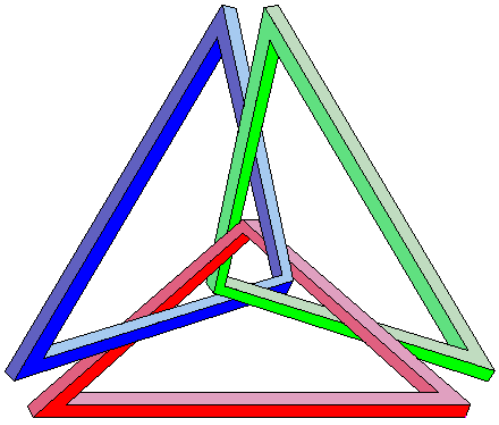
National Platform for Knowledge Triangle in Serbia –KNOWTS

158881-TEMPUS-RS-JPHES

National Platform for Knowledge Triangle in Serbia

Synergy between education, research and innovation



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PREPARED BY:

Prof. Ivan Milentijević, University of Niš

Prof. Milorad Tošić, University of Niš

Prof. Vera Dondur, National Council for Research and Technology Development

Prof. Ivanka Popović, University of Belgrade

Gordana Grković Danilović, University of Belgrade

Prof. Veljko Malbaša, University of Novi Sad

Prof. Vojin Šenk, University of Novi Sad

Prof. Ladislav Novak, University of Novi Sad

Prof. Dušica Pavlović, University of Niš

Prof. Dragan Milosavljević, University of Kragujevac

Prof. Vesna Mandić, University of Kragujevac

Marina Vukobratović Karan, Ministry of Education, Science and Technology Development

Sanja Pavlović, Ministry of Education, Science and Technology Development

Tijana Knežević, Ministry of Education, Science and Technology Development

REVIEWERS:

Prof. Srdjan Stanković, National Council for Higher Education, Serbia

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Prof. Katerina Georgouli, TEI-Athens, Greece

Prof. Željko Djurović, University of Belgrade, Serbia

Prof. Viktor Nedović, University of Belgrade, Serbia

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1. Executive summary

Synergy is a term that describes a condition in which a whole gets something better and more meaningful by integration of its subsystems. Education, research and innovation are the vertices of a knowledge triangle around which the subsystems that are the basis of the progress of modern society are organized. The process of circling of knowledge triangle assumes developing mutual interaction of these subsystems, which leads to mutual reinforcement of each of the subsystems, and the integration into a single system with a new added value. The central theme of the Lisbon strategy is the integration of education, research and innovation as key drivers of the knowledge economy, in order to achieve sustainable growth and to strengthen the EU's position in the world market. Most of European countries have documents that consider their own capabilities, set goals and propose measures to circle knowledge triangle and achieve coherence in research, innovation and educational policy. The Republic of Serbia has Education Development Strategy (2020) and Strategy of Scientific and Technological Development (2015). Strategies deal with important issues for development of education and research, but do not supplement each other enough and only partially touch the area of innovation. The aim of the Platform for synergy of education, research and innovation is to look for opportunities to encourage positive interaction between these fields, and to initiate a series of public meetings to raise awareness of the importance of the knowledge triangle in the academic community, as well as to encourage the creation of strategic documents at national level. This document is created within the frame of the project Tempus JP HES 158 881 RS - KNOWTS *National Platform for Knowledge Triangle in Serbia*, as one of the key outcomes of the project.

In the second chapter of the document, there are two sections, one related to the internal structure and the other that examines the influence of external factors. The internal structure subsection provides general remarks about the Republic of Serbia. The analysis of the state includes Global Competitiveness Index, the review of the population structure and list of applicable documents and laws governing technological development, scientific research and innovation activities. In the subsection Education, national education system in Serbia is described and information about higher education institutions, their study programmes, number of students, teaching stuff and quality assurance mechanisms are provided. This section also analyzes situation of research and development activities in the Republic of Serbia and explains current innovation system. At the end of the section, business environment is discussed. The second section, within the second chapter, External factors, involves the influence of globalization, new technologies and the formation of the knowledge economy, as the most important external factors that affect Serbian society.

The third chapter sets strategic objectives related to the sustainable development, fostering university business cooperation and recognizing central position for education, research and innovation in Serbian society. The chapter contains the section devoted to harmonization of Serbian national strategic goals with EU strategic goals and regional strategies. To achieve the set goals, the fourth chapter presents how the measures are divided into six groups and covers developing more coherence between policies in education, research and innovation,

accelerating the pedagogical reforms, partnership between universities and business, the development of innovation culture, creating a portable and applicable knowledge in the universities, and the development of new criteria for quality assurance in institutions that take into account the research, education and innovation aspects.

The last chapter promotes best practice examples from Serbia where synergy between education, research and innovation is successfully exploited. There is a brief presentation of: Business Technology Incubator of Technical Faculties Belgrade, Best Technology Innovation Competition, UNESCO Chair for Entrepreneurial Studies, Technology incorporation at the University of Novi Sad, Cluster of Advanced Technologies - NiCAT from Niš, knowledge triangle integration from the University of Kragujevac, and CAPINFOOD project at Faculty of Agriculture, University of Belgrade.

The preparation of this document draws on numerous reports and analysis conducted in the fields of education, research and innovation, the existing strategies in the Republic of Serbia and Serbian legislative, as well as strategies of several European countries that discuss issues of the knowledge triangle. The aim of this paper is to demonstrate development opportunities that rely on education, research and innovation, to academic community, business and government authorities in the Republic of Serbia.

2. Republic of Serbia – current state

2.1. Internal structure

2.1.1. Serbia – general remarks and global competitiveness index

The Republic of Serbia is a state at the juncture of Central and South Eastern Europe, with a political structure of a parliamentary republic. It occupies about 88.000 km^2 with the population of somewhat above 7.290.000, without data on Kosovo, which from 1999 is under the protectorate of the United Nations and whose temporary institutions proclaimed independence in 2008, yet unacknowledged by Serbia. According to the data of the World Bank, the MMF, Serbia is categorized as a medium developed economy in the world parameters, but one of less developed in Europe.

Global Competitiveness Index is a complex and all-encompassing measure of productivity and prosperity of world nations, obtained through a method and by the World Economic Forum. The established values of the global index of competitiveness are published periodically in the Global Competitiveness Report[1]. The competitiveness index is based on the analysis of a few institutions, regulations as well as other social, macro economical and micro economical components that are individually valued on the 1-7 scale and according to some other measures. The measured aspects are categorized into 12 groups that reflect special aspects of the social development and the economical ambience of a state – ranging from institutions, infrastructure, financial market, to education and innovations.

According to the overall evaluation of the Report on Global Competitiveness 2012-2013, Serbia is at the 95th place out of 144 analyzed states, but according to the development of the innovativeness factor and sophistication is only 111th. According to the scale of the development phases, at which the authors define three phases and two transitional phases, Serbia is in the middle phase, a society driven by efficiency, as presented in the following figure:

[1]Klaus Schwab (ed.),The Global Competitiveness Report 2012–2013, World Economic Forum, 2012.

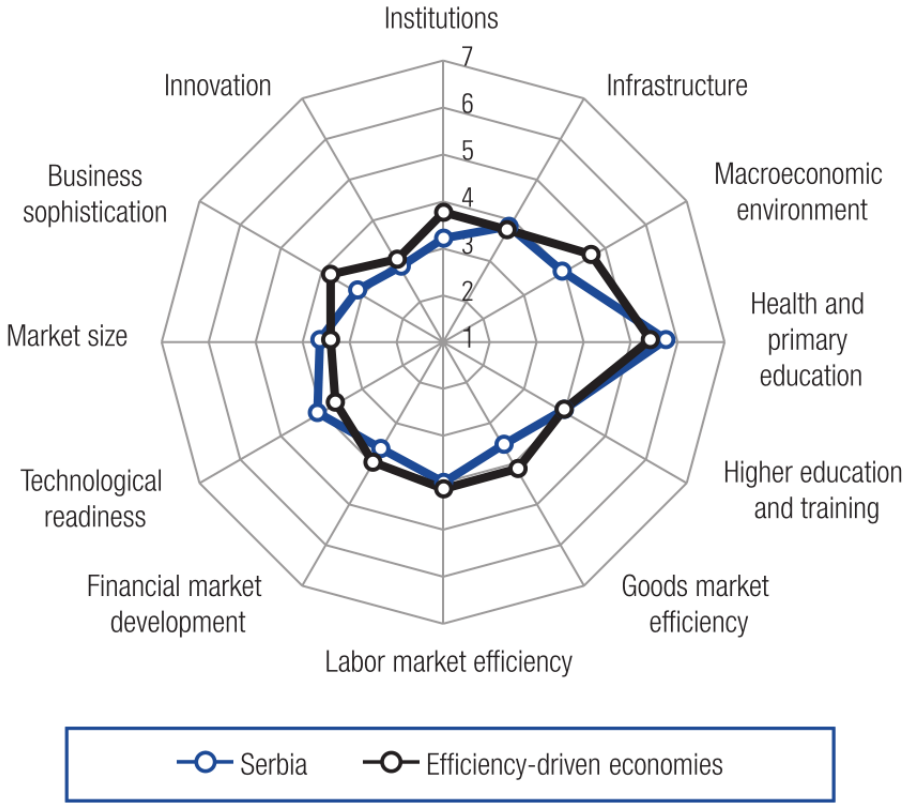

Figure 2.1.1.1. State of development according to GCI pillars

The following table presents details of measured factors of the Global competitiveness index for Serbia:

	INDICATOR	VALUE	RANK/144
	1st pillar: Institutions		
1.01	Property rights	3.1	130
1.02	Intellectual property protection	2.8	116
1.03	Diversion of public funds	2.8	95
1.04	Public trust in politicians	2.0	118
1.05	Irregular payments and bribes	3.6	86
1.06	Judicial independence	2.4	129
1.07	Favoritism in decisions of government officials	2.3	132
1.08	Wastefulness of government spending	2.2	132
1.09	Burden of government regulation	2.4	136
1.10	Efficiency of legal framework in settling disputes	2.5	138
1.11	Efficiency of legal framework in challenging regs.	2.6	133
1.12	Transparency of government policymaking	3.8	111
1.13	Gov't services for improved business performance	2.8	126
1.14	Business costs of terrorism	5.6	71
1.15	Business costs of crime and violence	4.6	85
1.16	Organized crime	4.1	118
1.17	Reliability of police services	4.0	78
1.18	Ethical behavior of firms	3.1	132
1.19	Strength of auditing and reporting standards	3.9	117
1.20	Efficacy of corporate boards	3.7	141
1.21	Protection of minority shareholders' interests	2.6	143
1.22	Strength of investor protection, 0–10 (best)*	5.3	65
	2nd pillar: Infrastructure		
2.01	Quality of overall infrastructure	3.2	120
2.02	Quality of roads	2.7	122
2.03	Quality of railroad infrastructure	1.7	102
2.04	Quality of port infrastructure	2.7	134
2.05	Quality of air transport infrastructure	3.2	130
2.06	Available airline seat kms/week, millions*	57.9	92
2.07	Quality of electricity supply	4.8	73
2.08	Mobile telephone subscriptions/100 pop.*	125.4	**38**
2.09	Fixed telephone lines/100 pop.*	37.3	**31**
	3rd pillar: Macroeconomic environment		
3.01	Government budget balance, % GDP*	-4.0	90
3.02	Gross national savings, % GDP*	16.1	93
3.03	Inflation, annual % change*	11.2	129
3.04	General government debt, % GDP*	47.9	92
3.05	Country credit rating, 0–100 (best)*	39.8	79
	4th pillar: Health and primary education		
4.01	Business impact of malaria	n/appl.	**1**
4.02	Malaria cases/100,000 pop.*	(NE)	**1**
4.03	Business impact of tuberculosis	6.0	**35**
4.04	Tuberculosis cases/100,000 pop.*	18.0	**40**
4.05	Business impact of HIV/AIDS	6.0	**29**
4.06	HIV prevalence, % adult pop.*	0.1	**12**
4.07	Infant mortality, deaths/1,000 live births*	6.1	**39**
4.08	Life expectancy, years*	73.9	61
4.09	Quality of primary education	3.5	83
4.10	Primary education enrollment, net %*	92.7	77
	5th pillar: Higher education and training		
5.01	Secondary education enrollment, gross %*	91.4	58
5.02	Tertiary education enrollment, gross %*	49.1	52
5.03	Quality of the educational system	3.1	111
5.04	Quality of math and science education	4.1	60
5.05	Quality of management schools	3.5	116
5.06	Internet access in schools	3.6	92
5.07	Availability of research and training services	3.2	125
5.08	Extent of staff training	2.9	138

	INDICATOR	VALUE	RANK/144
	6th pillar: Goods market efficiency		
6.01	Intensity of local competition	3.6	137
6.02	Extent of market dominance	2.6	142
6.03	Effectiveness of anti-monopoly policy	2.8	142
6.04	Extent and effect of taxation	2.9	122
6.05	Total tax rate, % profits*	34.0	**50**
6.06	No. procedures to start a business*	7	74
6.07	No. days to start a business*	13	59
6.08	Agricultural policy costs	3.3	119
6.09	Prevalence of trade barriers	3.8	113
6.10	Trade tariffs, % duty*	5.3	72
6.11	Prevalence of foreign ownership	3.8	124
6.12	Business impact of rules on FDI	3.7	123
6.13	Burden of customs procedures	3.5	102
6.14	Imports as a percentage of GDP*	53.5	56
6.15	Degree of customer orientation	3.7	135
6.16	Buyer sophistication	2.2	138
	7th pillar: Labor market efficiency		
7.01	Cooperation in labor-employer relations	3.3	139
7.02	Flexibility of wage determination	5.4	**41**
7.03	Hiring and firing practices	3.6	98
7.04	Redundancy costs, weeks of salary*	8	**21**
7.05	Pay and productivity	3.5	106
7.06	Reliance on professional management	3.3	135
7.07	Brain drain	1.9	141
7.08	Women in labor force, ratio to men*	0.77	77
	8th pillar: Financial market development		
8.01	Availability of financial services	4.0	97
8.02	Affordability of financial services	3.7	100
8.03	Financing through local equity market	2.4	124
8.04	Ease of access to loans	2.4	105
8.05	Venture capital availability	1.9	126
8.06	Soundness of banks	4.3	119
8.07	Regulation of securities exchanges	3.3	120
8.08	Legal rights index, 0–10 (best)*	8	**24**
	9th pillar: Technological readiness		
9.01	Availability of latest technologies	3.9	127
9.02	Firm-level technology absorption	3.6	142
9.03	FDI and technology transfer	3.8	123
9.04	Individuals using Internet, %*	42.2	67
9.05	Broadband Internet subscriptions/100 pop.*	10.8	53
9.06	Int'l Internet bandwidth, kb/s per user*	76.8	**20**
9.07	Mobile broadband subscriptions/100 pop.*	34.5	**32**
	10th pillar: Market size		
10.01	Domestic market size index, 1–7 (best)*	3.5	67
10.02	Foreign market size index, 1–7 (best)*	4.1	74
	11th pillar: Business sophistication		
11.01	Local supplier quantity	4.2	110
11.02	Local supplier quality	3.9	113
11.03	State of cluster development	2.7	133
11.04	Nature of competitive advantage	2.5	134
11.05	Value chain breadth	2.9	119
11.06	Control of international distribution	3.5	120
11.07	Production process sophistication	2.7	128
11.08	Extent of marketing	2.9	129
11.09	Willingness to delegate authority	2.6	139
	12th pillar: Innovation		
12.01	Capacity for innovation	2.5	120
12.02	Quality of scientific research institutions	3.6	67
12.03	Company spending on R&D	2.3	132
12.04	University-industry collaboration in R&D	3.2	99
12.05	Gov't procurement of advanced tech products	3.1	115
12.06	Availability of scientists and engineers	3.9	78
12.07	PCT patents, applications/million pop.*	0.0	119

Figure 2.1.1.2. The Global Competitiveness Index in detail

Yet another indicator of the conditions in Serbia is the Global Innovation Index issued in cooperation with WIPO (World Intellectual Property Organization, the agency of the United Nations) and an international educational organization INSEAD. According to the results from the latest issue of the Global Innovation Index[2], Serbia is at the 46th position out of 141 countries examined. The analysis of the individual components from 7 groups of indicators (the total of 84 indicators), the lowest values are indicators 5.1.3 R&D performed by business, 5.1.4 R&D financed by business, 5.2 Innovation linkage, 7.1.3 ICT & business model creation and 7.1.4 ICT & organizational model creation.

[2]Soumitra Dutta (ed.), Global Innovation Index 2012 Edition, INSEAD, Fontaineblau, France, http://www.globalinnovationindex.org/gii/main/fullreport/index.html

2.1.2. Population structure

Economic development is linked in various ways to population structure. In this section, population structure of Serbia is presented in different manners with the aim to clarify its potentials.

The data on population by large age group and sex are given in Table 2.1.2.1. according to the Statistical Office of the Republic of Serbia.

Table 2.1.2.1. Population, by large age group and sex[3]

	The number of inhabitants			Structure,%		
	Total	Males	Females	Total	Males	Females
Total	7291436	3546374	3745062	100	100	100
0-14 year	1102260	566616	535644	15.1	16	14.3
0-19 year	1525296	783422	741874	20.9	22.1	19.8
20-39 year	1986451	1006482	979969	27.2	28.4	26.2
40-59 year	2080059	1018325	1061734	28.5	28.7	28.4
60 year and more	1699630	738145	961485	23.3	20.8	25.7
65 year and more	1233412	519348	714064	16.9	14.6	19.1

Table 2.1.2.2. More important functional age population contingents[4]

	The number of inhabitants	Share in total population,%
Total	**7291436**	**100.00**
Infants	68892	0.94
Preschool (0-6)	500016	6.86
Compulsory school (7-14)	602244	8.26
Adult (18 +)	5939600	81.46
Work - Total (15-64)	4955764	67.97
Working population - male (15-64)	2460410	33.74
Working population - female (15-64)	2495354	34.22
Fertility (15-49)	1677562	23.01
Optimal fertility (20-34)	734188	10.07
Seniors (80 +)	258629	3.55

[3]The Statistical Office of the Republic of Serbia, http://webrzs.stat.gov.rs/WebSite/public/ReportView.aspx
[4]The Statistical Office of the Republic of Serbia, http://webrzs.stat.gov.rs/WebSite/public/ReportView.aspx

Table 2.1.2.3. Number of employed[5]

	In total	Legal entities	Private entrepreneurs
2010	1795775	1354637	441138
2011	1746138	1342892	403246
2012	1727048	1341114	385934

Table 2.1.2.4. Education structure of unemployed persons, population age 15-64[6]

Education level	November 2011	April 2012	October 2012
No school	1.0%	0.3%	0.4%
Primary education	18.5%	18.4%	19.0%
Secondary education	66.8%	66.8%	66.0%
Tertiary education	13.6%	14.5%	14.6%

The data on employment in the Republic of Serbia in October, 2012 give the following picture[7]: the unemployment rate, which represents the share of the unemployed in the total number of active citizens (both employed and unemployed) in the Republic of Serbia was 22.4%, out of which 21.5% were men, and 23.7% were women. The employment rate represents the percentage of employment in the total of the population older than 15, and in October 2012, it was 36.7%. Out of that the rate of employment for men was 44.0%, and for women 29.8%. Women in Serbia make up a half of the total population, but that percentage is not reflected in economic, social or educational structures of the population.
Based on the data from the research performed by the Statistical Office of the Republic of Serbia, it can be concluded that the male population 15 and above years of age is almost twice as much more time engaged in paid jobs than female population, and that it is somewhat more than 4 hours. On the other side, women mostly have unpaid jobs in the houses and in dealing with care for the members of the family in the proportion twice as more than men. All in all, persons of both sexes, but especially women, spend a lot of time in housework that is not paid, and that work has a large contribution in the total realized value of human work.

This graph also shows that both men and women spend a quarter of the day in work activities, regardless the fact that they are paid or not. For men, the total work, that is both paid and unpaid, lasts on average over six hours, but for women longer than that: seven hours exactly. So, the total work spent in both paid and unpaid work for women lasts longer, although the ratio of paid and unpaid work is in favor of men and the paid work.

