application centres, S&T parks), the support of more market-driven and application-oriented projects and R&D programmes according to the long-term development strategy, the reconstruction and privatisation of the R&D system, evaluation and benchmarking, as well as changing mind-sets and market-orientation, and improving networking and marketing activities (Kutlača, 2005a).

Meanwhile, a noticeable improvement is achieved in international cooperation and provision of new library services. In its evaluation of research, the MSEP opted for assessing and categorising individual researchers instead of project teams, based on criteria stimulating publication performance rather than quality of output. In this context, a programme of benchmarking locally published journals is introduced and made permanent (MEST Kosovo, 2005; Sipka, 2008).

Table 5.3: Thematic priorities in Serbia (Dall, 2006)[30]

Research priorities in the Basic Research Programme are:

- physics, chemistry, mathematics and mechanics, biology, geosciences, medicine
- social sciences (economy, law, philosophy, sociology, psychology)
- humanities (history, archaeology, ethnography, Serbian language and literature)

The Technology Development Programme covers thematic areas such as:

- information technology
- electronics and electrical engineering
- mechanical engineering
- construction industry and civil engineering
- biotechnology

There are also a few specific programmes or sub-programmes that address particular issues:

- Energy Efficiency National Programme
- Biotechnology and Agro Industry National Programme.

6 Summary and Draft Conclusions

In recent years, Serbia has demonstrated serious commitment towards creating a favourable R&D platform for the future. The government has adopted a "National Investment Plan" and committed itself to increasing the budget for S&T, with the objective of gradually meeting the criteria set out in the Lisbon Agreement. Furthermore, a number of laws have been adopted to provide a legal framework in the fields of science, education and research. The Ministry of

[30] According to the Ministry of Science and Environmental Protection of the Republic of Serbia, 2005

Science, the Ministry of Education, and other important stakeholders are all committed to the task of improving the general conditions in the country regarding R&D.

Nevertheless, it must be stressed that Serbia cannot fully benefit from international funds and logistical support until it finally fulfils its obligations with the ICTY. When that prerequisite is fulfilled, the European Commission will resume the SAA negotiations, bringing the country closer to meeting the standards of the European Union, which would promote economic and trade relations, regulate the movement of workers, freedom of establishment, supply of services and movement of capital (European Commission, 2006a).

The countries of the Western Balkans, including Serbia, will have to undertake serious measures in order to improve the unsatisfactory conditions currently present in the R&D sector. Many complex tasks are ahead if the countries wish to prevent an increase in the technological gap vis-à-vis the European Union. The adoption of more appropriate policies is necessary on both the national and the international level. Furthermore, it is of the utmost importance to raise public awareness about the knowledge-based economy, and to enhance the awareness of the key role played by innovation and technological progress in economic growth and development (Uvalic, 2006). Serbia is still in the stage of searching for full political stabilisation: a solution to the Kosovo problem and fulfilling obligations towards the ICTY being the biggest challenges preventing the government from concentrating on the advancement of economy and utilisation of RTD in this process (Sipka, 2008).

Although the research systems in countries of the Balkan region have substantial potential, they are generally troubled by the inappropriate treatment of the research institutions, unfavourable structure, weak interaction with the business sector, and insufficient linkages with the education and research systems of the other countries. Over the course of time, science, scientists and scientific research in the countries under survey have been marginalised. R&D has not been registered among the key priorities and a clear longer-term strategy in this area is still absent. According to Uvalić, the links between business enterprises, universities and research institutes need to be improved and efforts should also be made in accelerating the implementation of laws and related measures (Uvalic, 2006).

In addressing these complex issues, the Serbian government will have to face the challenge of finding the right balance between restrictive economic policy, clearly necessary for macroeconomic stabilisation purposes, and other types of policies with long-term effects, which can contribute to raising economic competitiveness, such as the increased investment in human capital, including increased spending on R&D and on education. It would be desirable to address the issue of a longer-term strategy of R&D for all Western Balkan countries in a regional context. Although some results were achieved during the two previous years (2006-07), there is still much need to attract more Foreign Direct Investment (FDI) by further improving the business environment and decreasing the investment risks in the country, which ought also to facilitate the transfer of modern technologies and know-how (Uvalic, 2006).

