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Contents

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 31 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 summer/autumn 2006 by the Information Office and reviewed by the following actors:
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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. After the independence declarations of Slovenia, Croatia, Bosnia and Herzegovina and the FYR of Macedonia, the two remaining republics (Serbia and Montenegro) declared a new Federal Republic of Yugoslavia (FRY) in April 1992. 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 Metohia), 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 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 June 3, 2006. Subsequently, Serbia declared itself the successor state of the union of Serbia and Montenegro (European Commission 2006).

Following discussions, the European Council adopted a conclusion recognising the Republic of Serbia as a legal successor of the state union on June 12, 2006. As a result of strong gains in trade, transportation, financial services and construction, Serbian GDP, at EUR 2,506 per capita in 2005, grew by 6.5 % in 2005 (European Commission 2006). 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)

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 etc.

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. 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 2006).

[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).

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 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.

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 2006).

This process has been prolonged through the European Commission's decision on May 3, 2006 to block SAA negotiations with Serbia until its obligation to co-operate 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 October 16, 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 European Enlargement official, Olli Rehn, has confirmed Serbia's economic and intellectual potential in becoming an European Union Member State; hence, the EU is prepared to continue with the discussions as soon as Serbia demonstrates full cooperation with the Tribunal. Unfortunately, no new information regarding this plan is currently available. According to Rehn, the implementation of the Action Plan has yet to yield results and discussions will remain frozen until further notice. Nevertheless, the mandate for negotiations on visa facilities will be adopted and the number of scholarships for Serbian students will be increased as of January 2007 (FOCUS 2006).

The adoption of an agreement to continue separate SAA negotiations with Montenegro and with Serbia (following the proclamation of Montenegro's independence) will enable the Commission to resume negotiations immediately after ICTY obligations are fulfilled. The aim of the negotiations is to conclude the first comprehensive agreement between the EU and Montenegro and Serbia respectively, providing for wide-ranging cooperation in order to facilitate

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

integration into EU structures. 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 (European Commission - DG Enlargement 2006).

The EU provides substantial financial assistance to the Western Balkan countries through CARDS (Community Assistance for Reconstruction, Development and Stabilisation), which will be replaced by the new Instrument for Pre-Accession Assistance (IPA), starting from January 2007. The IPA aims to provide targeted assistance to candidate countries and potential candidate countries with their EU membership application, and will entirely replace CARDS and other pre-accession financial instruments. The programming will have 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 2006).
Even though science is not among the main objectives of the IPA, support of S&T infrastructure and related activities is envisaged. This significant change is mainly the result of the following dynamics: Serbia's formal request to CARDS for funding for S&T related activities, which was supported by EU Member States and the SEE-ERA.NET project, drew particular attention to the issue of S&T support and discussions on the matter proceeded to specific contacts with EC officials. Hence, it is mostly in the hands of to the endeavours of the WB countries, who need to demonstrate certain efforts in formulating and submitting requests to the relevant authorities. The SEE-ERA.NET project and especially the recently launched 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).

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 2006).

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 cooperations 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 and Environmental Protection (MSEP) [3]. It also has core and full responsibility for international R&D cooperation. 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 MSEP, while higher education policy is managed under the authority of the Ministry of Education and Sports. 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. Scientific issues, however, are held under the authority of the Ministry of Science and Environmental Protection. 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 MSEP 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).
According to the constitution adopted in 2005, autonomous rights are given to the province of Vojvodine, 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

[3] In the previous government it was the Ministry for Science, Technology and Development.

the Higher Education Department amounted to EUR 11.6 million, or 62.4 % of the budget of the ministry (MSET Kosovo 2002).[4]

The University of Belgrade 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 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).

The most renowned research centre in Serbia is the "Mihajlo Pupin" Institute in Belgrade, also a member of the University of Belgrade. The leading Serbian R&D institution in information and communication technologies (ICT) was founded in 1946 and is the oldest ICT institute in South Eastern Europe. The institute is engaged in contract and application-orientated research on behalf of the main utility and transportation companies and various vertical industrial sectors. Its mission is to deliver information technology and engineering solutions, based on verified practices, innovative technologies and cutting-edge expertise. 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), 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 Education and Sports of the Repubic of Serbia 2007; Ministry of Science and Environmental Protection of the Republic of Serbia 2006).