[5]The Statistical Office of the Republic of Serbia, http://webrzs.stat.gov.rs/WebSite/public/ReportView.aspx
[6]Labor Force Survey, Republic Statistical Office
[7] Survey on labor force, October 2012, The Statistical Office of the Republic of Serbia, http://webrzs.stat.gov.rs/WebSite/public/PublicationView.aspx?pKey=41&pLevel=1&pubType=2&pubKey=1517

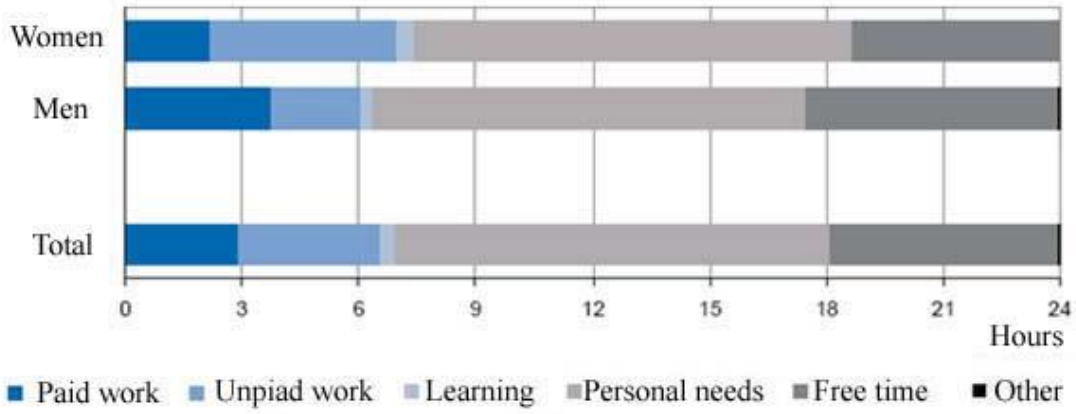

Figure 2.1.2.1. Average time spent in activities for the population older than 15 for all weekdays in the Republic of Serbia for 2010/2011[8]

Table 2.1.2.5. Average salaries in various sectors[9]

	Gross earnings (RSD)	**Net earnings (RSD)**
Total	47450	34142
Business	51165	37020
Agricul., hunt., forestry and water works supply	41334	29713
Fishing	32818	23692
Mining and quarrying	69610	49652
Manufacturing	40338	29225
Electricity, gas and water supply	65076	46352
Construction	40279	28961
Wholesale and retail trade	35366	25692
Hotels and restaurants	25867	18910
Transport, storage and communications	54380	39106
Financial intermediation	101585	73382
Real estate, renting and business activities	51176	37035
Public administration and defense; compulsory social security	58331	41677
Education	50141	35867
Health and social work	50389	36069
Other commun., social and person. service activit.	44587	32060

[8] Research on using time in the Republic of Serbia, 2010/11, The Statistical Office of the Republic of Serbia, http://webrzs.stat.gov.rs/WebSite/public/PublicationView.aspx?pKey=41&pLevel=1&pubType=2&pubKey=1383
[9] Statistical Office of the Republic of Serbia, http://webrzs.stat.gov.rs/WebSite/public/ReportView.aspx

Serbia has the largest refugee population in Europe. Refugees and internally displaced persons (IDPs) in Serbia form between 7% and 7.5% of its population – about half a million refugees sought refuge in the country following the series of Yugoslav wars, mainly from Croatia, and to a lesser extent from Bosnia and Herzegovina and the IDPs from Kosovo, which are currently the most numerous are over 200,000.

Meanwhile, it is estimated that 300,000 people left Serbia during the 1990s alone, and around 20% of those had college or higher education. Serbia has a comparatively old overall population (among the 10 oldest in the world), mostly due to low birth rates. In addition, Serbia has among the most negative population growth rates in the world, ranking 225th out of 233 countries overall.

2.1.3. Development Policy – Legislative Framework and Documents

The following section contains a list of applicable documents and laws governing technological development, scientific research and innovation activities, in order to provide a holistic approach to the strategy. It is important to note that listed documents and laws do not contain any restrictive provisions that apply to mobility of researchers between universities and industry and their cooperation.

Research and Innovation policy related documents:

- Education Development Strategy in the Republic of Serbia until 2020[10],
- Strategy of Scientific and Technological Development of the Republic of Serbia in 2010-2015[11],
- Strategy and Development Policy of the Serbian Industry for 2011 -2020[12],
- Information Society Development Strategy until 2020[13],
- Competitive and Innovative Small and Medium Enterprises' Development Strategy for the period 2008-2013[14],
- Intellectual Property Development Strategy for the Period 2011 - 2015[15],
- National Sustainable Development Strategy[16]
- National Strategy for Youth[17]
- Law on Scientific and Research Activities ("Official Gazette of the Republic of Serbia ", No. 110/2005, 50/2006 – corr. and 18/2010)[18],
- Changes of the Law on Scientific and Research Activities[19],
- Law on Higher Education[20],
- Law on innovation activities[21],
- Law on Serbian Academy of Sciences and Arts[22],
- Law on Matica Srpska[23],
- Labor Law[24].

[10] http://www.srbija.gov.rs/extfile/sr/179119/strategija_obrazovanje026_cyr.zip
[11] http://www.mpn.gov.rs/images/content/strategije/strategija_naucno-tehnoloski_razvoj0224_cyr.doc
[12] http://www.media.srbija.gov.rs/medsrp/dokumenti/strategija_industrija0466_cyr.zip
[13] http://www.paragraf.rs/propisi/strategija_razvoja_informacionog_drustva_u_republici_srbiji.html
[14] http://www.srbija.gov.rs/extfile/sr/97228/strategija_razvoj_malih_srednjih_preduzeca0029_cyr.zip
[15] http://www.srbija.gov.rs/extfile/sr/155968/strategija_razvoj_intelektualne_svojine00463_cyr.zip
[16] http://www.srbija.gov.rs/extfile/sr/170160/nacionalna_strategija_odrzivog_koriscenja_prirodnih_resursa_dobara00636_cyr.zip
[17] http://www.srbija.gov.rs/extfile/sr/88759/nacionalna_strategija_za_mlade0081_cyr.zip
[18] http://www.mpn.gov.rs/dokumenta-i-propisi/zakoni/nauka-i-tehnoloski-razvoj/92-zakoni-u-nauci-i-tehnoloskom-razvoju
[19] http://www.mpn.gov.rs/dokumenta-i-propisi/zakoni/nauka-i-tehnoloski-razvoj/92-zakoni-u-nauci-i-tehnoloskom-razvoju
[20] http://www.mpn.gov.rs/dokumenta-i-propisi/zakoni/obrazovanje-i-vaspitanje/505-zakon-o-visokom-obrazovanju
[21] http://www.mpn.gov.rs/images/content/nauka/pravna_akta/zakon_ino-cir.pdf
[22] http://www.mpn.gov.rs/images/content/nauka/pravna_akta/zakon_o_sanu-cir.pdf
[23] http://kultura.gov.rs/sites/default/files/documents/Zakon-o-Matici-srpskoj.doc
[24] http://www.paragraf.rs/propisi/zakon_o_radu.html

Intellectual property related laws:

- The Patent Law ("Official Gazette of the Republic of Serbia", No. 99/11, dated December 27, 2011)[25],
- The Law on Trademarks ("Official Gazette of the Republic of Serbia", No. 104/2009)[26],
- The Law on Legal Protection of Industrial Design ("Official Gazette of the Republic of Serbia", No. 104/09)[27],
- The Patent Law ("Official Gazette of Serbia and Montenegro", No. 32/2004 and 35/2004 – corr. and "Official Gazette of the Republic of Serbia", No. 115/2006)[28].

The applicable legal framework in the Republic of Serbia (including the Constitution, Labor Law, research reulations, internal Unversity regulations, etc.) provides the following legal environment for research activities:

Definition of researcher (Law on scientific and research activities):

- The researcher, within the meaning of this Law, is the person with at least university education, i.e. with at least basic academic studies completed, who performs scientific research and development tasks and is elected to the respective position, pursuant to this Law.

Titles and election procedures:

- Research titles
  - Research apprentice, RAp (enrolled in graduate academic studies, or specialist academic studies in the year of completion of the basic academic studies, involved in scientific research work, overall grade at least eight – 8)
    - equivalent to position of teaching associate
  - Research associate, RAss (enrolled in doctoral studies, overall grade of at least eight (8), involved in scientific research work and has **reviewed scientific papers published**.)
    - equivalent to position of teaching assistant
- Scientific titles
  - Scientific associate, SAs (holds PhD, has reviewed scientific papers and other research results published)
    - equivalent to position of assistant professor
  - Senior scientific associate, SSA (scientific associate conditions + citation rates, project leaderships)
    - equivalent to position of associated professor
  - Scientific advisor, SAd (same as senior sci. assoc.)

[25] http://www.paragraf.rs/propisi/zakon_o_patentima.html
[26] http://www.paragraf.rs/propisi/zakon_o_zigovima.html
[27] http://www.zis.gov.rs/pravna-regulativa/закони-и-други-прописи.54.html
[28] http://www.wipo.int/wipolex/en/text.jsp?file_id=174377

- equivalent to position of full professor

- For each scientific field are in detail specified the type, minimum of quantitatively expressed results and criteria for assessment of the quality of scientific research work, required for acquiring a title, i.e. reelection to a position.
- Election procedures
- Duration
  - SAs and SSA are acquired for the period of 5 years (with possibility for re-election for two more terms), while SAd is permanent.
  - RAp is acquired for the period of 3 years (without the right to re-election)
  - RAss is acquired for the period of 3 years, with max one more term to re-elect

2.1.4. Education

Higher education in Serbia is part of the national educational system of the classical type: pre-primary, primary, secondary and higher education. The length of the primary school programme is eight, and secondary (grammar, vocational and art schools) is four years. From 2000, higher education institutions in Serbia became involved in the European trends of reforms and harmonization in the field of higher education – Bologna process. In September 2003, Serbia officially signed the Bologna Declaration and the main principles of it were incorporated in the Law on Higher Education[29] (LoHE) that came into the force two years later, in September 2005. By adopting the main principles of the Bologna process, Serbia committed itself to become a full member of the European Higher Education Area. A three-cycle education process, accreditation and external evaluation of higher education institutions and its programmes, mobility of students, professors and staff, as well as recognition of diplomas have been the main pillars of Serbian reform.

Degree structure

Higher education activities are carried out through academic and professional career courses based on accredited study programmes for acquiring higher education degrees. There are 3 levels of studies (degrees) in our HE system (presented in Figure 2.1.4.1):

- The first level includes: basic academic and professional courses.
- The second level includes: academic courses for a master's degree, specialist professional courses and specialist academic studies.
- The third level includes doctoral academic courses.

Each subject within a study programme receives a certain number of ECTS credits, whereas the scope of studies as a whole is expressed by aggregate ECTS credits. A total of 60 ECTS credits should correspond to an average of 40 h per student for the work done each week during an academic year. ECTS credits may be transferred between study programmes, but only within the same type of courses. Criteria and conditions for the transfer of ECTS credits are determined in the general act of an independent HEI or in an agreement reached between HEIs. LoHE offers the possibility of acquiring a joined diploma or degree organized and implemented by several HEIs.

[29] http://www.mpn.gov.rs/dokumenta-i-propisi/zakoni/obrazovanje-i-vaspitanje/505-zakon-o-visokom-obrazovanju

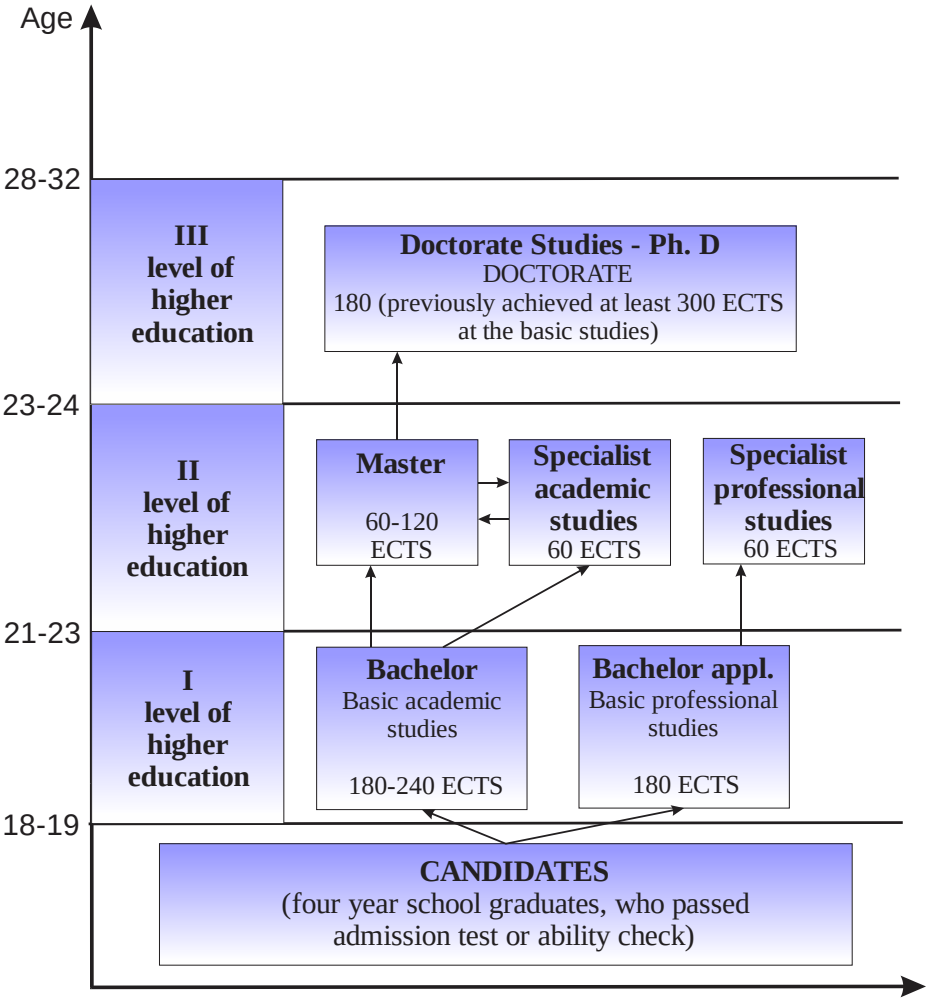

Figure 2.1.4.1. Degree structure of Serbian HE

Bachelor - Basic studies are organized by all HEIs defined by the LoHE and last three to four years. Total number of credits earned at this cycle could be 180 to 240 depending on the length of study programme (3 or 4 years). The degree for basic professional studies should be completed in three years. The study programme of basic studies can include a final paper. A person who finishes the basic academic studies and earns 180 credits acquires the professional title that includes the name of the profession of the first degree academic studies in the corresponding area - *bachelor*. If a person earns 240 credits, he or she acquires the title *bachelor with honors*. A person who finishes the basic professional studies acquires the professional title that includes the name of the profession of the first degree of the professional studies in the corresponding area - *bachelor appl*.

Master and Specialist studies - Master and specialist academic studies can be organized by the university, faculty or higher school of academic studies (college). Master degree academic studies last one or two years depending on the duration of the basic academic studies. Study programmes of master academic studies contain an obligation to create a master thesis. A person who finishes master academic studies acquires the academic title - *master*, with the name of the profession of the second degree of academic studies in a corresponding area. The number of ECTS that can be earned in this cycle is 60 to 120. Specialist academic studies last one year with 60 ECTS.

Specialist professional studies can be organised by the university, faculty, higher school of academic studies or higher school of professional studies. The number of ECTS that could be earned is 60.

Integrated studies (one cycle programme) **-** Academic study programmes can be organized and integrated within basic and master academic studies with 300 ECTS. One-cycle study programmes in the field of medicine can be organized with 360 ECTS.

PhD studies **-** PhD studies can be organized by universities and faculties. PhD studies are carried out for at least three years with previous basic and master academic studies. Serbia has adopted the ECTS system for PhD studies. The number of ECTS that should be earned is 180, if the candidate has at least 300 ECTS collected in previous levels of education. A PhD dissertation is the final part of the study programme of PhD studies, with the exception of a PhD in the Arts which is an artistic project.

Grading system

A student's achievement in a specific subject is continuously assessed during the teaching process as well as at the end of the course (final exam) and it is expressed in points. By fulfilling the duties preceding an exam and passing the exams, a student can achieve a maximum of 100 points. Every course establishes the proportion of points achieved during the pre-exam duties and in the exam, the pre-exam duties being worth a minimum of 30 and maximum of 70 points. A student's success is assessed by grades from 5 (failed) to 10 (excellent). An institution of higher education can establish a different, non-numeric method of grading, by establishing the relation between these grades and those of 5 to 10. A general act of an institution of higher education defines more closely the way in which exams are taken and grading.

Institutional structure

Relevant bodies in the system of Serbian higher education including their responsibilities are presented in Figure 2.1.4.2:

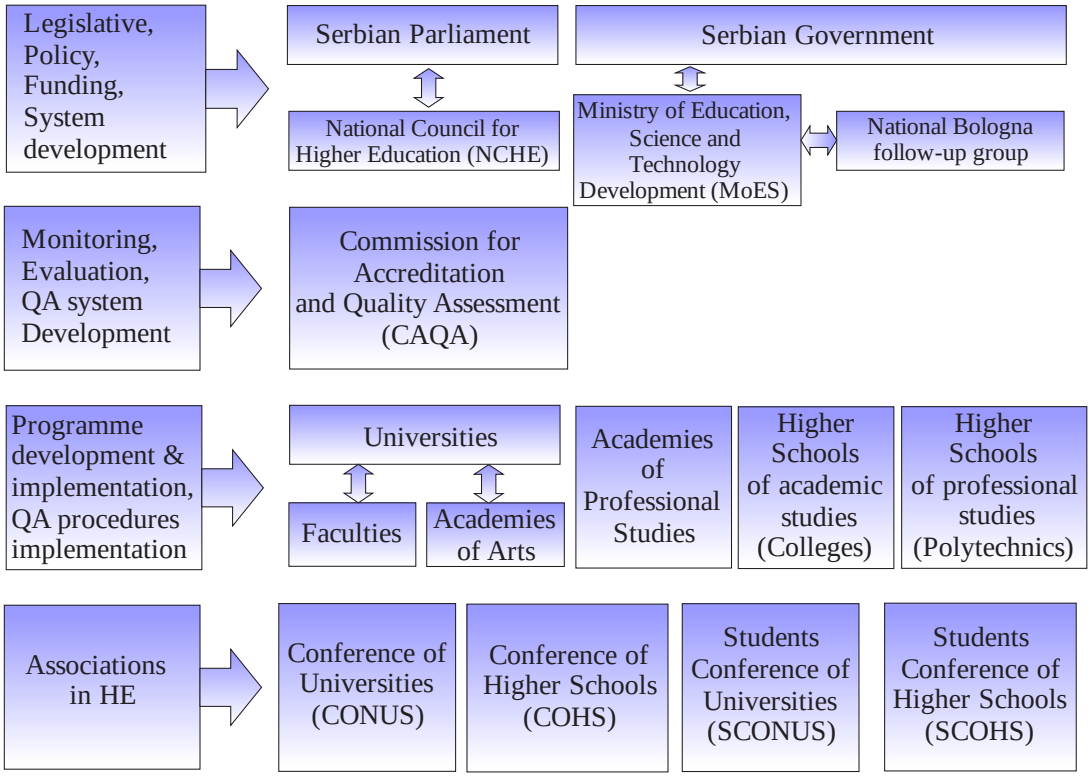

Figure 2.1.4.2. Relevant bodies in the system of Serbian HE

Higher Education Institutions (HEIs)

According to the LoHE, activities in the area of higher education are carried out by both: state and private higher education institutions that are equally treated. The total number of accredited HEIs in the Republic of Serbia is 206.

Universities – are carrying out activities combining educational and scientific-research, professional and/or artistic work. According to the LoHE, a university has to have accredited academic study programmes in at least 3 scientific/artistic fields at all 3 levels. The LoHE gives certain integrative functions to the universities. There are 16 accredited universities in Serbia, of which 8 are founded by state and 8 are private universities. State universities enrol 85% of the student population.