In recent years, excellent experiences have been gained with the EC funded projects that supported institution- and capacity-building on a regional level. As most of the researchers and scientists are employed at the universities, the reform of the higher education system was, and still remains crucial, and cannot be regarded as independent from the R&D sector (Uvalic, 2006). Nevertheless, building a national innovation system must be of highest priority and the accreditation of R&D and higher education organisations is part of this process. However, the restructuring of the R&D system also has to be put in practice in the business sector so that R&D is also carried out in industry (Kutlača, 2007a).

Full responsibility for creating incentives for further developments in this direction lies with the government as a whole. In order to build a fertile research-industry relationship, substantial changes in fiscal policy has to be effectuated. There is evidence for the need to launch specific programmes and organisational schemes to invoke the process, such as those used earlier by some EU countries, for example, Slovenia or Portugal.

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8 List of Acronyms

AUF	Agency of the Francophonic Universities
BERD	Business Sector Expenditure on R&D
BOS	Belgrade Open School
BSEC	Black-Sea Economic Co-operation
CARDS	Community Assistance for Reconstruction, Development and Stabilisation
CEEPUS	Central European Exchange Programme for University Studies
CEI	Central European Initiative
CEON/CEES	Centre for Evaluation in Education and Science
COBISS	Co-operative On-line Bibliographic System and Services
CORDIS	Community Research and Development Information Service
COST	Co-operation in Science and Technology
CSI NLS	Centre for Scientific Information of the National Library
CTF	Consultative Task Force
DG	Directorate General
DOI	Digital Object Identifier
DRC	Danube Rectors' Conference
DVON	Departman za visoko obrazovanje i nauku (Department for Higher Education and Science) in the Ministry of Education, Science and Technology Kosovo/UNMIK
EBRD	European Bank for Reconstruction and Development
ECTS	European Credit Transfer System
EDEP	Enterprise and Development Entrepreneurship Programme
EPC	European Patent Convention
EPD	Enhanced Permanent Dialogue
EPO	European Patent Office
ERA	European Research Area
ERA-NET	European Research Area Network
EUA	European University Association
EUREKA	Pan-European Network for market-oriented, industrial R&D
FP	Framework Programme
FP6	Sixth EU Framework Programme for R&D
FP7	Seventh EU Framework Programme for R&D
FRY	Federal Republic of Yugoslavia
FTE	Full Time Equivalent
GÉANT	Multi-Gigabit Pan-European Data Communications Network
GERD	General Expenditure on R&D
GDP	Gross Domestic Product
GOVERD	Government Sector Expenditure on R&D
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
HC	Headcount Equivalent

HE	Higher Education
HERD	Higher Education Sector Expenditure on R&D
HP	Hewlett Packard
IAEA	International Atomic Energy Agency
ICGEB	International Centre for Genetic Engineering and Biotechnology
ICT	Information and Communication Technologies
ICTY	International Criminal Tribunal for the Former Yugoslavia
IMF	International Monetary Fund
INASP	International Network for the Availability of Scientific Publications
INCO	International Cooperation (Acronym for Programme in FP6, part of 'Capacities' in FP7)
IPA	Instrument for Pre-Accession Assistance
IPRO	Intellectual Property Rights Office
IST	Information Society Technologies
ITIDA	Information Technology and Internet Development Agency
IZUM	Slovenian Institute of Information Sciences
JRC	Joint Research Centre
JISA	Union of ICT Societies of Serbia
KFOR	Kosovo Force
KoBSON	Consortium for Coordinated Acquisition (Konzorcijum biblioteka Srbije za objedinjenu nabavku)
LPJ	Locally Published Journal
MEST	Ministry of Education, Science and Technology of Kosovo/UNMIK
MoU	Memorandum of Understanding
MSEP	Ministry of Science and Environmental Protection (till 2007)
MSCI	Ministry of Science
NATO	North Atlantic Treaty Organisation
NBS	Nacionalna Bibilioteka Srbije (National Library of Serbia)
NGO	Non-governmental Organisation
NIP	Networking Infrastructure Project
PCT	Patent Cooperation Treaty
RCC	Regional Co-operation Council
R&D	Research and Development
RTD	Research and Technological Development
SAA	Stabilisation and Association Agreement
SANU	Srpska Akademija Nauka i Umetnosti (Serbian Academy of Sciences and Arts)
SAP	Stabilisation and Association Process
SASA	Serbian Academy of Sciences and Arts
SCOPES	Scientific Cooperation between Eastern Europe and Switzerland
S&E	Science and Engineering
SEE	South-Eastern Europe
SEE-ERA.NET	FP6 project "Southeast European Era-Net"
SIDA	Swedish International Development Cooperation Agency
SIEPA	Serbia Investment and Export Promotion Agency
SME	Small and Medium Size Enterprise
SNSF	Swiss National Science Foundation
S&T	Science and Technology
TEMPUS	Trans-European Mobility Scheme for University Studies
TERENA	Trans European Research and Education Network Association
TRIPS	Trade Related Aspects of Intellectual Property Rights
UN	United Nations

UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNIADRION	Adriatic-Ionian Initiative
UNIDO	United Nations Industrial Development Organisation
UNMIK	UN Interim Administration Mission in Kosovo
USAID	United States Agency for International Development
VAT	Value Added Tax
VET	Vocational Education and Training
WB	Western Balkans
WBC	Western Balkan country/countries
WIPO	World Intellectual Property Organisation
WoS	Web of Science
WTO	World Trade Organisation
WUS	World University Service
ZSI	Zentrum für Soziale Innovation (Centre for Social Innovation, Austria)

Annex I - Main R&D institutes in Serbia

Science and Research institutes founded by Republic of Serbia

Archaeological Institute of the Serbian Academy of Science and Arts Astronomical Observatory
Etnografski institut SANU
Institute of Social Sciences
Institute of Economic Sciences
Institute of Technical Sciences
“Mihajlo Pupin” Institute
Institute of Architecture and Regional & Urban Planning of Serbia
Institute of Biological Research “Siniša Stanković”
Institute of Agricultural Economics
Institute of European Studies
Institute of Philosophy and Social Theory
Institute of Physics
Institute of Chemistry, Technology and Metallurgy “IHTM”
“IMS” – Institute of Material Testing of Serbia
Agricultural Research Institute “Srbija”
Institute of Literature and Arts Institute of Medical Research
Institute of Recent History of Serbia
Institute of Nuclear Sciences “Vinča”
Education Research Institute
Institute of Application of Nuclear Energy “INEP”
Scientific Institute of Medical Plants Research “Dr Josif Pančić”
Crop and Vegetable Scientific Institute
Institute of Contemporary History
Institute for Serbian Culture - Prishtina - Leposavić
Institute of Animal Husbandry
Institute of Forestry
Institute of Technology of Nuclear and Other Mineral Raw Materials
Institute of Plant Protection and Environment
Institute of Soil Sciences
Historical Institute of the Serbian Academy of Science and Arts
Mathematical Institute of the Serbian Academy of Sciences and Arts
Scientific Institute of Veterinary Medicine “Novi Sad”
Scientific Institute of Veterinary Medicine Geoinstitute
Mining Institute
Fruit Research Institute

Science and Research institutes not founded by Republic of Serbia

Centre of Multidisciplinary Studies University of Belgrade
Institute for Economics
Electrical Engineering Institute “Nikola Tesla”
Copper Institute – Rtb-Bor
“IHIS” Holding d.o.o.
Institute of Hygiene and Technology of Meat
Institute of Criminological and Sociological Research
Maize Research Institute “Zemun Polje”
Department of Mathematics and Informatics of Faculty of Sciences, Novi Sad
Institute of International Politics and Economics

Institute of Molecular Genetics and Genetic Engineering
Institute of Oncology and Radiology of Serbia
Institute of General and Physical Chemistry
Institute of Lung Diseases
Institute of Political Studies
Institute of Science Application in Agriculture
Highway Institute
Traffic Institute “CIP”
Institute for Technology of Nuclear and Other Raw Materials
Institute of Comparative Law
Institute for Water Management
“IRITEL”, telecommunications and electronics co.
Research and Development Institute “Kirilo Savić”
Research Institute for Reproduction, Artificial Insemination and Embryo Transfer „Temerin”
Serbian Chemical Society (SCS)
WUS Austria - World University Service