In Kosovo/UNMIK, the only 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

[4] The official web page of the Ministry of Education, Science and Technology of Kosovo was being reconstructed at the time of writing of this report.

located in various regions. The University of Prishtina is now a member of the European University Association (EUA), 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 (MSET Kosovo 2002). There has been a strong tendency to establish a university 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).

Table 2.1 Main S&T Stakeholders in Serbia (Dall 2006)

Main ministry in Serbia competent for S&T:	- Ministry of Science and Environmental Protection (MSEP)
Other ministries with importance to the S&T sector:	- Ministry of Education and Sport - Ministry of Economy - 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
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 - University of Prishtina (Kosovo/UNMIK) - 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.)

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 UNESCO, UNIDO, UNDP, UNECE[5], 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).
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 U.S. 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. In 2006, USAID administered USD 60 million[6] in financial assistance to Serbia to support the mission's three strategic objectives and cross-cutting programmes, and since 2004, USAID has allocated a total of almost USD 300 million[7] to support Serbia's development process (USAID 2005).

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 (CEI), the Adriatic-Ionian Initiative, the Stability Pact for Southeast Europe, the Black-Sea Economic Co-operation (BSEC) and the International Centre for Genetic Engineering and Biotechnology (ICGEB). Serbia is also maintaining active cooperation with the International Atomic Energy Agency (IAEA) and the Joint Research Centre (JRC). The JRC is the European Commission's Directorate-General, 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 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 aid the Western Balkans countries to participate in the EU Framework Programmes (FP) for R&D, as defined by the EU-Balkan countries' Action Plan on Science & Technology adopted at the Ministerial Conference in Thessaloniki on June 26 and 27, 2003. The "Action

[5] Please see the List of Acronyms (chapter 9).
[6] Around EUR 45 million (www.oanda.com/classic/converter; December 2006).
[7] Around EUR 230 million (www.oanda.com/classic/converter; December 2006).

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). The two FP6 calls (2005 and 2006) for the reinforcement of research capacities will introduce more than EUR 7 million into 30 Centres of Excellence awarded throughout the Western Balkan countries. 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).

Current bilateral S&T cooperation in Serbia has also been used as a starting point for identifying partners for FP6, COST (Co-operation in the field of Scientific and Technical Research) and EUREKA (the Pan-European network for market-oriented, industrial R&D). COST 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. Serbia participated in FP6 as an 'INCO country' with co-financing of projects provided by the Ministry for Science and Environmental Protection. 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[8] (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. In 2005, as a further strategy for boosting innovation, the MSEP launched a competition for the best technological innovation. According to the latest data (www.inovacija.org), 346 innovations and 900 participants were registered in the first year, and 257 innovations and 919 participants (or 471 teams) were registered in 2006.

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 Southeast European ERA-NET (SEE-ERA.NET) (Ministry of Science and Environmental Protection of the Republic of Serbia 2006; Uvalic 2006).
ERA-WESTBALKAN is another project focussing 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 and Environmental Protection.

[8] Around EUR 700,000 (www.oanda.com/convert/classic).

IS2WEB is a support action to familiarise scientists with the IST/ICT priorities of the Framework Programmes for Research and Development (FP6/FP7). IS2WEB in Serbia co-operates with the Belgrade Open School (BOS), a non-governmental, non-profitable educational organisation. SEE-INNOVATION is a project with a similar approach but focussing on the integration of SMEs in the field. It co-operates with the Association for Information Systems and Computer Networks (Information Society of Serbia).
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; to mention only few – CEP (Centre of Excellence Projects), NIP (Networking Infrastructure Projects), Training Courses on Project Management and International Cooperation, Internet and Computer Training Programme etc. 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).

In 2004, Serbia dedicated 1.21 % of its R&D budget to the International Cooperation Programme, which is somewhat more than in 2003, but less than in 2002. Higher education institutions maintain bilateral connections with a number of foreign university associations, support participation in Tempus and the CEEPUS (Central European Exchange Program for University Studies). There are also programmes and various international competitions which 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 programs (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 (AUF), 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).