Faculties or Academies of arts within universities - are higher education units within a university carrying out academic study programmes and developing scientific-research, professional and/or artistic work in one or more areas. The Law provides the possibility for individual faculties/academies to act as legal bodies if they have at least 3 accredited study programmes. All faculties and academies of arts are legal entities in our country – they count as HEIs and are subjects of institutional accreditation. The total number of accredited faculties is 118.

Academies of professional studies - are carrying out their activities combining educational, research, professional and artistic work. According to the LoHE, an academy has to have 5 accredited professional study programmes in at least 3 scientific/artistic fields. There are no such HEIs in Serbia, so far.

Higher schools of academic studies (Colleges) - have basic academic, specialist and master degree courses in one or more areas within scientific/artistic fields defined by the LoHE. There are 5 accredited colleges in Serbia.

Higher schools of professional studies (Polytechnics) – offer basic professional and specialist professional courses in one or more areas within scientific/artistic fields defined by the Law. There are 65 accredited polytechnics in Serbia.

National Council for Higher Education (NCHE) is established by the National Assembly to ensure the development and promotion of quality of higher education in Serbia, particularly in creation of strategy and policies concerning higher education and its correspondence with European and international standards (Articles 9-12, LoHE). The Council has 21 members who are elected by the National Assembly of the Republic of Serbia. The NCHE elects members of CAQA on the recommendation of CONUS. The NCHE approves QA standards, rules and regulations defined by CAQA.

Conference of Universities (CONUS) and Conference of higher schools (COHS) – are both established for the purpose of coordinating work, formulation of common policies, realization of shared interests and for carrying out of tasks defined by the LoHE. All rectors of Serbian universities are members of CONUS and all higher school principals are members of CSPS. CONUS recommends the members of CAQA to the NCHE.

Student Conference of Universities (SCONUS) and Student Conference of higher schools (SCOHS) – are established to pursue the common interests of students as partners in the process of developing higher education as defined by the LoHE. SCONUS and SCOHS provide lists of student evaluators taking part in the site visits of HEIs for the purpose of accreditation and external QA.

Ministry of Education, Science and Technology Development (MoES) is responsible for overseeing the development of higher education by recommending higher education policies to the Government, issuing operating licences, administrative supervision of higher education, keeping records on the register of professors. On the basis of the certificate for accreditation of an HEI given by CAQA, the Ministry automatically issues the operating licence and performs administrative supervision. The Ministry does not have the right to change accreditation decisions made by CAQA. The Ministry provides administrative and technical support to the CAQA.

National Assembly (Parliament) elects members of the NCHE and brings the document that defines the system of higher education-LoHE.

The structure of the QA system in Serbia involving all relevant parties is presented in Figure 2.1.4.3.

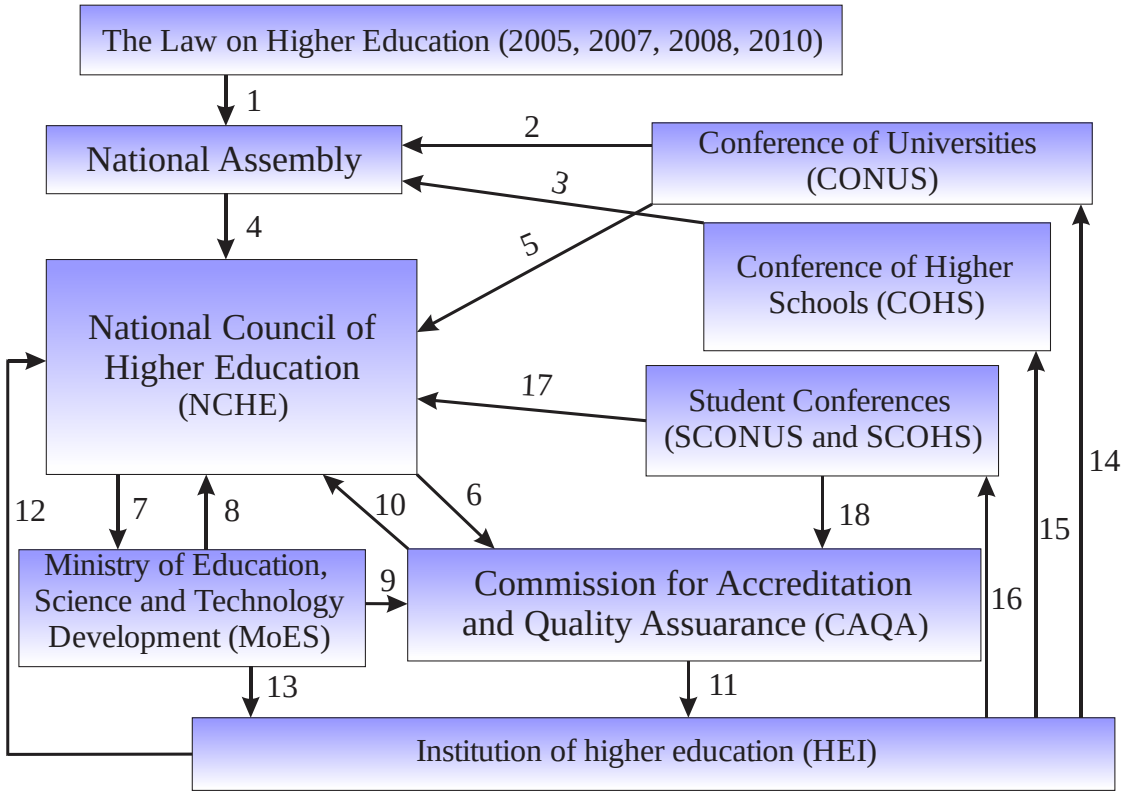

Figure 2.1.4.3. Links between the relevant parties in the QA system in Serbia

1 - passes, 2 and 3 - recommends NCHE members, 4 elects NCHE members, 5 – recommends CAQA members, 6 – elects CAQA members, 7- creates HE policies, 8 and 9 – provides administrative and technical support, 10 – reports, 11 – evaluates (accredits, warns, rejects), 12 – appeals, 13 – gives operating licence, 14 – delegates rector, 15 – delegates director, 16, 17 and 18 – delegates student representative

Accreditation in Higher Education

The Commission for Accreditation and Quality Assurance (CAQA), as it is now, was established by the LoHE (Act of parliament) adopted in 2005 (Official Gazette no 76/2005 and amendments in 2007 and 2010. CAQA members in the first mandate were elected in June 2006, and in the second mandate in March 2011.

The Mission of the Commission for Accreditation and Quality Assurance (CAQA) is to contribute to the maintenance and enhancement of the quality of Serbian HE, to comply with internationally-accepted quality standards, to create a pool of trained reviewers for the process of accreditation and external quality control and to act as the main driving force for the development of quality assurance in the HE of Western Balkan countries by fostering cooperation between agencies in the region.

CAQA became a full member of ENQA (European Association for Quality Assurance in Higher Education) on April 25th, 2013.

CAQA tasks

CAQA, since its establishment, actively participates in a whole variety of tasks aimed at implementing changes and reforms in the field of quality assurance in HE. By LoHE, tasks and competences of the CAQA in relation to its mission are:

1. Carries out the accreditation procedure for HE institutions and study programmes, decides on the application for accreditation and issues a certificate of accreditation
2. Recommends to the National Council
   - standards concerning initial accreditation;
   - standards and procedures for accreditation of higher education institutions;
   - standards and procedures for accreditation of study programmes;
   - standards for internal assessment and quality evaluation of higher education institutions;
   - standards and procedures for external quality assessment of HEIs
3. Assists and cooperates with higher education institutions in assuring and promoting quality assurance
4. Assists stakeholders (students, labour market and government representatives, etc) in understanding the importance of quality assurance and demonstrates their ability to foster changes.
5. Creates a pool of evaluators
6. Endeavours to ensure that accreditation standards and procedures conform to those of the European Higher Education Area;
7. Reports on initial accreditation in the process of licensing of new HEIs by the MoES
8. Cooperates with other national and international QA agencies

To accomplish its mission, CAQA cooperates with the NCHE, MoES and other state bodies and higher education institutions, educational and scientific research institutions, labour market and student organizations. The Commission endeavours to establish an active cooperation with similar institutions and organizations in other European countries aiming to implement fully the Bologna declaration guidelines and to establish the European Higher Education Area (EHEA).

At the beginning of the first mandate in 2006, CAQA developed the documents related to external quality assurance processes: Rules and regulations, standards, guidelines, instructions. During 2006 and 2007 a pool of reviewers was created by conducting training seminars together with briefings of HEIs on how to prepare accreditation documentation. At that time it was necessary to provide a legal basis for the operation of the existing state HEIs, as well as for the growing number of private HEIs by accreditation of both: institutions and their study programmes under the same criteria and procedures. Since then, the first accreditation round has been completed. Now the higher education system in Serbia is in the period between two accreditation rounds and most of the activities are external quality controls of HEIs with the aim to check whether their performances have changed since accreditation, to monitor the development of their quality system and to prepare them for the second accreditation round.

CAQA undertakes 3 types of external quality assurance methods:

- Accreditation of study programmes,
- Accreditation of HEIs and
- External quality control of HEIs.

After adoption of Standards, Rules and Regulation for QA of both HEIs and study programmes in 2006, during 2007 CAQA organised 20 seminars to train around 700 reviewers (10%) of the academic community. Since then, the process of accreditation (first round of accreditation) of all HEIs and their study programmes has been completed in 9 cycles according to the plan adopted by CAQA. At the same time, external evaluation of HEIs started in parallel in 2011.

CAQA has conducted since 2007 a total of 2233 quality assessments, of which 232 were accreditation requests of HEIs; 1947 accreditation requests of study programmes and 54 requests for external quality control of HEIs. Data on the annual number of the requests for the quality assessments in the period 2007-2011 are presented in Figure 2.1.4.4.

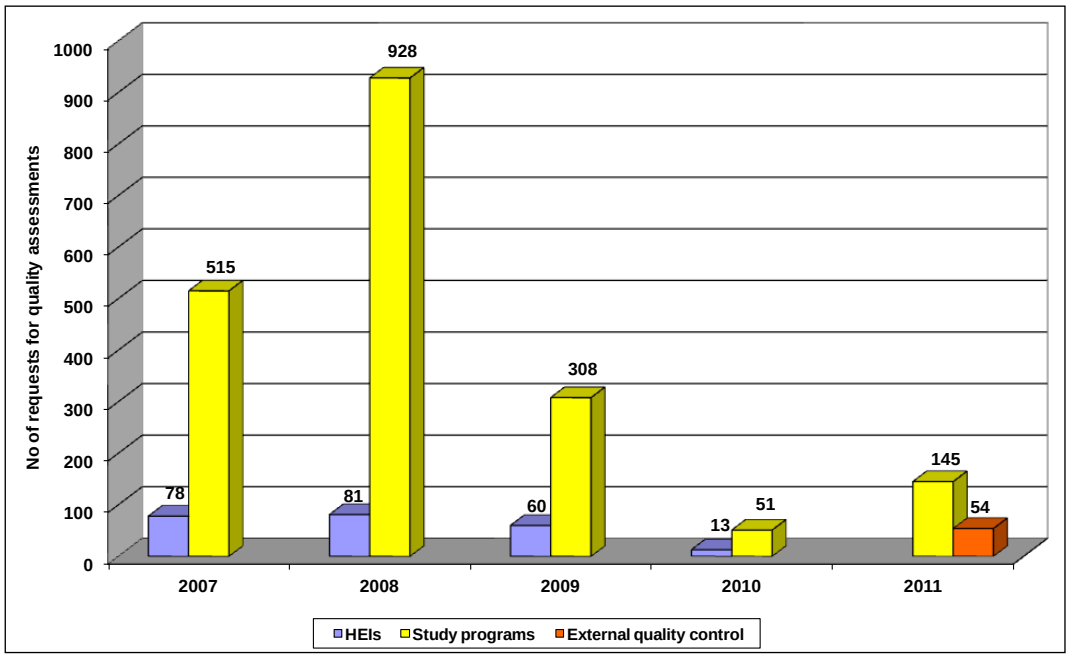

Figure 2.1.4.4. Number of requests for quality assessments in the period 2006-2011

Accreditation of HEIs

- 19 universities applied for accreditation (8 public and 11 private). Until December 2011, 8 public and 8 private universities were accredited and 3 were rejected. Accredited public universities cover 85% of the student population enrolling in the first year and 15% private
- 117 faculties within universities have been accredited (85 public and 32 private)
- 69 higher schools have been accredited (47 public and 22 private)

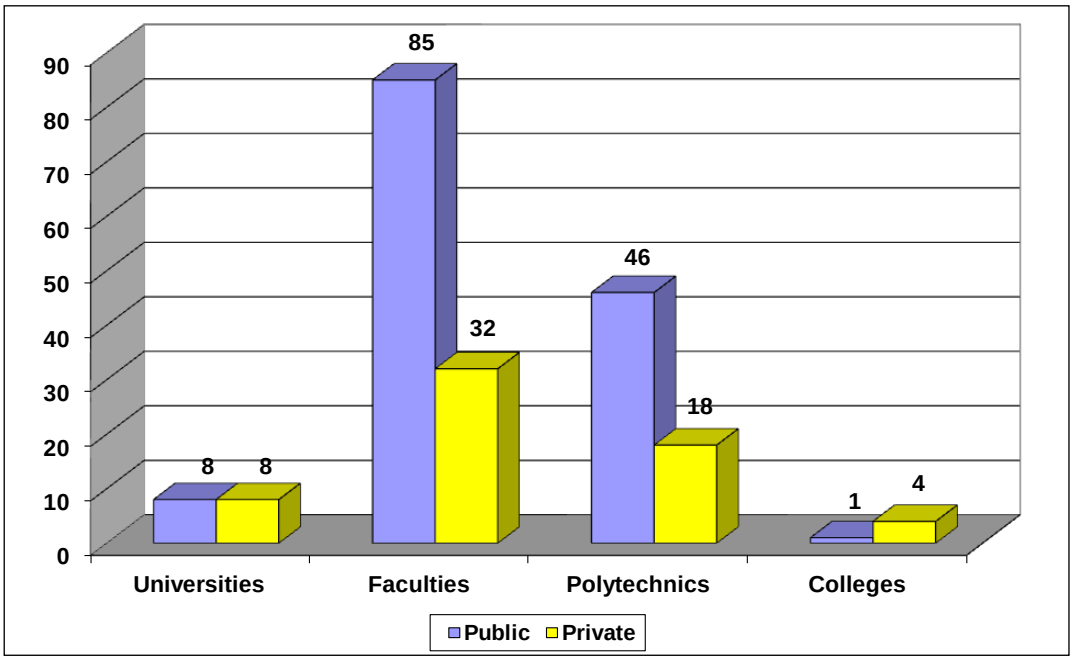

Figure 2.1.4.5. Number of accredited universities, polytechnics and colleges in the Republic of Serbia (2011)

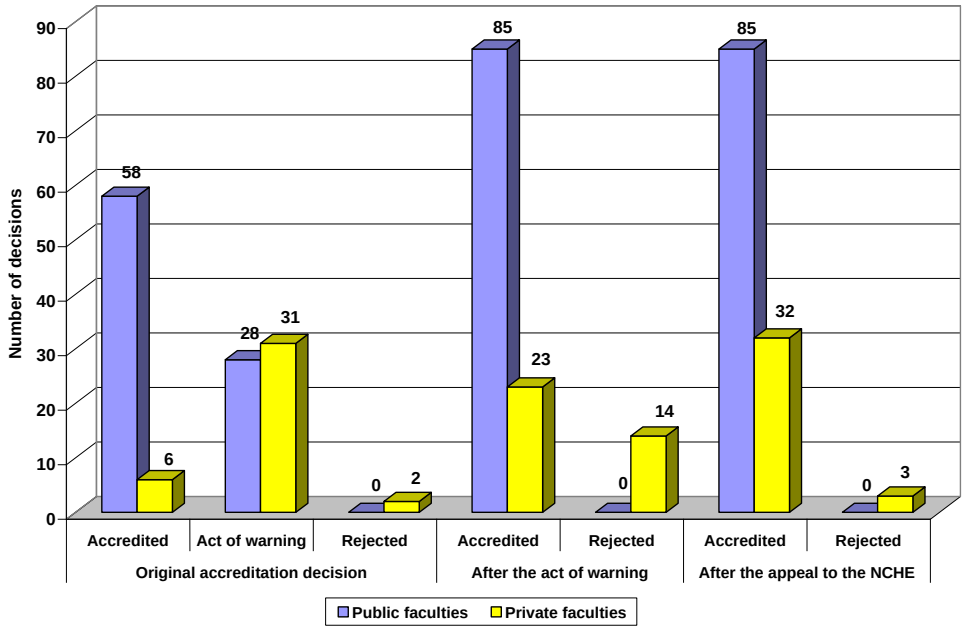

Figure 2.1.4.6. Outcomes of accreditation of faculties in the Republic of Serbia (2011)

Table 2.1.4.1. Number of accredited universities with legal status in the Republic of Serbia (2011)

Public universities	Number of faculties	Private universities*	Number of faculties
University of Belgrade	31	Singidunum University	5
University of Arts in Belgrade	4	Megatrend University	10
University of Novi Sad	14	Privredna Akademija University	4
University of Niš	13	Educons University	1
University of Kragujevac	11	Metropolitan	1
University of Priština	10	Union "Nikola Tesla" University	integrated
University of Defence	2	European University	3
University of Novi Pazar	integrated	Union University	4
Total	85		28

Accreditation of study programmes

Until December 2011, in all accredited universities 1.205 study programmes were accredited for the enrolment of 65,607 students, of which public universities had 1040 study programmes for 55,934 students and private universities had 165 study programmes for 9,673 students.

In accredited higher schools, 348 (299 in public and 49 in private schools) study programmes were accredited for 23,885 (19,976 in public and 3,909 in private schools) students.