3 The Input Side of the National Innovation Systems

Regarding the input indicators for the S&T system, some questions (e.g. the amount spent in terms of the gross domestic product (GDP), volumes, growth rates etc.) 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 (MSEP) and the Statistical Office of the Republic of Serbia. Statistics on Serbian R&D activities calculated by the MSEP 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 80's and 90's). 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 (e.g. the software industry etc.). 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). 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 (Kutlaca 2007).

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 (Kutlaca 2007).

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 (Kutlaca 2007) (Source: State Statistical Office according to Kutlaca)

	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

Figure1: Dynamics of Expenditure for R&D per sector

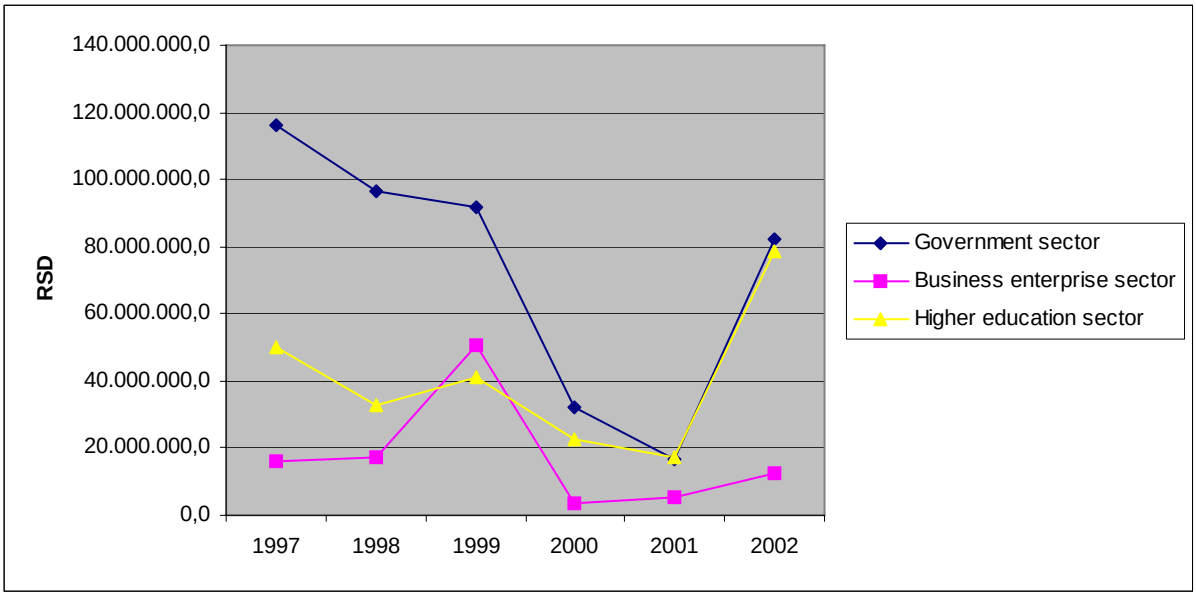
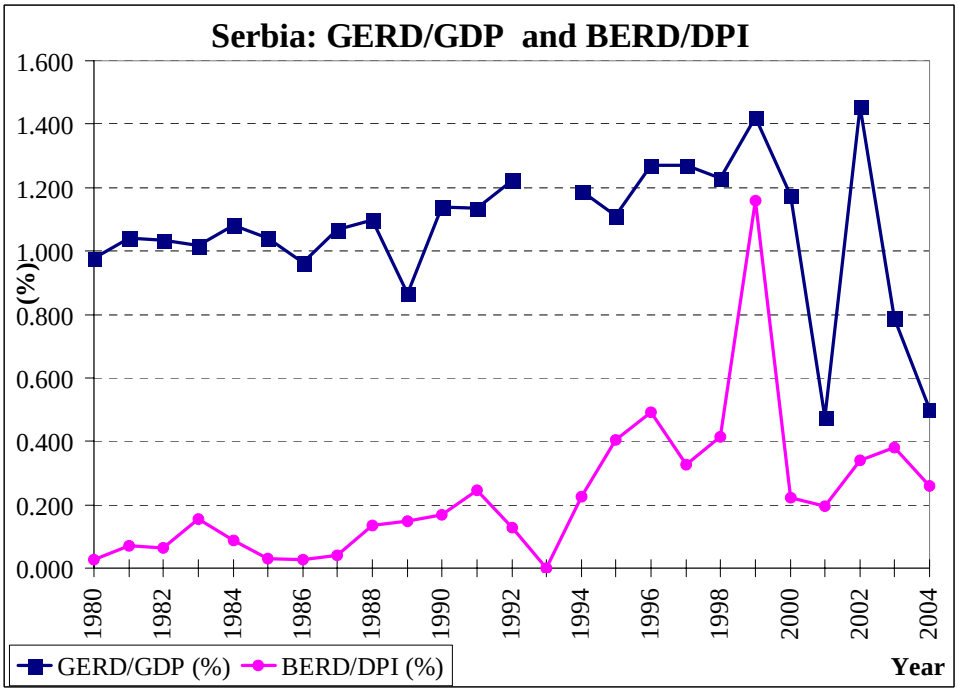