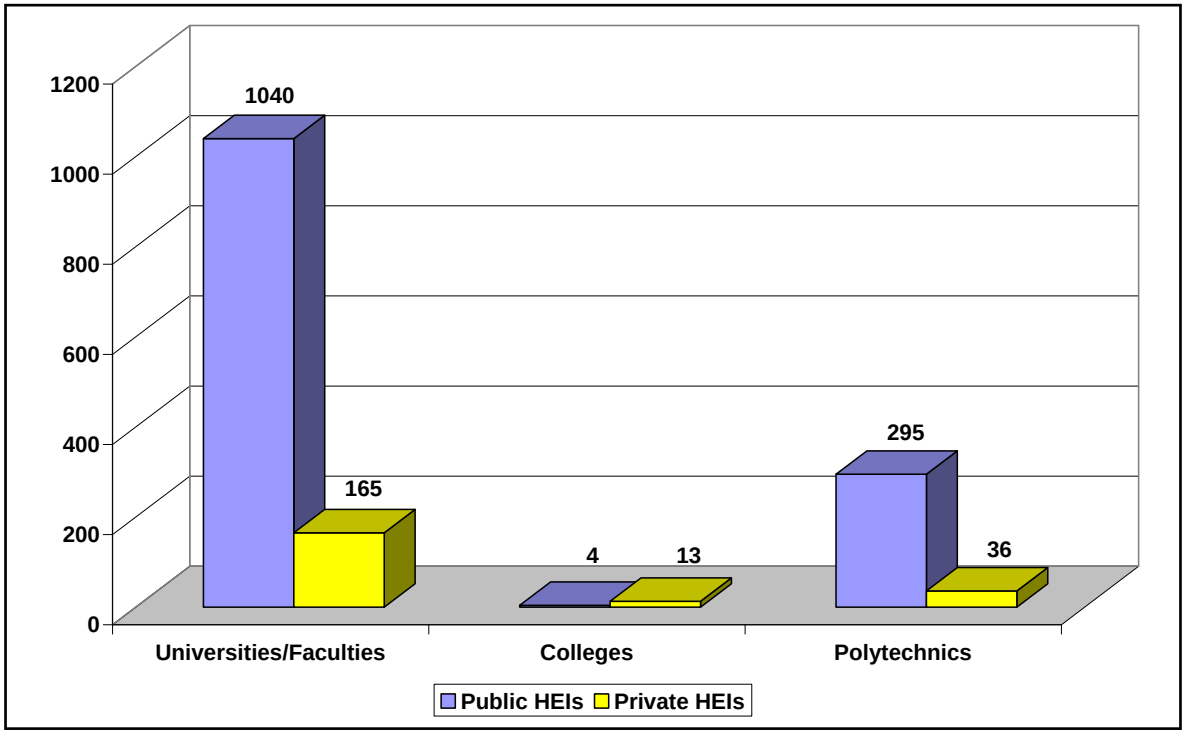

Figure 2.1.4.7. Number of accredited programmes at HEIs in the Republic of Serbia (2011)

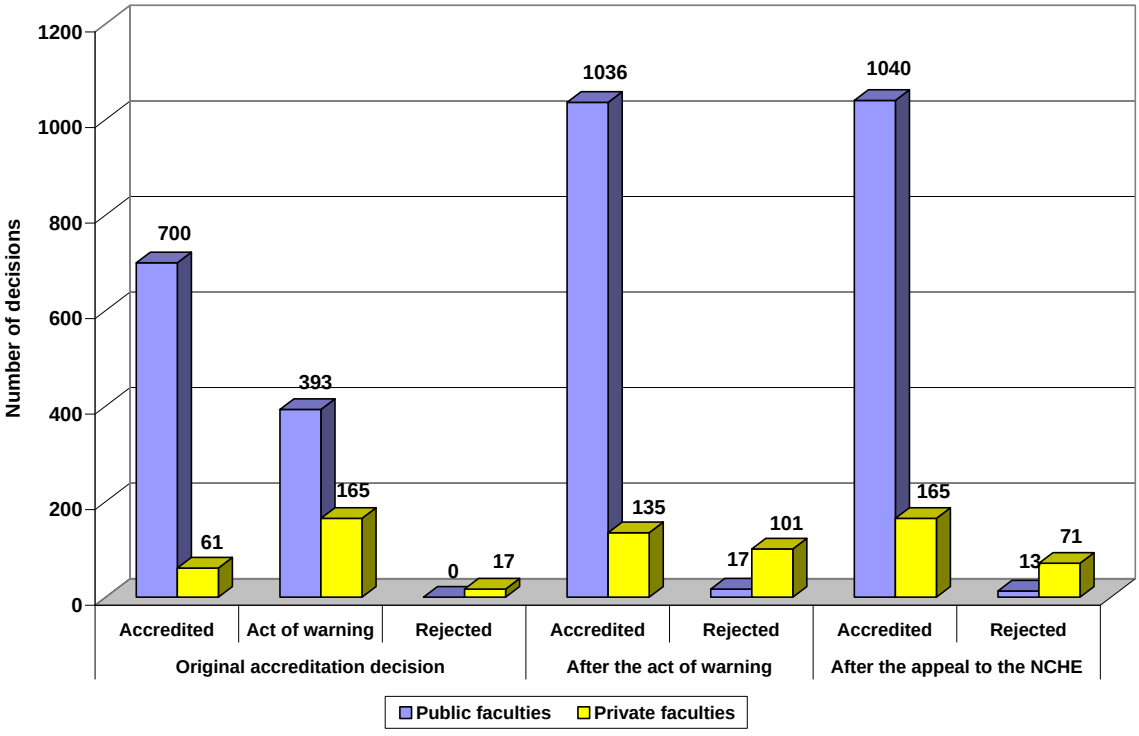

Figure 2.1.4.8. Outcomes of study programme accreditation at public and private faculties in the Republic of Serbia (2011)

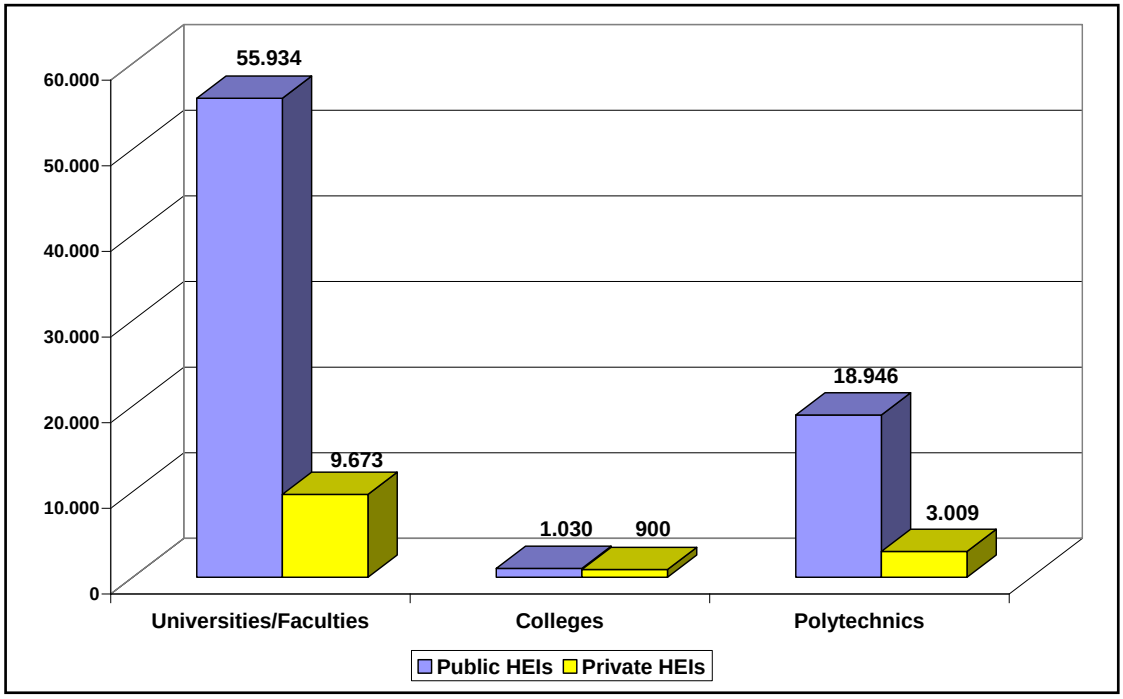

Figure 2.1.4.9. Number of students in accredited HEIs in the Republic of Serbia (2011)

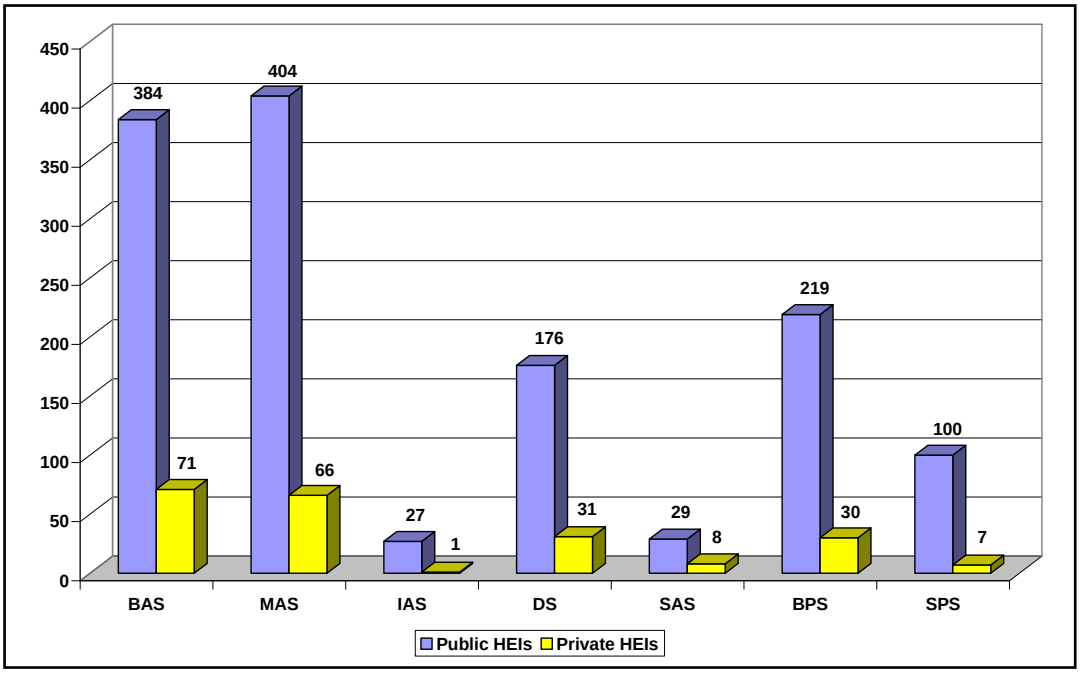

Figure 2.1.4.10. Number of accredited study programmes of different level and HEI type in the Republic of Serbia (2011)

BAS – Basic academic studies, MAS – Master academic studies, IAS – Integrated academic studies, DS – Doctorate studies, SAS – Specialist academic studies, BPS – Basic professional studies, SPS – Specialist professional studies

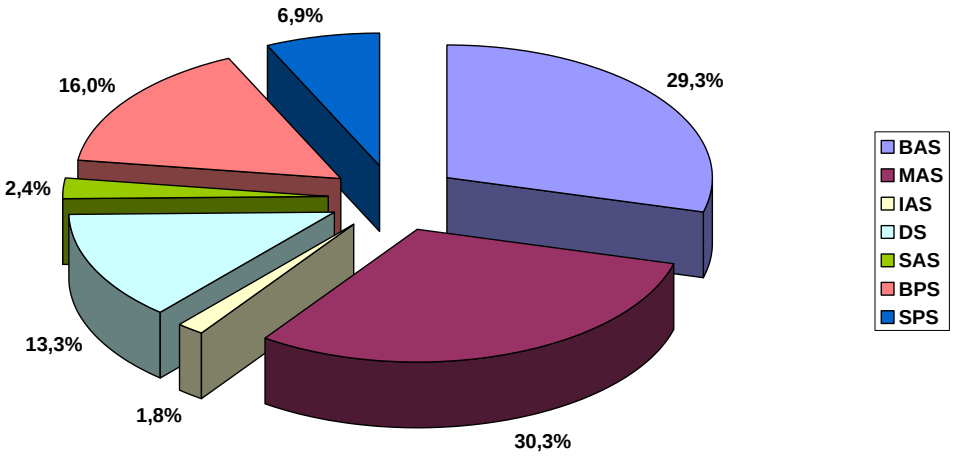

Figure 2.1.4.11. Percentages of accredited study programmes of different levels at all HEIs in the Republic of Serbia (2011)

BAS – Basic academic studies, MAS – Master academic studies, IAS – Integrated academic studies, DS – Doctoral studies, SAS – Specialist academic studies, BPS – Basic professional studies, SPS – Specialist professional studies

The highest percentage of students enrolled in the first year of study were in Basic academic studies (35.5% in public and 8.8% in private HEIs). The percentage of students enrolled in the first year of Master academic studies was 21.4% (19.1% in public and 2.3% in private HEIs).

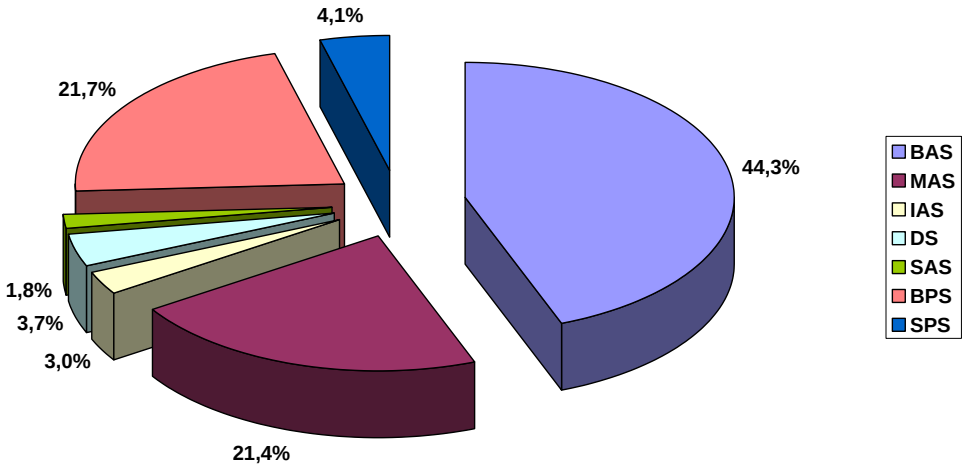

Figure 2.1.4.12. Percentages of students attending particular study programme types at HEIs in the Republic of Serbia (2011)

BAS – Basic academic studies, MAS – Master academic studies, IAS – Integrated academic studies, DS – Doctorate studies, SAS – Specialist academic studies, BPS – Basic professional studies, SPS – Specialist professional studies

The largest number of accredited programmes was in the field of TTS (technical and technological sciences), with 34.6% in public and 2.2% in private HEIs. In the field of HHS (humanities and social sciences), 25.4% programmes were accredited in public as well as 9.1% programmes in private HEIs.

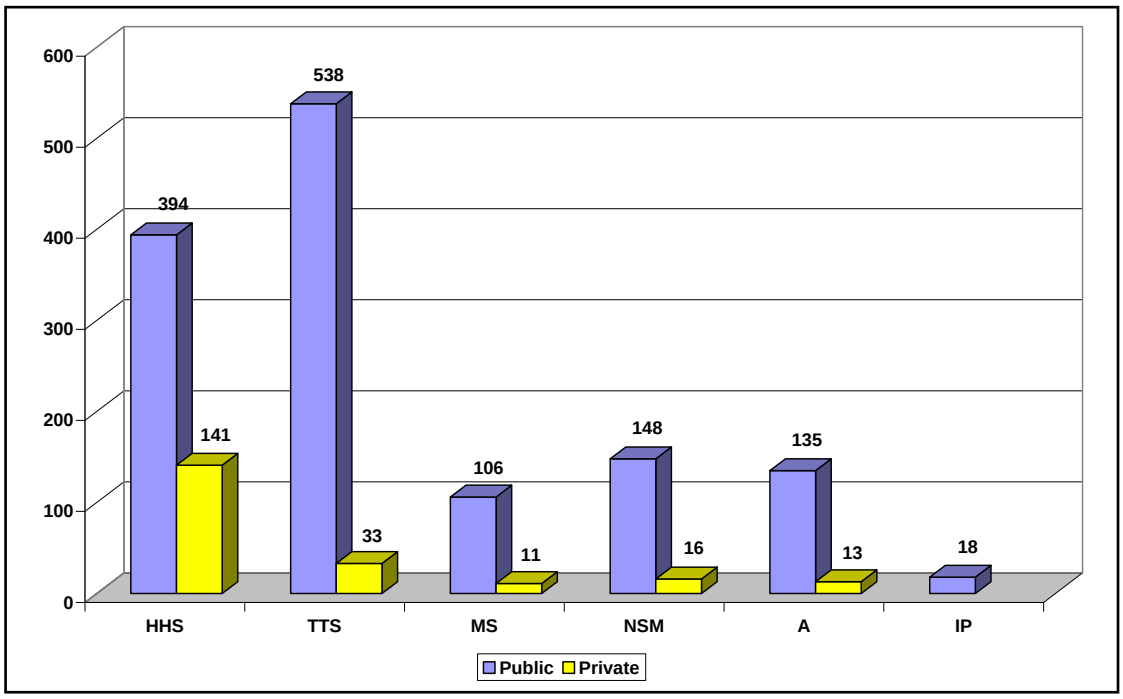

Figure 2.1.4.13. Number of study programmes in different scientific/artistic fields and HEI type in the Republic of Serbia (2011)

HHS – Humanities and Social Sciences, TTS – Technical and Technological Sciences, MS – Medical Sciences, NSM – Natural Sciences and Mathematics, A – Arts, IP – Interdisciplinary Programmes

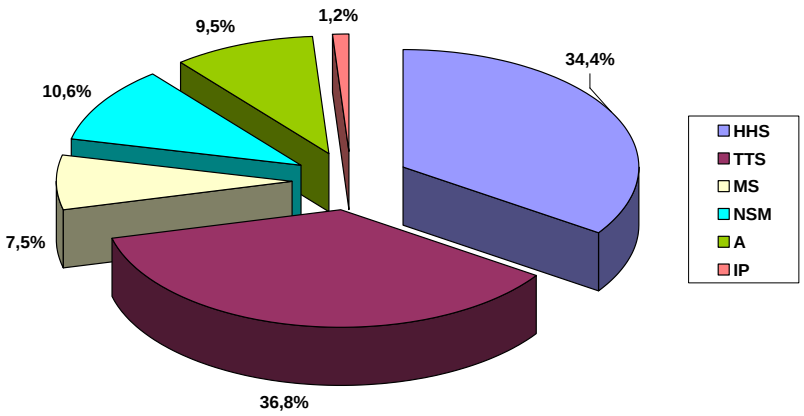

Figure 2.1.4.14. Percentages of study programmes in different scientific/artistic fields in all HEIs in the Republic of Serbia (2011)

HHS – Humanities and Social Sciences, TTS – technical and Technological Sciences, MS – Medical Sciences, NSM – Natural Sciences and Mathematics, A – Arts, IP – Interdisciplinary Programmes

Data for figures from Figure 2.1.4.1.toFigure 2.1.4.14.are taken from CAQA Self-evaluation report.[30]

In order to analyze the real number of students according to the type of studies, data from Statistical yearbook[31] for 2010/11are used.

Side by side with the rise of the number of higher education institution there increased the number of students. The total rise of the number of students in the ten year period is somewhat over 30000. The largest number of students' studies at academic studies, and in 2010/11, a bit over 9600 students who studied according to the old programs still did not finish their studies.

Realization of doctoral studies began in 2007/8 at a limited number of faculties when only a few tens of students were enrolled. Only after three years the number of students at these studies was over 5200, which deserves a special attention Based on these data, it can be expected that in the next period the interest for doctoral studies grows, but what is needed is that in parallel with the development of these studies there should follow an extensive social action on the part of universities and economy and public sector, directed at opening new job positions at which doctors of philosophy can be employed as well as a severe control of doctoral studies. Of the total number of students, 83% studies at state higher education institutions. Figure 2.1.4.15 shows the distribution of students who study at state and private higher education institutions. The above given data clearly state that the newly formed higher education institutions are numerous with yet not such a large number of students which is a

[30]Self–evaluation report of The Commission for Accreditation and Quality Assurance (CAQA), 2012, http://www.kapk.org/index.php?option=com_content&task=view&id=51&Itemid=59
[31] Statistical Office of the Republic of Serbia, http://webrzs.stat.gov.rs/WebSite/public/ReportView.aspx

consequence of the unfavourable economic situation in the country, still not enough developed study programs in all fields offered by private universities and to a large extent the limited teaching stuff resources in those higher education institutions. The largest number of private higher education institutions has developed study programs in the field of humanities, social sciences and arts, and a very small number of students in other fields. The largest number of students study social sciences, up to 38%, while natural sciences and technology is studied by 34% of students. Surprisingly big is the percentage of students who study different kinds of arts, and a very low percentage of students who study agricultural and veterinary sciences, only 3%. This distribution of the number of students in relation to the fields is the consequence on one side of the capacity and the high autonomy of higher education institutions and on the other the way of financing and the unregulated development of higher education in the previous ten years. The distribution of students according to the area of studies completely follows the number of students that complete studies. In 2010/11 the total of 45000 students completed their studies.