Figure2: GERD and BERD as % of GDP (1980 – 2004)



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[9] in 2000, USD 39.9 million[10] in 2001 and USD 173.4 million[11] in 2002 (Kutlaca 2003).

Political determination to improve the situation has been expressed by the 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[12]: according to Popović, although the MSEP is extremely dissatisfied with the 0.4 % of GDP that the government is currently allocating to science and research, it also announced significant improvement 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 (Popovic 2006). Inside the EU-25, 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) (Kutlaca 2007) (Source: State Statistical Office according to Kutlaca)

	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 dedicates 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

[9] EUR 62.3 million (31.12.2000, www.oanda.com/converter/classic)
[10] EUR 44 million (31.12.2001, www.oanda.com/converter/classic)
[11] EUR 165.4 million (31.12.2002, www.oanda.com/converter/classic)
[12] 04.08.2006, Interview in daily newspaper "DANAS".

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 (Kutlaca 1998b).

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. Therefore data for 1999 is also given in the following table.

Table 3.3: Business Sector Expenditure on R&D (BERD) (Kutlaca 2007) (Source: State Statistical Office according to Kutlaca)

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

Compared to the EU-15 (4.3 %, 1995-2000), BERD increased relatively slowly in South Eastern Europe[13] (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).

[13] Fischer has included Bulgaria and Romania in this calculation but not Albania and BiH – due to the lack of data.

3.4 Higher Education Sector Expenditure on R&D

University research represents one of the key activities within the higher education sector affecting national innovation systems, providing scientific and technological knowledge which 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[14] (more than triple compared to the year 2000), which represented 0.66 % of GDP in 2002.

Table 3.4: Higher Education Sector Expenditure on R&D (HERD) (Kutlaca 2007) (Source: State Statistical Office according to Kutlaca)

	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), author 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 Science and Environmental Protection, 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 and the internet and the Electronic Business Law have been adopted and contracts between the government and ICT companies have been implemented.

[14] Around EUR 77 million (31.12.2002, www.oanda.com/converter/classic).

The MSEP has already signed contracts with Microsoft[15] 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 institutions in the 18 cities in Serbia (Uvalic 2006). The infrastructure at faculties and research institutions comprises several local computer networks and special-purpose computer purchases. Since the Optical Academic Network has been formed, the MSEP is planning to finance local computer networking and Optical Academic Network connectivity, and to purchase special-purpose computers for research institutions (Uvalic 2006).
The Centre for Research of Information Technologies at the Belgrade Open School (CePIT) conducted a study on the "Internet Penetration in Serbia 2006" on a nationally representative sample of Serbia (excluding Kosovo and Metohia). Basic findings of this research have shown that 41 % of households in Serbia own a computer (the rate of PC penetration being the highest in Belgrade, where it reaches 55 %) and 24.2 % of the general population uses the internet. According to the latest Serbian population census from 2002, over 1.5 million citizens use the internet. This share surpasses the 2006 global average (approximately 16.7 % or 1 billion internet users around the world, according to the latest statistics), although it cannot compare to the EU average (52 % or about 240 million internet users in 2006, according to Internet World Stats[16]). Significantly higher percentages of users in Slovenia (54 %) and Croatia (45 %) are the result of strategic work and endeavours to develop an information society. The situation in the FYR of Macedonia is encouraging, where the number of internet users significantly increased as a consequence of the "Macedonia Connects" project, implemented with the support of USAID (CePIT 2006).