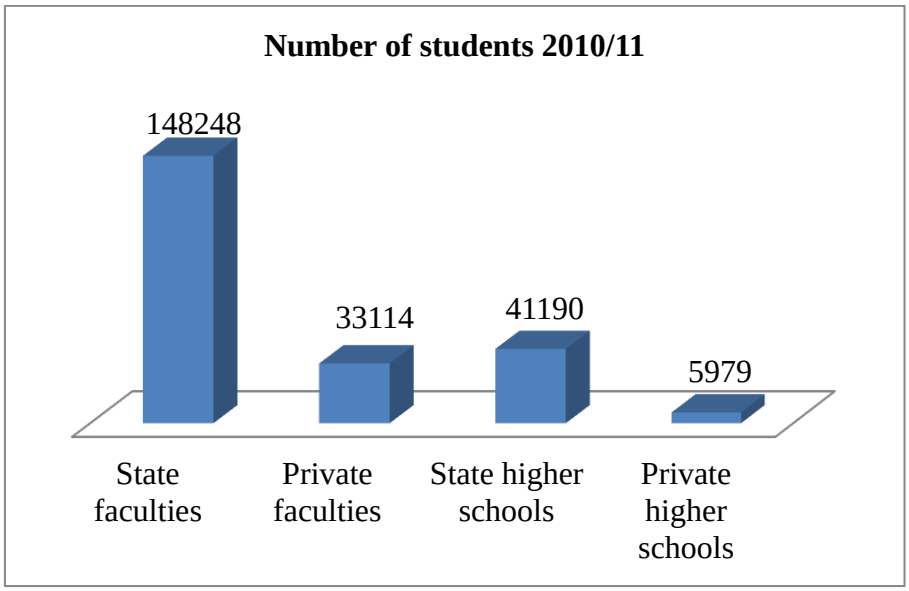

Figure 2.1.4.15. Comparative overview of the number of students at state and private higher education institutions who studies in 2010/11 school year

Table 2.1.4.2. Students ofthe Republic of Serbia according to the types and levels of studies, school year 2010/11

Type of studies	Number of students
First stage studies	**184237**
Basic academic studies	135477
Basic vocational studies	48760
Second stage studies	**29471**
Master and integrated studies	26996
Specialist vocational studies	1744
Specialist academic studies	731
Third stage studies	**14823**
Doctorate academic studies	5206
Former Ph.D programme	9617
Total	**228531**

Table 2.1.4.3. Graduated students according to the types of financing, 2010

Type of financing	Number of graduated students
State faculties	28476
Private faculties	8179
State higher schools	8518
Private higher schools	989
Total	**46162**

Table 2.1.4.4. Graduated students of the Republic of Serbia by type and level of studies, 2010

Type and level of studies	Number of students
First stage studies	**15243**
Basic academic studies	5535
Basic vocational studies	9708
Second stage studies	**24415**
Master and integrated studies	23566
Specialist vocational studies	349
Specialist academic studies	500
Third stage studies	**6504**
Doctorate academic studies	596
Former Ph.D programme	5908
Total	**46162**

Table 2.1.4.5. Graduated students by fields of education, 2010

Field of education	Number of students
Education	4020
Arts	5341
Social sciences, business and law	15811
Natural sciences, mathematics and computing	4265
Engineering, manufacturing and construction	7306
Agriculture and veterinary	1231
Health and welfare	4210
Services	3960
Total	**46162**

Currently, at the labour market there are 58440 unemployed with higher education, 55 of them are doctors of science and 804 are masters of science.

This fact is telling of the need to coordinate the enrolment policy with the needs of the labour market and the directions of the country development.

According to the data noted by the Statistical Office, the number of professors and assistants in the previous ten year period is significantly larger, which supports the fact that in this period there was an important improvement in the number of students per one professor. In 2000 that ratio was 42, and in 2010 it fell to 27, but was still much higher than the European average where the ratio is on average 12 students per a professor. According to the data presented by CAQA out of the total of professors employed full time, 73% work at state universities. The distribution of the number of professors according to the type of higher education institution in the state and private higher education institutions is not known as there is no register of teaching stuff and no register of study programs which are to be compiled according to the Law on higher education.

In the next period, especially in the process of reaccreditation, it is necessary to enhance competencies but also the number of professors in higher education institutions. That especially relates to professors in academies of professional studies where currently there are even 50% of lecturers who do not hold a PhD degree. The lecturers of professional studies do not have a reappointment which is necessary to be introduced.

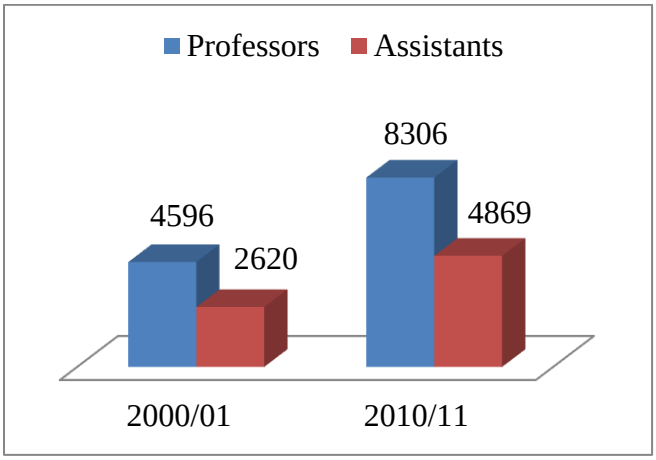

Figure 2.1.4.15. Comparative overview of the number of professors and assistants full time employed

Table 2.1.4.6. Teaching staff in tertiary education institutions, 2010/11 school year

Teaching staff	Number of people
With full working hours	13175
Doctors of Arts (Sciences)	8087
Full-time	7090
Masters of Arts (Sciences) and Specialists	3873
Without scientific title	2895
Total	14855

Another fact needs also to be pointed out, namely, in comparison to European Union countries the age structure of professors in our country is unfavorable as even 57% of professors are over 50 years of age while in Europe 37% of professors are over 50 years of age. The largest number of professors holds the highest scientific title, while the number of assistant professors does not grow in speed that would allow for a smooth development of higher education.

The aforementioned data clearly illustrate that, apart from increasing the number of professors, it is necessary to pay special attention to the appointment of assistant professors at universities and professors of professional studies by giving advantage to younger candidates. The amendments to the Law on higher education are not to prolong the engagement of professors who have completed the first condition for retirement (65 years of age).

2.1.5. Research

Serbia has achieved good progress in recent years in the area of R&D. Even with the significant progress in the development and modernization of the R&D and innovation system, several challenges remain:

- brain drain,
- low budgetary allocation for science,
- investment in science,
- effectiveness of research and innovation activities,
- weak cooperation between the public research sector and the business sector.

The objective of research and development policies is to increase the quality and quantity of R&D, create conditions for R&D cooperation and create efficient public research infrastructure. The Strategy of Scientific and Technological Development of the Republic of Serbia for the period 2010-2015 was adopted by the Government in February, 2010 (*Official Gazette of RS*, No.13/10). The Changes and Amendments to the Law on Scientific Research Activities were adopted by the Parliament in 2010 (*Official Gazette of RS*, No. 18/10, the Law on R&D).

The two key elements of the Strategy are: **focus and partnership**. Focus signifies the definition of national priorities within the science and technology domain, and partnership reinforcement achieves a critical mass in these domains, a greater presence on the international science scene and a stronger connection with the economy and technological development.

The seven national priorities within the science and technology domain defined by the Strategy are:

1. biomedicine,
2. new materials and nanosciences,
3. environmental protection and countering climate changes,
4. energy and energy efficiency,
5. agriculture and food,
6. information and communication technologies and
7. improvement of the decision-making process and affirmation of national identity.

The Strategy proposes a timetable of increasing investments in science and technology by 0.2% GDP per year, which would mean that, in 2015, Serbia would surpass 1% of GDP investments in science. In addition to the budget investments, a 400 million Euro investment into science and technology infrastructure is planned during the realization of the Strategy and in cooperation with international financial institutions.

An Action Plan of the implementation of the Strategy has been prepared by the Ministry and approved by the National Council for Science and Technological Development. The Action Plan should be approved by the Government in the near future. The implementation of the

Strategy is supervised by the Ministry of Education, Science and Technological Development in cooperation with other ministries, the National Council for Science and Technological Development, the National Council for Higher Education, the Serbian Academy of Sciences and Arts and other advisory domestic and international authorities and experts.

The sixteen programmes of general interest for the Republic of Serbia are defined in the Law on R&D activities: **Basic Research Program; Program of research and technological development; Program of co-financing of integral and interdisciplinary research;** Program of the transfer of knowledge and technologies and the implementation of scientific research results; Program of scientific and research work of the Serbian Academy of Sciences and Arts, Program of scientific and research work of the Matica Srpska; Program of scientific and research work of centres of excellence; Program of provision and maintenance of science and research equipment and science and research facilities; Program of international scientific cooperation important for the Republic; Program of information society development; Program of further education of scientific and research work experts; Program of scholarships and encouragement of young talents for scientific research work; Program of providing scientific and professional literature from abroad and access to electronic scientific and professional data bases; Program of publishing scientific publications and the organization of scientific meetings; Program of encouraging activities of scientific and professional groups, associations and other organizations as a function of improving scientific research, promotions and popularization of science and engineering and the protection of science and technology heritage; Program of project co-financing of doctoral studies; Program of co-financing the construction of apartments for young researchers and scientists in Serbia.

The funding system is based mainly on budget funds. The selection, evaluation and financing of the following programs: the Program of basic research (BR), Program of research in the area of technological development (TD), Program of integral and interdisciplinary research (IIR) and Program of provision and maintenance of scientific research equipment, are defined by law ("The Act of selection, evaluation and financing" adopted in 2010). The other programs are also financed from the budget, which is annually adopted. The funding of many programs is defined by specific by-laws (adopted by the Ministry, published on their website).

The quality of scientific research results and the quantification of individual scientific research results, the minimum levels for promotion are defined in the Rulebook of Procedures and Methods of the Evaluation and Quantitative Expression of Scientific Research of Researchers. The main scientific production indicators are the number of published articles, the quality of scientific work measured by impact factor, and citations. The relevant data bases for scientific production monitoring are the ISI Web of Science, Scopus, Pub Med, Medline, Science Citation Index. Patenting activities are also included in technical sciences.

R&D: SITUATION ANALYSIS

Research Cycle Program 2011-2014

The scientific research system of the Republic of Serbia is composed of the following institutions:

1. Accredited scientific research organizations: institutes, faculties, integrated universities, centers of excellence and
2. Innovation centers
3. Serbian Academy of Sciences and Arts - SANU and Matica Srpska.

The vast majority of R&D activities in the country are carried out by the public sector, mainly through state universities and other public research institutions. The quality of Serbian research institutions is also highlighted in the Global Competitiveness Index (World Economic Forum, 2012). Indeed, the 'quality of scientific research institutions' is the dimension in which Serbia performs best under the Innovation Pillar, ranking 58th out of 142 countries. The number of institutions active in the **Research Cycle Program 2011-2014 are** presented in Table 2.1.5.1.

Table 2.1.5.1. The number of institutions active in the Research Cycle Program 2011-2014

Research institutions	Number of institutions	
	State	Private
Institutes	56	3
Integrated universities	1	2
Faculties	83	4
Centers of excellence	5	
Innovation centers	4	
Total	158	

Pure basic research, beyond bringing new knowledge into existence, contributes to the creation of the most up-to-date methodology and the international portability of Serbian science; while targeted basic research additionally contributes to technological innovation, sustainability and societal adaptation.

The Ministry of Education, Science and Technological Development is implementing the following programs to boost research careers and support researchers financially:

- Program supporting basic research for the research cycle 2011-14 (BR program);
- Program supporting research in the field of technological development for the research cycle 2011-14 (TD program);
- Program of co-funding integrated and interdisciplinary research for the research cycle 2011-14 (IIR program) to support the integration of basic, applied and development research as well as to fully utilize R&D resources, emphasizing the commercialization of R&D activities and results.

Basic research and technological development programs cover all research fields from a pure and applied research standpoint, whereas the integral and interdisciplinary research program targets large-scale research projects, which draw together several research institutions and industry representatives in priority research areas.

The programs selected by the aforementioned Act are financed on a project basis, including the financing of the scientific and research work of the researchers and the financing of direct material expenses of research. The programs are financed from the budget, which is annually adopted and planned for 4 years. The distribution of financed projects in the BR program, TD program and IIR program of the **Research Cycle 2011-2014** is presented in figures from Figure 2.1.5.1. to Figure 2.1.5.4. The budget funds granted for the projects are monitored through the annual/semi-annual financial statements, and subsequently a decision on the continuation or termination of financing is made.

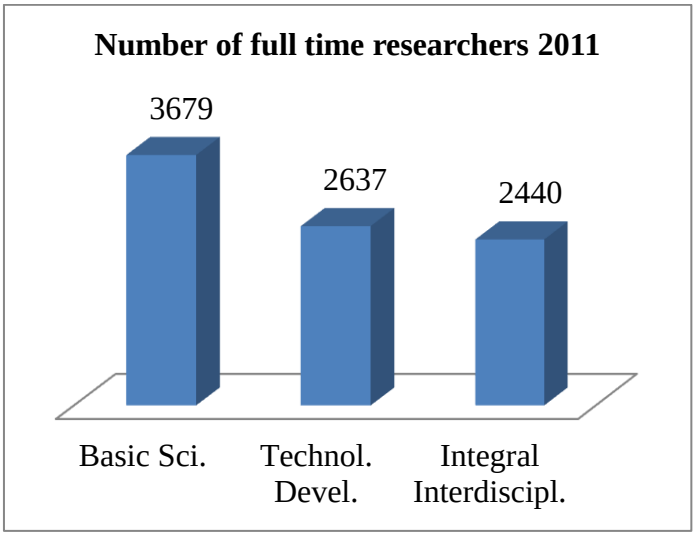

Figure 2.1.5.1. Number of full time researchers 2011

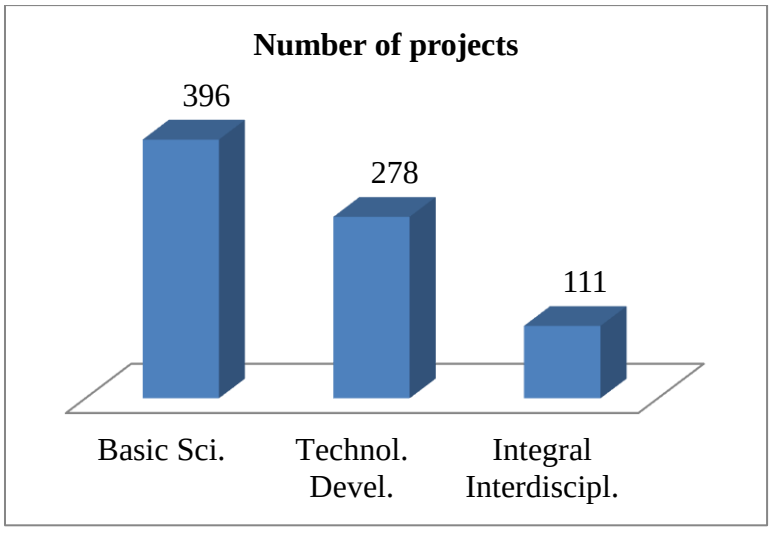

Figure 2.1.5.2. Number of projects

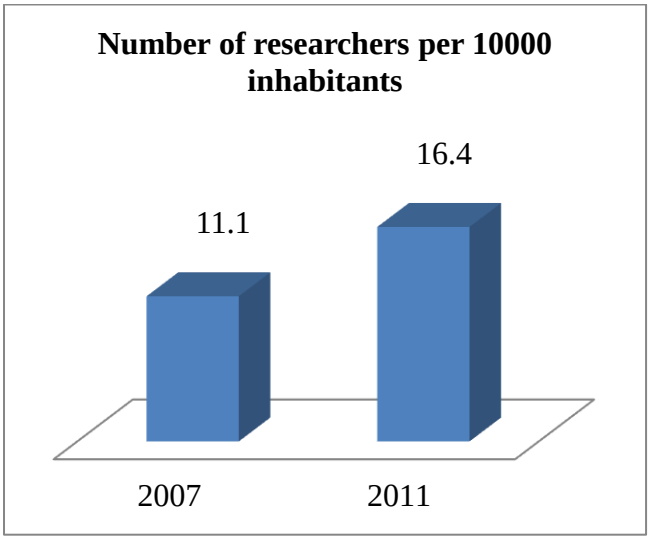

Figure 2.1.5.3. Number of researchers per 10000 inhabitants

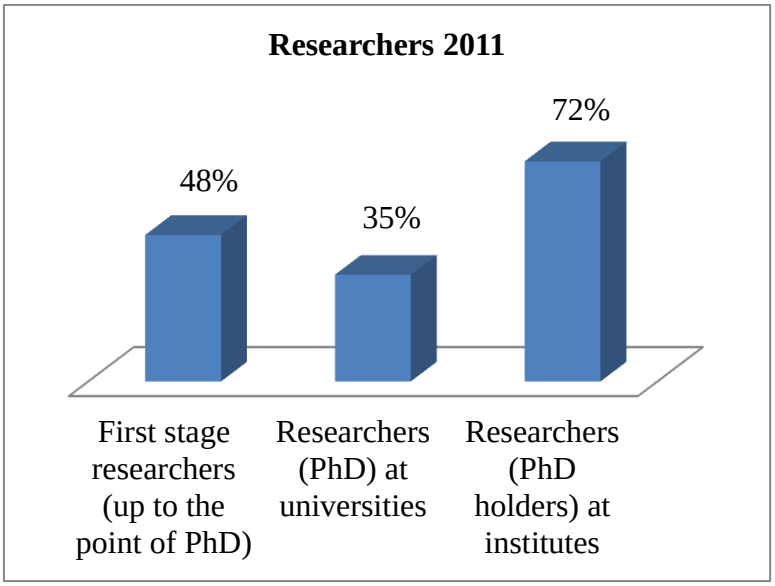

Figure 2.1.5.4. Researchers 2011

Research & development –primarily basic research – has major importance in the training of a highly qualified, creative workforce and the development of a readiness to work together. Between 2007 and 2011, the number of researchers increased from 8800 to over 11700. The number of researchers (Full Time Equivalent, FTE) in relation to the active labour force in 2012 (The total number of employed persons is 2,201,760) is 4.2, compared to 6.63 in the EU-27 (2009). The number of people employed in research & development – dependent on financial opportunities – has increased by 32% by 2011, in comparison to 2007.The number of researchers in the business sector is negligible. The majority of researchers in Serbia are trained in a traditional academic setting and are not adequately prepared for the market, to manage their intellectual property, to seek employment or set up their own company. The Strategy of Education 2020 was adopted with the goal of training enough researchers to meet national R&D targets and improve the quality of doctoral training. Universities must ensure

that future graduates are fully equipped with the skills necessary to meet modern knowledge economy challenges.

The first step in increasing the number of researchers is to ensure that enough young people study science. The distribution of PhD students among different disciplines in the academic year 2011 is presented in Figure 2.1.5.5 and Figure 2.1.5.6. The total number of PhD students studying at Serbian universities (state and private) in 2011/12 was 5026. In order to secure an adequate science base, the Serbian government and institutions have put in place measures to attract young people to PhD studies. Over 3900 PhD students were granted or engaged as young researchers in the Research Cycle Programs 2011-2014. If graduates are to go on to take doctorates, then Serbian educational institutions need to offer high-quality doctoral training. However, the picture is varied across universities and disciplines and additional efforts are needed to improve the quality of PhD studies. Enhancing the quality of doctoral training serves as a precondition for excellence and innovation. The number of new doctoral graduates increased from 330 in 2001 to around 60 in 2010.

During the first two years of the Research Cycle Programs 2011-2014, 1056 PhD students have graduated, among them 45% in basic and technical sciences.