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 MSEP. 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 which 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).

[15] In course of ratification at the time of writing this report.
[16] http://www.internetworldstats.com/stats4.htm

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 realised 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 major challenges are associated with capturing and publishing national science outputs in full-text format. The INASP has suggested various areas for activity, e.g. Accessing International Journals, Online Journal Service, Open Access Publishing, Open Access Archiving, Library Strengthening, Regional Co-operation, Communicating Science etc. (INASP 2006).

3.6 Human Resources in R&D

The quality of the science system in Serbia is generally considered to be much higher than the level of economy would suggest, possibly as a result of the sufficient 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 elite of scientist 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 which 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 2005). It is quite 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 (e.g. in Albania or Croatia), while in others (e.g. in the FYR of Macedonia or Serbia) it has been stagnating or declining (Uvalic 2006). In 2003, Serbia[17] 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).

[17] The data is for Serbia and Montenegro.

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).

Table 3.5: R&D Personnel (Kutlaca 2007)

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 RD Organizations	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 (Kutlaca 2003).

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

Table 3.6: R&D Personnel. Source: OECD-MSTI, Kutlaca according to (Kutlaca 2007)

Distribution of researchers by sectors, OECD and Serbia, year 2001			
	Business Enterprise Sector	Government Sector	High 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 confirm 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, 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[18] 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).

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).

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 which are produced. Indicators such as the 'Gross Expenditure on Research and Development' 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 (Uvalic 2006).

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 (European Patent Office 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 November 1, 2004. This means that although the State Union recognises European patents, it was not formally a member of the organisation (European Patent Office 2006).

[18] Data is for Serbia and Montenegro.

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 (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 (Kutlaca 2007).

In 2003, there were all together 62,873 patents granted by the EPO, 31,027 of which were granted to EU countries Austria, a country comparable in size, was granted 765 patents in 2003, while Serbia registered only 4 granted patents[19] (Hörlesberger 2005).

For the purposes of her survey, Marianne Hörlesberger used the data on the total number of patents granted between 1996 and 2004 (Hörlesberger 2005). The six technological fields which 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[20] is similar to that of Romania. 38 % of all patents granted at the EPO were in the field of chemicals and pharmaceuticals, followed 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 2005).

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 (Kutlaca 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. (Kutlaca 2004a, 2007)

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

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 2005).

It is indeed disputed whether the use of registered patents is measuring the country's output activity. Kutlaca 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 although exists in line with international standards, is not fully operational, as well as the lack of human resources, computer and technical equipment and 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. Kutlaca argues that it is therefore more reasonable to use the number of patent applications instead of the number of registered patents (see Table 4.1) for the purposes of the survey (Kutlaca 2004b, 2007).

Table 4.1: Patenting Activity in Serbia 1994-2004, Patent Applications and Registered Patents (Intellectual Property Office of the Republic of Serbia) provided by (Kutlaca 2007)

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 application, %	**86%**	**63%**	**39%**	**40%**	**40%**	**15%**	**0%**	**4%**	**13%**	**18%**	**15%**

The number of registered patents in Serbia has considerably varied in recent years. In the period before 2000, Serbia had been registering very different results through patenting activity, at times demonstrating a sharp decline with only 3 patents granted in the year 2000 (Hörlesberger 2005).
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 2.1).

4.2 Publication Activity in Serbia

Another possibility for measuring innovative output can be found in bibliographic data, such as scientific 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 2005).

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).

Speaking of scientific publications, Uvalić reports that the total number of recently[21] published books in Serbia was 300; the most numerous in technical and technological sciences (80), followed by humanities (85), and social sciences (70). Many fewer science and mathematics books are published (40), along with medical sciences (35), and biotechnological sciences (30). There are numerous – more than 70 – scientific journals in Serbia, covering practically all scientific disciplines (Uvalic 2006).

The number of articles published by authors from Serbia in internationally refereed journals is significant and increasing as shown in an analysis by the National Library of Serbia based on the Web of Science (Kutlaca 2007).

Table 4.2: Articles by Serbian Authors in Internationally Refereed Journals (National Library of Serbia 2006) by (Kutlaca 2007)

Year	2000	2001	2002	2003	2004	2005
Number of Articles	2,200	2,114	2,309	2,535	3,192	3,630

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, etc. 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

[21] Report by Milica Uvalić was drafted in 2006 (no time frame was specified in the report).

the implementation of science policy, taking into account 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, see (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 new version has been in place since December 2005.
Law on Universities	Specifies that universities organise and conduct scientific and educational activities as complementary aspects.
Law on the Innovative Activity	Adopted in 2005, this law defines the innovation activity and regulates its organisation, infrastructural support, programmes, financing, IP rights deriving from such activity etc.
Laws on IP Protection: Patents Law, Copyrights and Related Rights Law, Trademark Law, Law on the Legal Protection of Designs, Law on the Protection of Integrated Circuit Topographies	The Assembly of Serbia and Montenegro adopted these laws in 2004 in order to fully harmonise regulations with WTO requirements and the TRIPS agreement. The adopted laws are also in line with the international conventions 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 and Research Activity defines the scope of scientific activities in Serbia, specifying the definition of state-owned R&D institutions, financing and management of 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.

The Law on Universities (2002) specifies that universities organise and conduct both scientific and educational activities, with scientific research being performed through basic, applied and development research channels. The primary

objective of the law in question was to reinstate the university autonomy, abolished by the previous Law on Universities of 1998.

Important novelty, introduced by both laws (Science and Higher education Laws) is the mandatory process of accreditation (for all R&D and higher education institutions). The process has a time limitation (to be concluded by the start of 2007) and is repetitive (every organisation must be re-accredited after several years, as defined in these two laws). During the process of accreditation, the number of issues will be evaluated (personnel, equipment, infrastructure, programmes, references etc.) and compared with pre-defined standards. Before the end of 2007, 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 (Kutlaca 2007).

A Law on Innovative Activity was introduced in December 2005, providing basic 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 (Dall 2006).

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 Law on the Legal Protection of Designs and the Law on the Protection of Integrated Circuit Topographies (all December 2004). These laws were adopted with the aim of fully harmonising with the requirements of the WTO and the TRIPS agreement (Trade Related Aspects of Intellectual Property Rights), as well as in accordance with related EU regulations.

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. 1,267 works were deposited during the period from October 1999, when the possibility of depositing works of authorship and subjects of related rights with the IPO was first introduced, until the end of 2004.
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).

Until recently, there has been no officially proclaimed S&T policy in Serbia (Kutlaca 2005). The situation has improved significantly 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 "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 Plan", the investment is worth millions of euros. The investment projection for the government was made by the Ministry of Science and Environmental Protection. 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- and bio-sciences. The plan is to start building an infrastructure which 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 (Popovic 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 towardsthe 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, the Serbian Minister of Science and Environmental Protection, has expressed his disappointment regarding the government's failed action called "Thousand Serbian Technologies". 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 (Popovic 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 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 Serbia 2003).

Another important document was in the process of finalisation at the time of writing this report – the "National Innovation Strategy" - co-ordinated by the Ministry of Science and Environmental Protection and the Ministry of Economy. The finalised version of this document should be available in early 2007.

In Kosovo, 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 been defined. (Ministry of Education; Science and Technology of the Kosovo)

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. Generally, the 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. 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. 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 and Environmental Protection is to increase the government's expenditure on R&D (Popovic 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 (Kutlaca 2005).

Table 5.3: Thematic priorities in Serbia (Dall 2006) according to the (Ministry of Science and Environmental Protection of the Republic of Serbia 2005)

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 Science and Environmental Protection, the Ministry of Education and Sport, the Academy of Sciences and Arts 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 - DG Enlargement 2006).

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 both on 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).
Although the research systems in countries of the 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 years, science, scientists and scientific research in the countries under survey have been marginalized. 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. There is also a 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).
Still, 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 (Kutlaca 2007).