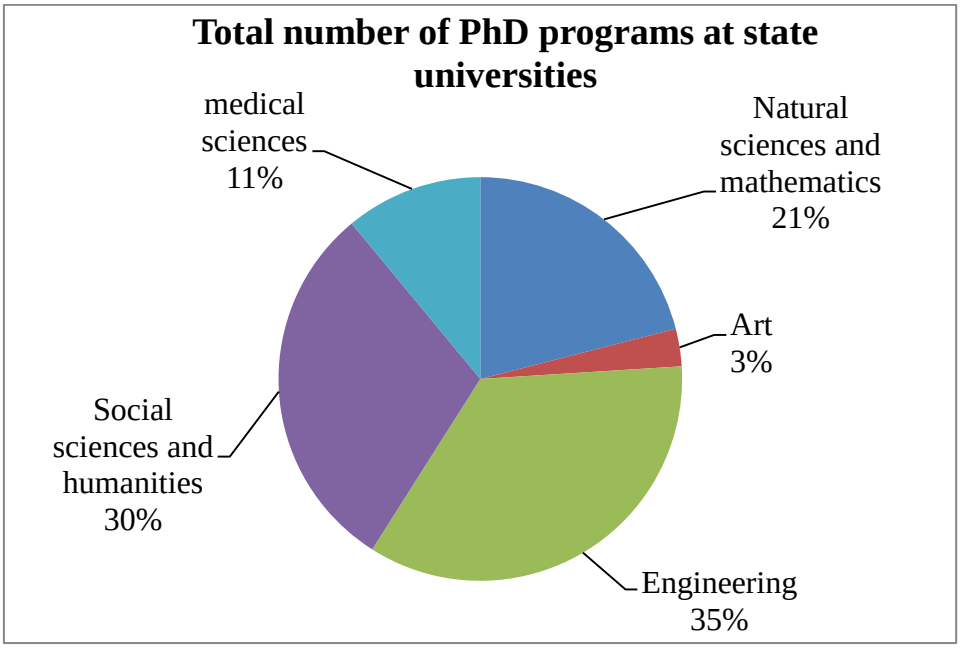

Figure 2.1.5.5. Total number of PhD programs at state universities

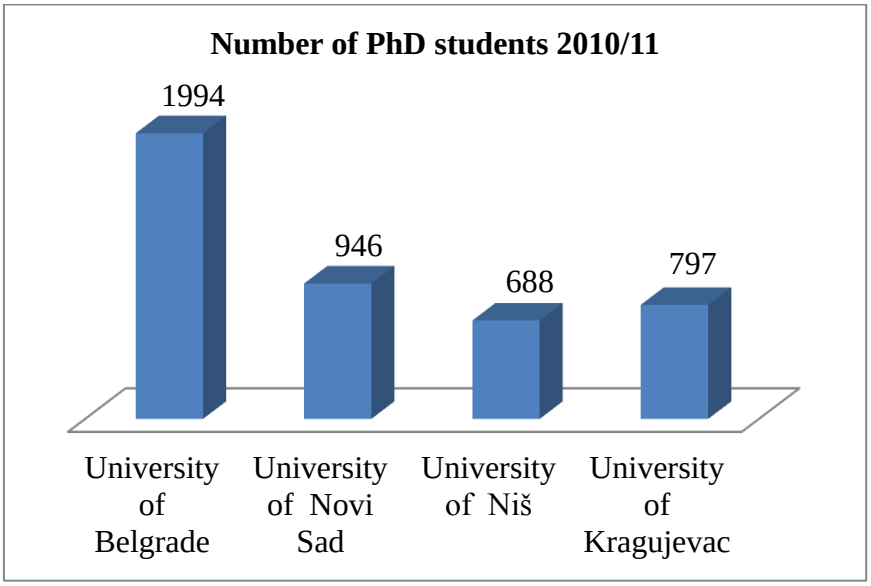

Figure 2.1.5.6. Number of PhD students 2010/11

The quality of Serbian public research is relatively high. The researchers are very productive in terms of number of scientific publications. In 2012 Serbian researchers published 5356 articles in international journals or 726 publication per million inhabitants, which is comparable with EU countries.

The number of articles (*Web of Science- Articles: SCI, SSCI, AHCI)* in different research disciplines is compared in Figure 2.1.5.7.

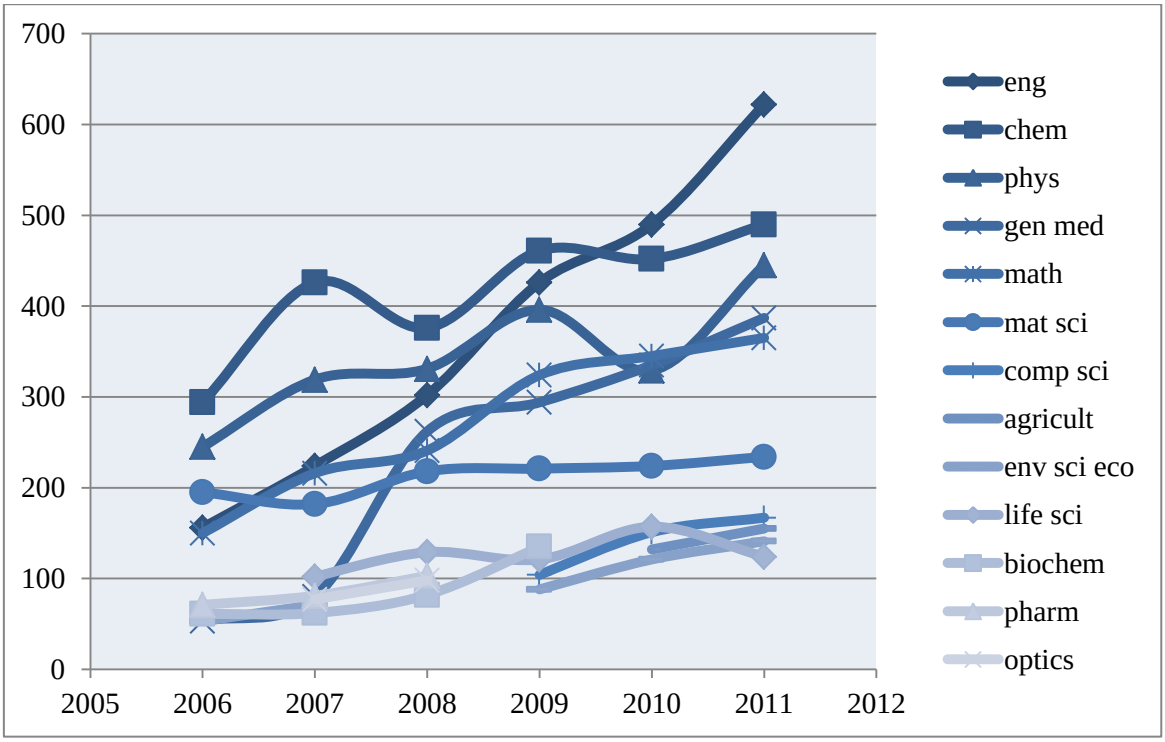

Figure 2.1.5.7. The number of articles in various research disciplines

According to assessments from 2011, the quantity of research in Serbia is relatively good. Serbia ranked 48th on the **SCImago Journal & Country Rank** among 140 countries. The achievements by Serbian science in many areas are encouraging and are an appropriate starting point for further development.

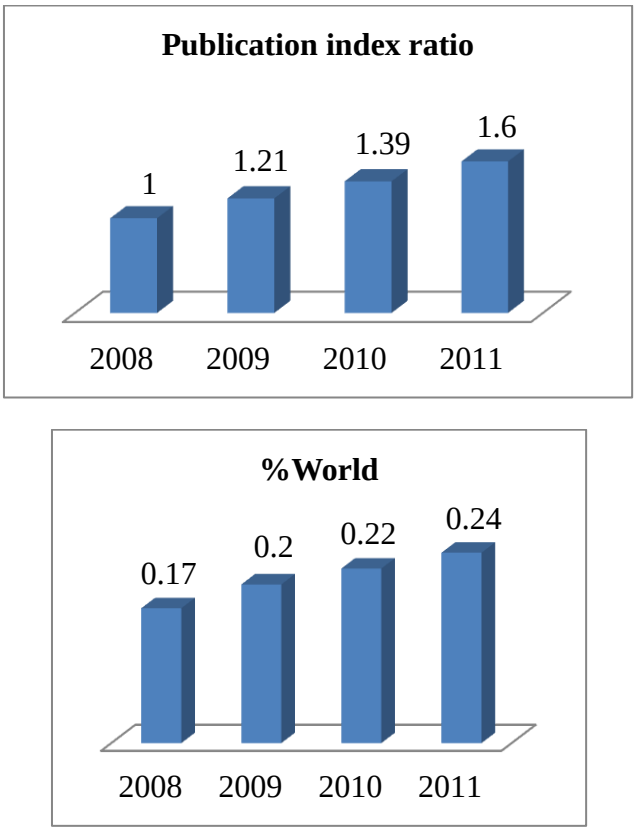

Figure 2.1.5.8. SCImago Journal & Country Rank Serbia 2011, a) increase in the number of scientific publications, b) percent of scientific publications from Serbia in the total number of global scientific publications.

International cooperation

The number of scientific co-publications provides insight into cooperation between researchers from different countries. The number of scientific publications in 2012 produced in collaboration with at least one author from another country outside of Serbia is shown in Figure 2.1.5.9. More than 200 scientific publications are a result of intensive collaborations with colleagues in the CERN programs ATLAS and CMS.

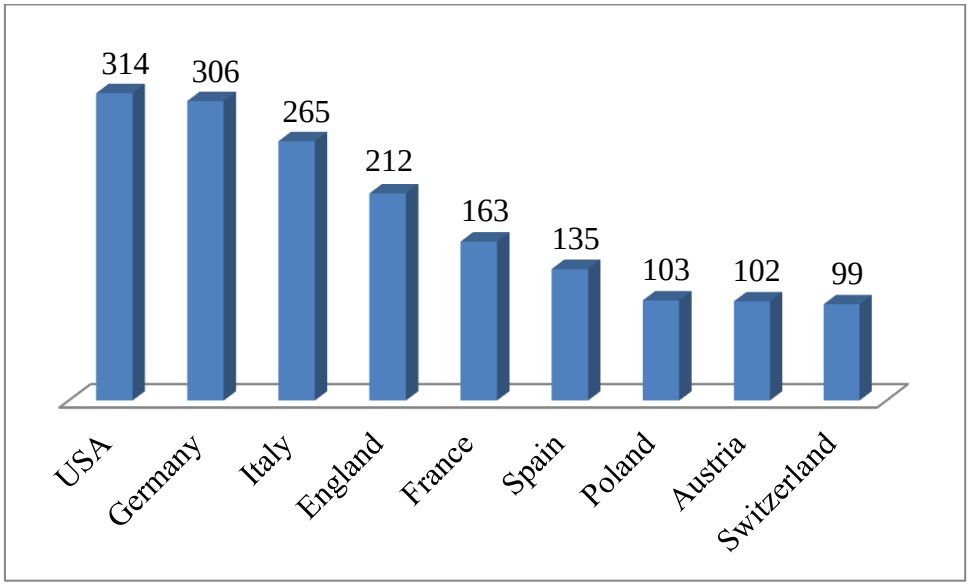

Figure 2.1.5.9. The number of scientific publications realized through international cooperation in 2012

Serbian researchers foster links with their international colleagues. In 2011 more than 5 % of publications were the result of international cooperation. Serbia is also relatively successful in drawing on the EU Framework Program funds. According to statistics from December, 2012, presented at a meeting of the Steering Platform for the Western Balkan countries, Serbian researchers participate in 187 projects of the Seventh Framework Program. They achieved a success rate of 13.32%, which is lower than the EU average, but are among the leaders in the region.

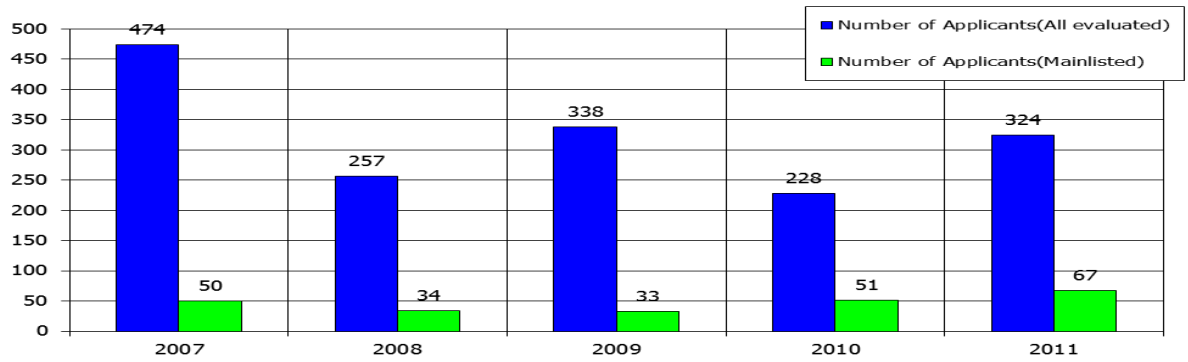

Figure 2.1.5.10. Number of applicants from Serbian for EU program funds

The "Training Workshop on Smart Specialization for South East European countries" was organized within the WBCINCO.NET project in early April, 2013 as the basis and beginning of the preparation of a Country position paper as an important document for drafting the Smart specialization strategy.

One of the results of the FP7 project EVAL-INNO is publication of the brochure *RTDI Evaluation Standards.*

Socialistic Federative Republic of Yugoslavia was one of the founders of the COST programme in 1971. Republic of Serbia joined the programme officially in 2001. At the moment, Serbia participates in over 140 COST actions of the 9 Domain plus Trans Domain, which cover a variety of professional and scientific fields. Estimates based on the number of participants in the working groups of COST in individual stocks, currently features more than 400 experienced and young researchers.

Serbia entered the Eureka program in 2002. Within the framework of the Eureka in 2013, the implementation of project activities in 16 Eureka projects is being continued, of which 14 were financed from the budget of the Republic of Serbia, on the basis of contractual obligations. So far Serbian researchers have participated in 77 Eureka projects involving 152 organizations.

The Republic of Serbia runs bilateral cooperation programs with a number of countries (Belarus, China, Croatia, France, Germany, Hungary, Slovakia, Slovenia, Switzerland, Spain, Portugal, Greece, Italy, Austria and Montenegro). This has resulted in the co-financing of R&D projects (143 projects in 2012) carried out by teams consisting of researchers from both countries. To improve R&D collaboration, bilateral cooperation has been established among all of the Western Balkan countries.

NATO Science for Peace and Security – Established in 2006 with the purpose of contributing to security, stability and solidarity among nations, by applying state of the art technical expertise, as well as with the purpose of enhancing cooperation in all the partnerships based on innovations and civil science. On July 27, 2007 the Republic of Serbia signed a Presentation document concerning the participation of the RS in the Partnership for Peace Programme committing itself to cooperation frameworks with NATO in the field of science and technology. Serbian researchers joined the programme late in 2007 and the results achieved so far have been reflected in the implementation of eight projects.

Cooperation programme with the International Atomic Energy Agency (IAEA) - Cooperation between the Republic of Serbia and the IAEA over the past several years developed primarily through technical assistance programmes involving equipment, expert knowledge and training courses, as well as through regional and interregional activities. Technical cooperation was mainly focused on programmes for decommissioning a research nuclear reactor and radioactive waste management, however it also involved nuclear and radiation security, radiation medicine and health, and nuclear and radio-chemical application of isotopes in hydrology, agriculture and industry.

Cooperation with UNESCO – is based on UNESCO’s support for organizing major international conferences on topics of global interest for the international community, support for maintaining regional cooperation networks between research teams that work in a specific area of basic research and expertise in science policy issues and the creation of strategic documents.

In addition to the cooperation programmes, Serbia has actively participated in European and international scientific organisations such as CERN (European Nuclear Research Centre) where our physicists and engineers made a notable contribution despite the fact that Serbia is not a member of that organisation. For that reason, Serbia filed an official application for membership in CERN, in March 2009. In November 2008, Serbia joined the membership of the Partnership for Advanced Computing in Europe. Serbia's membership in leading international organisations of this kind is one of the key factors in the development of its international cooperation.

Funding of research

The main source of investments in R&D is the government budget. Scientific institutes and higher education institutions generate part of the revenues through cooperation with the economy.

The Strategy foresees an increase in the allocation of budget funds for science and technological development in the next five years at the annual rate of 0.15% of the GDP. In this way, the budgetary allocation in 2015 will be 1.05%. However, the % of the GDP increased marginally during the four-year period up to 2010 from 0.31 % to 0.34 %.

Table 2.1.5.2. Percent of total budget and credit (loan) means in the GDP

	2010	2011	2012	2013	2014	2015
% participation of budget means in the GDP	0.31	0.35	0.36	0.34	0.33	0.32
% participation of budget and credit (loan) funds in the GDP	0.40	0.45	0.50	0.46	0.76	0.46
according to the Strategy	0.30	0.45	0.60	0.75	0.90	1.05

*The budget means are the total means allocated to the function of science. In 2010, 2011, 2012 and 2013 the means were approved, and for 2014 and 2015 they are planned – projected means. Credits (loans): for 2010, 2011 and 2012they are the drawn means and for 2013 they are the projected means. The prediction for 2014 and 2015 is based on the plan for drawing means from the loan.

Data on R&D expenditure are not available in Eurostat or in relevant EU documents. The Strategy predicts the growth of budget expenditures for science and technological development for the period 2010-2015 at an annual rate of 0.15% of the GDP. According to numerous studies, the threshold that should be reached and on which depends the support of R&D and innovation activities in a country is1% of the GDP. Only a few EU countries have not attained 1% of the GDP. Serbia, in the past ten years, is at a level of 0.3% of the GDP. Together with credit (loan) means invested in infrastructure and R&D equipment in 2012 the percent is 0.5%.

Mobility of researchers in Serbia - State of play

The collaborative nature of science requires, among other things, mobility of researchers, or more specific 'free circulation of researchers and scientific knowledge, including via digital means'. This implies not only geographical mobility, but also intersectoral (industry – academia) mobility. Even if researcher mobility contributes to excellence, still there are many obstacles that prevent mobility.

One of the most important obstacles is the lack of transparent, open and merit-based recruitment. The calls for researchers are usually answered by people who are educated or already work in the very institution that posts the call. It is rare to receive more than one application for the job. Vacancies are published in the local newspapers or web sites of the faculty or university. Only few, mainly private, universities are publishing vacancies on pan - European researcher's EURAXESS Job portal, although this portal has been operating in Serbia for years. The method of forming selection committees and their work is non-transparent.

There is no awareness of the importance of mobility. There is a misconception that outgoing mobility is identical with the brain drain, because there are no systematic mechanisms for the reintegration of researchers after their stay at a foreign institution and because there is no initiative to attract foreign researchers.

There is no cooperation with the industry in developing curriculum for doctoral studies, as well as other forms of cooperation, related to the career development of researchers, which may be a common interest.

Currently, it is not possible to transfer the national grant from one institution to another, preventing the mobility of researchers within the country. Without portability of grants it is impossible for researchers to carry out a part of their research in other academia or industry research institution.

The 'HR Excellence in Research' logo is awarded to research institutions and funding organizations that have been acknowledged by the European Commission for having made significant progress in implementing the European charter for researchers and the code of conduct for the recruitment of researchers (Charter & Code). Only four research institution from Serbia[32] signed Declarations of endorsement of Charter & Code (University of Niš, University of Novi Sad, Belgrade Metropolitan University, Institute of Field and Vegetable Crops, Novi Sad). For now, only the University of Nis is developing its "Human Resources Strategy for Researchers".

[32]http://ec.europa.eu/euraxess/index.cfm/rights/charterAndCode#S

2.1.6. Innovation system

Current state of the innovation system

Innovation system in the Republic of Serbia is mainly organized as a consequence of activities and measures of the Ministry in charge of science, technological development and innovation activities. In order to make this system effective, it would be necessary to include all other ministries, governmental agencies and local governments into its realization. We hope that this will be gradually implemented during the foreseen accession of Serbia to EU. An overview of the current state of the innovation system is given in the sequel according to WBinNO project[33].

The following data present innovation activities in Serbian companies, covering the three year period from 2008 to 2010. The survey was conducted on a sample of 3982 companies. Innovative companies are defined as the ones that introduce product or process innovation, innovation in organization or marketing innovation during the observed period. The research reveals that the share of companies with at least one of the innovation types mentioned above is around 47%. Almost 70% of large companies, more than half of medium companies and more than a third of small companies are innovative. Innovative activities are more common in manufacturing companies (innovations were introduced in more than half of them), while only 40% of service companies introduced any innovations.

Table 2.1.6.1. Companies in Serbia by innovation activity and size during the period 2008-2010[34]

	Total	Companies with innovations	Companies without innovations	% companies with innovations
Total	12141	5812	6329	47,9
Small companies	9347	4143	5204	44,3
Medium companies	2237	1280	957	57,2
Large companies	557	389	167	69,8
Manufacturing companies	4141	2314	1827	55,9
Service companies	8000	3498	4502	43,7

The share of companies with product and process innovation is almost the same. The share of companies with marketing and organization innovations is a bit more significant. Companies with all types of innovation are mostly in the manufacturing sector.

[33]Djuro Kutlaca, Marija Mosurovic-Ruzicic, Dusica Semencenko (2012): Serbia's national innovation system and its performance, project INNOVATION POLICY LEARNIG FROM NORWAY IN WESTERN BALKANS (WBinNO), funded by NIFU STEP, 2011-2013, working document.
[34]National Bank of Serbia, Statistical Office of Republic of Serbia

The share of innovative enterprises generally increases with the size of the enterprises, similarly to EU countries. However, there are generally far fewer medium-sized and large enterprises than small enterprises.