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8 List of Acronyms

BERD - Business Sector Expenditure on R&D

BSEC - Black-Sea Economic Co-operation

CARDS - Community Assistance for Reconstruction, Development and Stabilisation

COST - Co-operation in Science and Technology

CTF - Consultative Task Force

EBRD - European bank for Reconstruction and Development

EPD - Enhanced Permanent Dialogue

ERA - European Research Area

ERA-NET - European Research Area Network

FP6 - Sixth EU Framework Programme for R&D

FP7 - Seventh EU Framework Programme for R&D

FTE - Full Time Equivalent

EPC - European Patent Convention

EPO - European Patent Office

EUA - European University Association

FRY - Federal Republic of Yugoslavia

GÉANT - A multi-gigabit pan-European data communications network

GERD - General Expenditure on R&D

GOVERD - Government Sector Expenditure on R&D

HC - Headcount Equivalent

HE - Higher Education

HERD - Higher Education Sector Expenditure on R&D

IAEA - International Atomic Energy Agency

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

JRC – Joint Research Centre

KFOR – Kosovo Force

MSEP - Ministry of Science and Environmental Protection

NATO – North Atlantic Treaty Organisation

NBS – Nacionalna Bibilioteka Srbije (National Library of Serbia)

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

S&E - Science and Engineering

SEE - South-Eastern Europe

SEE-ERA.NET - Southeast European Era-Net Project

SME - Small and Medium Size Enterprise

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

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 Aid

WB - Western Balkans

WBC - Western Balkan country/countries

WIPO - World Intellectual Property Organisation

WTO - World Trade Organisation

WUS - World University Service

Annex I - Main R&D institutes in Serbia

R&D Institutes

Institute of Archeology SANU
Astronomical Observatory
Scientific Institute of Medical Plants Research "Dr. Josif Pancic"
Institute of Social Science
Institute of Economic Science
Institute of Architecture and Town Planning
Institute of Biological Research "Sinisa Stankovic"
Institute of Agricultural Economics
Institute of Herbal Protection and Environment
Institute of Soil Science
Institute of Material Testing
Agricultural Research Institute
Institute of Literature and Arts
Institute of Medical Research
Institute of Recent History of Serbia
Institute of Nuclear Science "Vinca"
Education Research Institute
Institute for the Application of Nuclear Energy "INEP"
Institute for Serbian Culture
Institute for Modern History
Institute of Animal Husbandry
Institute of Technology of Nuclear and Other Mineral Raw Materials
Institute for Physics
Institute of Philosophy and Social Theory
Historical Institute SANU
Institute for Chemistry, Technology and Metallurgy
Institute of Forestry
Scientific Institute of Veterinary Medicine of Serbia
Scientific Institute of Veterinary Medicine "Novi Sad"
Scientific Institute of Field and Vegetable Crops
"Geoinstitute"
Institute "Mihailo Pupin" – Information and Communication Technologies
Institute of European Studies
Mining Institute
Mathematical Institute SANU
Research and Development Institute "Kirilo Savic"
Institute for Economics
Electrical Engineering Institute "Nikola Tesla"
Institute of Criminological and Sociological Research
Maize Research Institute "Zemun Polje"
Institute of International Politics and Economics
Institute of Molecular Genetics and Genetic Engineering
Institute of Oncology and Radiology
Institute for Political Studies
Institute of Science Application in Agriculture

Highway Institute
Institute of Transportation "CIP"
Institute for Comparative Law
Institute of Hygiene and Technology of Meat
Institute of General and Physical Chemistry
RTB Institute for Copper – Bor
Institute "Gosa"
"IRITEL" Institute - Telecommunications And Electronics
"Jaroslav Cherny"-Water Resources Scientific Research Department
Institute of Microwave Techniques and Electronics-IMTEL
"IHIS"-Institute of Chemical Electric Energy Resources
LOLA Institute-Scientific Institute of Flexible Automation

The Project

The Information Office of the Steering Platform on Research for Western Balkan Countries (***see-science.eu***) acts as a source of high quality targeted information on research in the Western Balkan countries (WBCs) by supporting the Steering Platform through a regular eJournal, analytical studies and reports and directories.
The Information Office contributes to a dialogue on S&T issues between the EU and the Western Balkan countries and the integration of the research and innovation systems of the WBCs into the European Research Area (ERA).
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Reviews and Contributions

The readers are invited to contribute to the development of the report. It is planned to update it on a continuous basis and to publish the results in a book in the end of 2007. Please send your remarks to Ms. Elke Dall at dall@zsi.at