There are 47.9% of companies with innovation among the Serbian enterprises, and it is just a little bit below the EU-27 average (according to the Report for Sixth Innovation Survey, in the EU27, 52% of enterprises from industry and services reported innovation activity between 2006 and 2008).

Table 2.1.6.2. Companies by type of innovation and sectors[35]

	Innovative companies								
	Sum		Product innovation, Process innovation		Organizational innovation and Marketing innovation		Product innovation Process innovation Organizational innovation and Marketing innovation		Company without innovation
	Number	%	Number	%	Number	%	Number	%	%
Sum	5812	47.9	4495	37.0	4881	40.2	3564	29.4	52.1
Agriculture, forestry and fishing	221	43.2	177	34.6	159	31.1	114	22.3	56.8
Mining and quarrying	24	40.7	23	39.0	20	33.9	19	32.2	59.3
Manufacturing	2156	57.6	1769	47.3	1851	49.5	1464	39.1	42.4
Electricity, gas, steam and air conditioning supply	32	42.7	25	33.3	32	42.7	25	33.3	57.3
Water supply; sewerage, waste management and remediation activities	102	38.6	75	28.4	85	32.2	58	22.0	61.4
Construction	458	37.7	326	37.7	367	30.2	235	19.3	62.3
Wholesale and retail trade; repair of motor vehicles and motorcycles	1442	43.7	980	43.7	1237	37.5	776	23.5	56.3
Transportation and storage	264	37.9	228	37.9	183	26.3	147	21.1	62.1
Accommodation and food service activities	149	37.5	114	37.5	121	30.5	86	21.7	62.5
Information and communication	277	56.5	223	56.5	262	53.5	207	42.2	43.5
Financial and insurance activities	81	66.9	69	66.9	76	62.8	64	52.9	33.1
Real estate activities	13	36.1	13	36.1	6	16.7	6	16.7	63.9
Professional, scientific and technical activities	476	51.0	390	51.0	379	40.6	293	31.4	49.0
Public administration and defense; compulsory social security	117	39.0	85	39.0	102	34.0	70	23.3	61.0

[35] National Bank of Serbia, Statistical Office of Republic of Serbia

Structure of the innovation system

Innovation system includes a variety of stakeholders – government, financial market, education market, workforce market as well as research and technological organizations – establishing a context in which there is a possibility for companies to innovate. International experience shows that financial aid, either governmental or private, is by no means enough, but that all other elements of the innovation system must be put in motion in order to obtain measurable results. It is essential to stimulate entrepreneurial initiative, attract the critical mass of venture capital (VC) for enabling business start-up, as well as maintain a strong industrial base, while, at the same time, provide funding for education, ICT deployment and sustainable resource exploitation.

Key instruments of innovation policy are:

- Financial support for realization of innovations and for innovative companies;
- Technology centers which provide for technology transfer and give surveying services for companies;
- Support for companies in joint venturing;
- Support for universities and research centers in R&D commercialization;
- Development and engagement of innovation specialists for SMEs.

According to World Economic Forum's Global Competitiveness Index2012/13 Serbia is ranked at the meagre 144th place. Serbia's position in key international benchmark indicators shows evidence of a low level of innovation activities and relatively weak international competitiveness. Compared to the EU27 average, the total expenditures for research and development (R&D) in relation to the GDP are very low but comparable to those in the EU10, mainly due to the **comparatively low R&D spending of the Serbian business sector**. Regarding the outcomes of R&D activities, Serbia performs significantly weaker than the EU countries on average as evidenced by the number of patents by public R&D organizations and corporate sector. The reasons for this substantial gap between the EU average and Serbia is the **lower efficiency of the Serbian R&D system** due to **limited institutional capacity**, **lack of commercialization expertise**, a **low level of public-private collaboration in R&D and lack of incentives** to do so. (Sources: Eurostat, European Patent Office, World Intellectual Property Organization, Web of Science, Statistical Office of the Republic of Serbia and Erawatch).

Table 2.1.6.3. Serbian innovative activities[36]

Rank	2010/11 Rank/139	2011/12 Rank/142	2012/13 Rank/144
Capacity for innovation	82	110	120
Quality of scientific research institutions	56	61	67
Company spending on R&D	108	130	132
University-industry collaboration in R&D	71	81	99
Availability of scientists and engineers	92	83	78
Utility patents per million population	78	67	119
Availability of latest technologies	117	123	127
Firm-level technology absorption	134	136	142

Intellectual property

Protection of results of scientific research is one of the foremost prerequisites for successful commercialization of inventions. The process which starts with the creation of an invention and finishes with its commercialization, be it through a spin-out process or via licensing the technology, is known as technology transfer. Intellectual property office is one of the most important stakeholders in this process. Its role is to help researchers in a) Patenting, b) Education, c) Commercialization preparation, d) Information delivery, e) Commercialization, and f) Institutional strengthening. Information and Education Center of the Intellectual Property Office is pivotal for raising the general awareness about intellectual property and its significance for social and economic development.

The center concentrates on establishing the programs in the area of intellectual property in order to serve the main stakeholders, namely companies (including SMEs), research institutes, courts, police, market inspection, customs, media, legal entities and general public. Special importance can be given to Intellectual property diagnosis, a service aimed to help companies to identify the forms of intellectual property they have, as well as to adopt adequate strategies for intellectual property management.

A program for collaboration with technical faculties has been started in order to create centers for supporting technology transfer between R&D institutions and companies. This program is to be extended to all other faculties where this is possible.

The University of Belgrade has, in the framework of „Support for Education & and Information Centre of the Intellectual Property Office of the Republic of Serbia", founded the

[36] World Economic Forum's Global Competitiveness Index

Technology Transfer Centre (TTC). Its activities comprise identification, protection and commercialization of R&D results of the University of Belgrade.

Patent activity of our research institutions is quite modest. It is expected that a series of stimulus measures and actions lead to significant improvements in this area. So far, most patented are in the following three areas: electronics, telecommunications and information technology.

Table 2.1.6.4. Patent activity of research institutions

	2008	2009	2010	2011	2012
Patent applications, domestic applicants	386	299	290	180	191
Small Patent applications, domestic applicants	136	101	97	67	75
Registered patents, domestic holders	70	103	98	60	79
Registered small patents, domestic holders	81	86	74	48	61

Current initiatives and projects in the innovation system

At this moment, the following projects and initiatives are still active:

- ICIP – Improved SME Competitiveness and Innovation Project (www.icip-serbia.org)
- SECEP – Support to Enterprise Competitiveness and Export Promotion (www.secep.rs)
- LEDIB (Local Economic Development in the Balkans) Programme (www.ledib.org)
- Cluster Development Support Programme, implemented by the Ministry of Economy and Regional Development (http://klasteri.merr.gov.rs/en/)
- Enterprise Europe Network in Serbia (http://www.een-srbija.rs/)
- CIP and EIP projects in Serbia (http://www.cip-srbija.rs/)
- IISP- Integrated Innovation support Programme (http://www.iisp.rs/)
- EDIF (Enterprise Development and Innovation Facility) reform prioritization Serbia provides a short list of some 20-25 reform suggestions for each beneficiary economy in the Western Balkans.
- Regional R&D for Innovation Strategy WBC
- Project Export promotion of innovations products (www.bitf.rs)
- KNOWTS National Platform for Knowledge Triangle, Tempus project (http://knowts.elfak.ni.ac.rs/)
- Modernization of WBC universities through strengthening of structures and services for knowledge transfer, research and innovation, Tempus project (www.wbc-inno.kg.ac.rs)
- CAPINFOOD - Improving the enabling environment and public awareness for innovation in the South-East-European food sector through transnational collaboration (http://www.capinfood.eu/)

Development of consulting services: business and technology incubators (Business Incubator Novi Sad, Business Incubator Zrenjanin, Business and Technology Incubator of the

technical faculties in Belgrade), Technology Transfer Centers (such as the one at the University of Belgrade), Intellectual property protection centers (such as the one at the University of Novi Sad), EEN – Enterprise Europe Network.

Current mechanisms for promoting innovations: Best Technology Innovation Competition (www.inovacija.org), Tesla fest, education and trainings at workshops delivered through different international and national projects.

Knowledge transfer partnerships: clusters (Vojvodina ICT cluster, Niš ICT cluster, Creative Industry Cluster of Vojvodina, Vojvodina Metal Cluster…), Center for Competences and Clusters at FTN Novi Sad, UNESCO Chair for Entrepreneurial Studies at the University in Novi Sad, Centre for Financial Sector Development at FTN Novi Sad.

International partnership in knowledge transfer: IPA (COMPLEXIM, ECORYS, COMP-COMP, MORDIC etc.) and TEMPUS programs (S&T Park, KNOWTS, WBC Inno).

Science & Technology Parks: soon to be established - Science & Technology park of the University in Novi Sad – part at the Faculty of Technical Sciences and Science & Technology park Zvezdara in Belgrade.

Innovative organizations (Development and Production Centers (72), R&D Canters (25), Innovation Centers (5), Business and Technology Incubators (4) and Science & Technology Parks(2)) are registered according to the Law on Innovation Activity at the Ministry of Science, Technological Development and Innovation Activities. Currently, there are 108 organizations in this register.

Entrepreneurial education at University of Novi Sad is studied at different faculties such as Faculty of Economics, Faculty of Technical Sciences, Agriculture faculty and Faculty of Sciences. During 2006 at University of Novi Sad has been founded UNESCO Chair for Entrepreneurial Studies. Its main goal is promotion of entrepreneurship, not just inside but also, outside the University. Since 2009 master academic study program „Entrepreneurship“ is realized. Except study program, at the University are implementing many projects, which include education and trainings for students and academics, in order to support their entrepreneurial ventures. Since some of the UNS priorities are innovations and entrepreneurship, it participates in large number of initiatives for creation and support of entrepreneurial universities. As forms of support to entrepreneurship development, the University has participated in the establishment of the ICT Cluster, the Cluster of Creative Industries of Vojvodina and the Science and Technology Park. The aim of these activities is to educate and motivate students in their area, to start their own business or how to help in the realization business that already has started.

Financial mechanisms

The government accepts programmes for innovation activities for each fiscal year. They are realized through Public calls for financing the innovation projects of the registered innovative organizations. There are two types of projects contracted with them: 1. Product, process or

service innovation and 2. Infrastructural projects (knowledge infrastructure and human capacity building, and procurement of equipment for the organization of infrastructural support for innovation activities). An overview of the calls so far realized is given in the following table.

Table 2.1.6.5. An overview of innovation projects since adoption of the initial Low on Innovation Activities (December 2005)

	Applications	**Requested funds**	**Innovation projects accepted**	**Infrastructural projects accepted**	**Total funding for both types of projects**	**Time frame**
1 PC	108	€3.7m	**46**	**7**	**€2.1m**	July 2007/2008
2 PC	165	€6.9m	**80**	**15**	**€3.5m**	Nov 2008/2009
3 PC	220	€4.1m	**54**	**7**	**€1.2m**	April 2010/2011
4 PC	211	€3.6m	**95**	**4**	**€1.7 m**	June 2012/2013
Total	704	€18.3m	275	33	**€8.5m**	

Innovation Fund

The Ministry in charge of science, technological development and innovation activities has established the Innovation fund in the frame of implementing the Strategy for scientific and technological development 2010-2015.

- The Ministry aims at increasing non-budgetary funds in financing innovation activities, by exploiting the opportunities to use International financial institutions funds and the capital from private sector.
- The fund supports projects from **Partnership Program** (Investments in SMEs that already have an innovative product with a high share of knowledge and innovation and the potential to establish partnerships and sales in the world market) and **Support Program for venture capital funds** (Investments in newly established companies with high share of innovation in the early stages of the high risk have access to other forms of financing).

The Fund offers two types of projects:

- **Early development programs**, intended for private micro and small companies in the early stages of development, which possess a technological innovation and have a potential for developing intellectual property, as well as a clear market need (11/58 projects funded in the first call, 9/106 in the second).
- **Innovation co-financing programs**, intended for expansion of cooperation between Serbian innovative micro and small companies and their strategic partners, as well as Investment and VC funds, with the aim to increase the investment of the private

sector into R&D and commercialization of new and improved products and services (5/40 projects funded in 2012).

Also, **Ministry of Finance and Economy** supports innovation strengthening through a program within which it has donated about €300,000 for 1. Support for innovations in SMEs and entrepreneurs, 2. Connecting SMEs with R&D institutions, S&T Parks and consulting agencies as well as technology and knowledge transfer, 3. Increase in the number of SMEs and entrepreneurs investing in innovation activities and 4. Increase of the SME and entrepreneurs market share both at Serbian and international markets.

2.1.7. New infrastructure investments

Modern, globalized research demands new, large-scale infrastructures. The establishment of strong and competitive knowledge centers with business participation, innovation clusters and the modernization of research infrastructure are the main goals of the Strategy. The task of the state is primarily to ensure the frameworks, while the research infrastructure requires continuity, stability, and calculable conditions to be able to produce, adapt and disseminate new knowledge. The Government's goal is to fit the domestic research network into the European research infrastructures, and at the same time, into the EU common research policy.

The Serbian government considers that investment in infrastructure is a pre-condition for the success of the National Strategy for Scientific and Technological Development. The main sources of financing for the infrastructure projects are international financial institutions, specifically the European Investment Bank (EIB), European Commission, the European Bank of Reconstruction and Development, the Development Bank of the Council of Europe (CEB) in combination with other international donors and local institutions.

Table 2.1.7.1. The main sources of financing for the infrastructure projects

	Financial institution	**EUR**
1	EIB	200.000.000
2	IPA	25.600.000
3	CEB 1	35.000.000
4	CEB 2	70.000.000
5	Republic of Serbia	69.400.000

The types of projects which are supported include the following:

1. Upgrading the existing research facilities:
- Renovation of existing buildings and laboratories
- New capital equipment for research

2. The development of human capital through investments in:
- Human resources program (program to encourage the return of Serbian researchers from abroad)
- "Petnica" Research Station
- Mathematical High School Campus
- Center for promotion of sciences in Belgrade

3. Development of centers of excellence and academic research centers:
- Energy and Environment (National Institute of Energy and national laboratories for the quality of water, soil and air).
- New materials and nanoscience (National Laboratory of Physics, Materials and Nanotechnology).
- Agriculture and Food (Network of Institutes and faculties engaged in research in the field of agriculture).
- Biomedicine (a new campus for biomedical research and biotechnology companies in the area of the Clinical Center of Serbia and School of Medicine, University of Belgrade).

4. Development of technology infrastructure and information and communications technology through building:

- A campus for a faculty in the field of ICT, University of Belgrade
- Infrastructure for the supercomputing initiative "Blue Danube"

5. *Supporting knowledge-based economy through the construction of science parks in Belgrade, Novi Sad, Nis and Kragujevac*
6. *Residential buildings for researchers in Belgrade, Novi Sad, Nis and Kragujevac*

The design and construction of infrastructure projects are being led by the Project Implementation Unit "Research and Development" (PIU R&D). PIU R&D was established in August, 2010 by a governmental decision, in accordance with the obligations of the Republic of Serbia stipulated in the financial agreement with EIB, and CEB. To date, the following objects have been completed: Science and Technology Park Zvezdara (Belgrade), Science center "Petnica", Natural science center (Svilajnac), Science and Technology Park (Novi Sad), main building of the University of Novi Sad, repairing of the foundation of the Faculty of Chemistry (Belgrade).PIU R&D took part in the preparation of 15 projects, listed in Table 2.1.7.2. PIU R&D designed a centralized register of scientific equipment and started up a process of procurement of capital scientific equipment for R&D institutions, which is still in its execution phase, with completion scheduled for the first half of 2013. Till now, for the procurement of capital equipment (98 items of a value greater than 100.000 EUR each) PIU has signed 57 contracts with providers and delivered 31 items. At the moment, we are in the evaluation phase of a large tender through which we aim to procure 315 items worth between 30.000 and 100.000 EUR each, with a total estimated value cca 17 million EUR.

Table 2.1.7.2. List of infrastructure projects

Project
1. Natural science center (Svilajnac)
2. Joint laboratories for physics, materials and nanosiences, Nanocenter, Belgrade
3. Main building of the University of Novi Sad
4. Science and Technology Park Zvezdara (Belgrade)
5. Science and Technology Park Kragujevac
6. Science and Technology Park Novi Sad
7. Science center "Petnica"
8. Center for the Promotion of Science, Block 39, Belgrade
9. Adaptation of the UNESCO research center IRTCUD at the Faculty of Civil Engineering, University of Belgrade
10. Science and Technology Park Nis
11. Center for stem cells, Kragujevac
12. Apartments for scientific researchers Kragujevac
13. Apartments for young researchers, Block 32, New Belgrade
14. Biomedical Campus, Belgrade

Table 2.1.7.2. List of capital equipment

No.	Equipment	Project type
1	X-ray diffraction and SAXS PANalytical EMPYREAN	III45020
2	High-Resolution Microarray Scanner System	III41026
3	7900HT Fast Real-Time PCR System	III41004
4	Elastic backscatter Lidar system with depolarization	III43007
5	Single Column Testing Systems with Temperature Controlled Bath	III46010
6	An integrated system for distributed data access, data backup and long-term data archiving of complete information systems at the Mathematical Institute	III44006
7	ProLiant BL465c G7	III42004
8	Video microscopy system with high time resolution	III41005
9	System for electric, ferroelectric and multiferroic measurements on nanostructures and bulk ceramic samples	III45007
10	Temperature-programmed desorption, reduction and oxidation of the pulse chemisorptions, model TPDRO 1100	III45001
11	EPR spectrometer	III41005
12	Flow cytometer with high-speed sorting system and Automated Cell Deposition Unit	III41025
13	Illumina Array iScan Platform	III41028
14	DFS High Resolution GC/MS	III46009
15	FTIR 6200 Spectrometer integrated with IRT-5000 Infrared Microscope	III41006
16	Micro-Oxymax Multiple Sensor O2/CO2 10 Chamber System	III43004
17	Inductively Couple Plasma-Mass Spectrometer	III43005
18	UHV elipsometer	III45005
19	MOKE - m	III45005
20	HPLC-ICP-MS speciation system	III43009
21	RegA 9050 Regenerative Amplifier	III45010
22	SYSTEM3 SAXS	III45012
23	Optical Interferometric Profiler	III45016
24	Sputtering Systems	III45019
25	Twin-screw extruder BTSK	III46005
26	Upgrade of the existing IBM cluster with xBladeCenter HS22 with 16 x Blade AT Servers and management node	III44006
27	R&S ESCI7 EMI Test Receiver	III44009
28	R&S ZVAVector Network Analyzers	III44009
29	Simultaneous TG-DSC-DTA-STA 409 CD	III45004
30	Dynatek Dalta SVP Stent tester	III41007
31	Intravascular Stent/Graft Testing System	III41007
32	Ultrasound VIVID 7	III41022
33	Cardiovascular Angiography	III41022
34	Liquid chromatography (LC), 1200SL series, with diode array detector (DAD) and mass spectrometer (MS)	III41022
35	PulseForge Tool (TR32016), D-T neutron generator	III43002
36	MicroCT	III45005
37	AB SPEX TOF TOF	III45005

38	NanoESCA	III45005
39	Cell Cut Plus(III41013), laser capture microdissector	III41021
40	Multidisciplinary motion capture system	III44008
41	EMC3 Anechoic Chamber	III44009
42	GLOVEBOX system with integrated evaporation system MB-EVAP	III45003
43	Contour GT-K1	ON172019
44	ICP- MS	ON172030
45	ABI 3500 Genetic Analyzer capillary electrophoresis system	ON175090
46	Basic broadband confocal microscopy system-Leica TCS SP5 II Basic VIS system	ON173054
47	Mass spectrometer for determination of isotopic composition (IRMS)	ON172017
48	EDXRFA: XGT-7000 XRF microscope	ON176006
49	ACQUITY Tandem Quadrupole Detector (TQD) for UPLC upgrade	ON172023
50	NMR System, 500 Mhz	ON172061
51	AG2 Rheometer	ON172062
52	Laser scanning confocal mycroscope	ON173008
53	Extra - low background Gamma Spectoscopy System based on NIM electronic modules	ON171018
54	High Current Ion Implanter, Danfysik - model 1090, 200kV	ON171023
55	Multifunctional XRD, Empyrean	ON171035
56	Mass and Energy Analyser for Plasma Diagnostics	ON171037
57	Superconducting Fourier NMR Spectrometer AVANCE III, 400 MHz Nanobay	ON172006
58	GC MS/MS 7890/7000	ON172047
59	Flow cytometer with a sorting module	ON173013
60	UHPLC 1290 Infinity	ON173024
61	Spectrofluorimeter and Phosphorimeter with NIR T channel and TCSPC measurement	ON173017
62	Semi preparative HPLC system with DAD and MS detectors	ON173021
63	Microscope Zeiss Axio Imager Z1	ON173046
64	Cluster computer built from IBM iDataPlex components	ON174028
65	GS Junior Complete 454 Sequencing System	ON175024
66	WDS- Wavelength dispersive spectrometer	ON176016
67	X-ray powder diffractometer	ON176016
68	HPLC/MS/MS	ON176018
69	Upgrade of SCL PARADOX cluster	ON171017
70	MS/MS DETECTOR FOR HPLC	ON172052
71	Microscope LeicaDM6000 M ilislican	ON176006
72	Roboticteleskope "Milankovic"	ON176021
73	High-definition sonar for inspection and identification of objects underwater	ON173045
74	LCQ Fleet Ion Trap LC/MSn liquid chromatography mass spectrometry	TR33034
75	R&S SFE100 Test Transmitter	TR32014
76	Millimeter-Wave Network Analyzer N5250C	TR32024
77	MTS Landmark Servohydraulic Test System with370.10 Load Frame and FlexTest 40	TR32036
78	Desktop Scanning Electron Microscope – Phenom	TR35021

79	Nanoindenter with a Micro Scratch Test module – CSM	TR35021
80	Servohydraulic Test Systems	TR36050
81	HITS-P10 high speed puncture impact testing machine	TR34011
82	TOC-CRDS Isotopic Carbon Analyzer	TR37014
83	Liquid chromatography (LC), 1200SL series, with diode array detector (DAD) and mass spectrometer (MS)	TR31055
84	OTN 10/40/43Gbps Optical Network Tester	TR32007
85	Clean-room facility	TR32008
86	Mobil laboratory for biosystem engineering	TR35043
87	Stereo high frame rate (time-resolved) PIV system	TR35046

2.1.8. Business environment

World Economic Forum's Global Competitiveness Report for 2012-2013 places Serbia at 95th position out of 144 countries, according to the Global Competitiveness Index. This is the same ranking as in the previous report. However, in some important aspects that form the complex Global Competitiveness Index, Serbia actually slipped lower than the previous year's low ranking. For example, Serbia was ranked 134th according to the burden of government regulations last year but 136th this year; in the extent and effect of taxation 118th and 122nd respectively; in firm-level technology absorption 136th and 142nd; in company spending on R&D 130th and 132nd.

The most problematic factors for doing business that the companies have identified, inter alia include: inefficient government bureaucracy, corruption, access to financing, foreign currency regulations, tax rates and tax regulations, inadequate supply of infrastructure, insufficient capacity to innovate, etc. Particularly unfavourable are the rankings under the 1st pillar – institutions, for example: Serbia ranks 126th when Government services for improved business performance are in question.

Chapter 20: Enterprise and industrial policy of the Serbia 2012 Progress Report stipulates that "further efforts are needed in relation to company registration, business incubators and access to finance for SMEs"

According to the latest White Book 2012, Foreign Investors Council's Proposals for improvement of the business environment in Serbia, most progress has been achieved in the areas of e-commerce and intellectual property, followed by improvements in overall legal framework and fields of tobacco and telecommunications. Also, most recent cancellation of 138 quasi-fiscal charges is the step in the right direction. Unfortunately, it reiterates some of the recommendations that have already been tabled in previous White Books:

- Accelerate the rate of transition reforms with the dual goal of improving business conditions and bringing Serbia closer to the European Union;
- Reduce and simplify bureaucratic procedures at both the national and local level;
- Create conditions for market competition in a well-regulated market by providing equal rights to all competitors, as well as a proper regulation of monopolies;
- Intensify the fight against corruption, since this is seen as one of the most problematic factors for doing business in Serbia;
- Conduct a well-balanced economic policy that will be conducive to business and attract investment.

OECD's analysis EDIF (Enterprise Development and Innovation Facility) reform prioritization Serbia provides a short list of some 20-25 reform suggestions for each beneficiary economy in the Western Balkans. Five main barriers to growth according to the OECD's targeted survey of high growth SMEs in June 2012, determined on a sample of 110 firms included: corruption and shadow economy, access to finance, public procurement, investment policy and promotion, and regulation.

The latest Doing Business Report 2013 ranks Serbia the 89th out of 185 countries. This is a positive change in rank comparing to the previous year's 95th place.

The major improvement has been made in the area of Starting business – recording positive change in rank of even 49 places. Significant rise in ranking is also seen in the area of Resolving insolvency - 17 places up. It has to be noted though, that in this area, in spite of the progress, Serbia is still at 103rd place.

Moreover, there are still a lot of areas which need further improvement. For example, in the area of Enforcing Contracts, Serbia ranks 103rd, and in Paying Taxes ranking is much more unfavorable 149th. If we look at the Protecting Investors criterion, Serbia's rank is 82nd.

The analysis performed in 2011 by the USAID BEP project[37], which encompassed 1000 SMEs in Serbia, 36% of which are doing business with public sector, has revealed additional obstacles for doing business. The findings, among other, include:

- Quasi-fiscal charges have the second most negative impact on business competitiveness (the fiscal burden on wages is the first);
- Although the businesses consider that the regulatory burden has decreased, the negative sentiment still prevails – 75% of them believe that the burden hasn't been reduced when compared to the previous year, and that a lot more has to be done to improve this area.
- Businesses continue to suffer from "red tape." A mere 3% of respondents claim to have spent less time, and only 4% claim to have spent less money, on dealing with regulatory issues, compared to the previous year;
- Less than 10% of businesses believe that it is easier to obtain a building permit now (in 2011) than in 2009;
- 48% of respondents said that they have spent more time in 2011 and 56% spent more money to comply with inspections procedures than in 2010. Plus, the lack of a horizontal law on inspections is identified as one of the key impediments in this area, particularly given the fact that more than 1,000 laws and bylaws regulate the work of inspections.
- over two thirds (71%) of the companies are doing business within the boundaries of their cities/municipalities, while mere 6% are exporting to foreign markets;
- percentage of businesses (79%) claiming that personal and political connections influence the decisions in the public procurement procedures, remains worrying;
- access to finance still represents an issue for the SMEEs in Serbia. Two thirds of businesses predominantly use commercial banks as the sources of finance, while 25% of them borrow from family and friends. Other formal sources of finance are almost negligible, and their participation has actually decreased compared to 2011. Other financial instruments (e.g. revolving loans, factoring, leasing, etc.), which are widely used throughout the countries with developed financial systems, are not sufficiently used in Serbia.

[37] USAID - Business Enabling Project, http://www.bep.rs/

The new Government of Serbia is firmly committed to the existence of a functioning market economy as well as the capacity to cope with competitive pressure and market forces within the Union, in pursuit of its national policy objectives and reform agenda, on the path towards the EU. In addition, it is strongly committed to implementing regulatory, institutional and administrative reform in order to promote economic growth, improve business environment and facilitate FDI inflow to the country.

The general rate of VAT has been increased from 18% to 20%, but for small and medium sized enterprises from the 1st of January 2013 there is the possibility to pay VAT only after the goods collection. This improves the business climate for small and medium-sized enterprises.

Competitiveness of Serbian enterprises is closely connected with their ability to produce safe products, conformed to the requirements of relevant technical regulations and standards. An efficient and internationally recognized national quality infrastructure (NQI) system that provides Serbian enterprises and industries, with better conditions for implementation of technical regulations and standards for products and management systems (for: quality, environment protection, health and safety at work) is one of the prerequisites for the competitiveness of the Serbian economy.

The low level of industry competitiveness comes also from the low level of quality and compliance of products with relevant technical requirements, which disable companies to participate in international product chains and markets. According to the first findings of the analysis of QI system in Serbia, done within GIZ ACCESS project[38], the reasons are: insufficient implementation of standards, lack of technical knowledge in companies, lack of industry awareness about the importance of fulfillment of requirements from international product and management system standards, lack of testing facilities (for example: missing designated bodies for implementation of new technical regulations, missing accredited labs used by market surveillance authorities, etc.) which causes that products are tested abroad (i.e. in the region), which is time consuming and causes higher production costs in economically difficult times.

In 2011, out of 319.802 enterprises, entrepreneurial sector comprises 99,8% (319.304) enterprises. Sector SME generates 65,3% of employed (786.873), 65,5% turnover (5.200 billion dinars), 55,2% GVA (878,2 bill. dinars) and engages 55,7% of investments of the nonfinancial sector in 2011. Sector MSPP engages 45,1% of the entire employment, 51,7% of the entire investments, realizes 46,5% of export, 52,7% of import, generates 61,7% of foreign trade deficit of the economy of Serbia and participates with about 33% in the GDP of the Republic. If analyzed according to the size, in the structure of SME sector, the most numerous are micro enterprises (307.430), while small and medium size enterprises (11.874) are dominant in all the observed indicators (54,4% employment, 60,6% turnover, 61,5% GVA, 76,0% export, 74,4% import of SMEs).

[38] Assistance to competitiveness and compatibility with the EU of Serbian SMEs, GIZ ACCESS project, http://www.giz.de/themen/en/34334.htm

2.2. External factors

2.2.1. Globalization

During the last few decades, human dynamics, institutional change, political relations, and the global environment have become more intertwined. It is commonly recognized as globalization. The greater international movement of goods and services, financial capital, information and people are among the most visible manifestations of the globalization. In addition, there are technological developments, new and enhanced legal systems, and institutions that facilitate these flows. Consequences of the globalization are deep, fundamental, and they wide open new opportunities for growth but with possible negative effect on the overall economy. For example, industrial manufacturing is very flexibly placed in locations offering the most favourable operating conditions; Knowledge and competence are undergoing similar development; Developing countries are striving to challenge those who are presently enjoying success throughout the world.

In such globalized and rapidly changing world, Europe's pathway to the future rests on growth which is smart, sustainable and inclusive. Being strategically tightly connected to EU, Serbia has an opportunity to leapfrog along that direction by aggressively adopting new innovation strategies. To achieve this goal and to remain competitive in the global knowledge economy, the 'knowledge triangle' of research, education and innovation and the interaction between these three sides have been recognized as the key driving forces. In the context of increasing global competition and facing a demographic challenge at home, Serbia's future economic growth and jobs will increasingly come from innovation breakthroughs in products, services and business models as well as from its ability to nurture, attract and retain talent. While there are individual success stories across Europe, EU Member States on average underperform in comparison with global innovation leaders. Moreover, the EU is facing increased competition for talent from new centers of excellence in the emerging economies. As a consequence, there is a window of opportunity for Serbia to build a competitive strategic position.

The ability to attract talents, both on the level of Europe and primarily to retain its own, is at the same time a development chance of Serbia and a necessary precondition to catch up with the development. That is why for Serbia it is necessary to stimulate higher education institutions as the initiators of innovations because talented people need a unique choice of skills, knowledge and motives to push forward and create innovations. However, the opportunity comes with a threat: globalization, deregulation, liberalization and financial crisis may come together as a process that creates great instability and fragility in their emergent markets economies that consequently may negatively affect the growth of economy as witnessed for example in the case of some EU countries[39]. In order to avoid the negative effects interrelation of classic and modern economic growth theories searching for impact of globalization on change of value must be taken into account.

[39]Rasa Daugeliene, Hypothetical crisis policy framework for the recovery of Lithuania's economy: Searching for impact of globalization, ISSN 1822–8402 EUROPEAN INTEGRATION STUDIES. 2011. No 5. pp.116-124.

2.2.2. New technologies and innovation

There is political agreement in Europe that to ensure competitiveness, prosperity and well-being, all forms of innovation need to be supported, and that the progressive shift in emphasis of European innovation policy from exclusive reliance on technology towards more demand- and user-driven innovation must continue. In this section we give a short overview of "new innovation patterns" as identified in research literature. The concepts, strategies, and paradigms of changing innovation patterns (with their most important proponents), that have big potential to make impact on the growth of Serbia's economy, are[40,41]:

- *Innovation Union* - With over thirty action points, it aims to improve conditions and access to finance for research and innovation in Europe, to ensure that innovative ideas can be turned into products and services that create growth and jobs[42].
- *Open Innovation* - is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. This paradigm assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology[43].
- *Demand side innovation* – with policy tools (such as for instance health and safety regulations, standardization, labeling and public procurement of innovations) complements public funding schemes (e.g. grants, loans and tax credits) that are called 'supply-side innovation policy tools', because they lead to an increase in the supply and particularly in the uptake of innovations.
- *User Innovation* - refers to new product and service development by individual users or individual user firms for themselves, without the assistance or involvement of producers. Innovation by individual users is perhaps the most important change in the innovation process since the Industrial Revolution. This approach offers great advantages over the producer-centered innovation development systems that have been the mainstay of commerce for hundreds of years. Notably, when users can innovate for themselves, they can develop exactly what they want, rather than having to rely on manufacturers to act as their (often very imperfect) agents[44].
- *Innovation communities* – are a form of Communities of Practice that are dedicated to the support of innovation. They can be formed from champions of innovation and their social network and are safe places for the creation and support of innovatory ideas. They are groups made up of motivated individuals working together towards a common goal, not because of orders from their superiors, but because they are convinced of their common cause.

[40] Innovation Futures: A Foresight Exercise on Emerging Patterns of Innovation Visions, Scenarios and Implications for Policy and Practice, Final Report, http://www.innovation-futures.org/, Brussels, March 2012.
[41] http://www.innovationexcellence.com/blog/2013/05/24/eight-innovation-drivers-for-our-innovating-future/?goback=.gde_164166_member_244111286 (Accessed May 21, 2013)
[42] http://ec.europa.eu/research/innovation-union/index_en.cfm
[43] Henry Chesbrough, *Open Innovation: Researching a New Paradigm*
[44] http://lexicon.ft.com/Term?term=user-innovation

- *Commons-based Peer-Production* – is a socio-economic system of production that is emerging in the digitally networked environments. Facilitated by the technical infrastructure of the Internet, the hallmark of this socio-technical system is collaboration among large groups of individuals, sometimes in the order of tens or even hundreds of thousands, who cooperate effectively to provide information, knowledge or cultural goods without relying on either market pricing or managerial hierarchies to coordinate their common enterprise[45]
- *Crowdsourcing* - can be seen as a strategy for partial outsourcing of innovation activities that were formerly done in-house--to a crowd in the internet. It is used in different phases of the innovation process and involves idea generation, product development, design, marketing and problem solving stages. Crowdsourcing platforms usually act as mediators and brokers between the crowdsourcers and crowdsourcees.
- *Personal Fabrication* – is a democratization of manufacturing, a trend that promises to revolutionize the means of design, production and distribution of material goods and give rise to a new class of creators and producers. A disruptive technology and several cultural and economic driving forces are leading to what has already been called the next industrial revolution: public access to digital fabrication tools, software and databases of blueprints; a tech Do-It-Yourself movement; and a growing desire amongst individuals to shape and personalize the material goods they consume[46].
- *Soft Innovation and Design Innovation* - is innovation in goods and services that primarily impacts upon aesthetic or intellectual appeal rather than functional performance[47].
- *Eco-Innovation Models* – are any form of innovation aiming at significant and demonstrable progress towards the goal of sustainable development. This can be achieved either by reducing the environmental impact or achieving a more efficient and responsible use of resources. Eco-innovation projects aim to produce quality products with less environmental impact, whilst innovation can also include moving towards more environmentally friendly production processes and services. Ultimately they contribute towards the reduction of greenhouse gases or the more efficient use of various resources[48].
- *Innovation in Services* - While the service sector plays an increasingly important role in the economy, accounting for about 2/3 of employment and Gross Domestic Product (GDP) in Europe, the share of service firms which innovate is still low when compared to the level of innovation in manufacturing, with the notable exception of Information and Communication Technology (ICT) services. Furthermore, evidence suggests that non-technological innovation plays a very important role in the service sector.
- *Innovation in the Public Sector* - The public sector plays a key economic role as regulator, service provider and employer. It accounts for more than 25% of total employment and a significant share of economic activity in the EU Member States. An

[45] Yochai Benkler, "Coase's penguin, or Linux and the nature of the firm," Yale Law Journal, 112 (2002), 369–446.

[46] Catarina Mota. 2011. The rise of personal fabrication. In *Proceedings of the 8th ACM conference on Creativity and cognition* (C&C '11). ACM, New York, NY, USA, 279-288.

[47] Paul Stoneman, *"Soft Innovation: Economics, Product Aesthetics, and the Creative Industries"*

[48] http://ec.europa.eu/environment/eco-innovation/faq/index_en.htm

efficient and productive public sector can be a strong driver of economic growth in Serbia also through its support for and governance of the private sector. At a time where governments face the challenge to ensure financial consolidation while fostering growth, competitiveness and employment, there is a strong justification for efficiency gains, better governance, faster delivery and more user involvement in public sector.

- *Social Innovation* - is about new ideas that work to address pressing unmet needs. We simply describe it as innovations that are both social in their ends and in their means. Social innovations are new ideas (products, services and models) that simultaneously meet social needs (more effectively than alternatives) and create new social relationships or collaborations[49].
- *Regional Innovation* - Growth is increasingly related to the capacity of regional economies to change and innovate. Regions and cities have become the primary spatial units where knowledge is transferred, innovation systems are built and competition to attract investments and talents takes place. Regions are an appropriate level for stimulating innovation: Many regional governments have important competences and budgets in the field of innovation. Their geographical proximity facilitates the acquisition, accumulation and use of knowledge. Regions' performance depends not only on that of enterprises and research institutes but also on interactions between different stakeholders, enterprises and organisations, whose knowledge and know-how build up over time[50].

[49] *Open Book of Social Innovation*, Murray, Calulier-Grice and Mulgan, March 2010
[50] http://ec.europa.eu/enterprise/policies/innovation/policy/regional-innovation/index_en.htm

2.2.3. New Economy (service/knowledge economy)

Knowledge economy is a system of consumption and production that is based on intellectual capital. It commonly makes up a large share of all economic activity in developed countries. In a knowledge economy, a significant part of a company's value may consist of intangible assets, such as the value of its workers' knowledge (intellectual capital). However, generally accepted accounting principles do not allow companies to include these assets on balance sheets. Lesser-developed countries tend to have agriculture or agriculture and manufacturing-based economies, while developing countries tend to have manufacturing or manufacturing and service-based economies, and developed countries tend to have service-based economies.

Open innovation processes combine internal and external ideas together into platforms, architectures and systems and utilize business models to define the requirements for these architectures and systems[51]. These business models access both external and internal ideas to create value while defining internal mechanisms to claim some portion of that value. In short, the open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation. Consequently, we can distinguish two important kinds of open innovation: outside-in and inside-out. The outside-in part of open innovation involves opening up a company's innovation processes to many kinds of external inputs and contributions. Inside-out open innovation requires organizations to allow unused and underutilized ideas to go outside the organization for others to use in their businesses and business models.

Open innovation is often described by contrasting it with closed innovation. The closed innovation, as predecessor of the open innovation, assumes context where companies generate their own innovation ideas, and then develop, build, market, distribute, service, finance, and support them on their own. Relevant developments in the wider innovation environment include social and economic changes in working patterns, increased labor division due to globalization, improved market institutions for trading ideas, and the rise of new technologies to collaborate across geographical distances.

A well-structured open innovation program has the objective and the ability to create and empower value drivers such as: new products & services, complementary & leveraging technologies, adjacent markets, inside – out technology, virtuous ecosystem, and talent attraction. It is evident that the list of value drivers significantly matches set of identified strategic goals of the Knowledge Triangle. As a consequence, we can conclude that the open innovation should be considered as one of the most important mechanisms in the development of the Knowledge Triangle strategy. It is important to note that a successful adoption of an open innovation has different circumstances in developed opposing developing countries, big enterprises vs. SMEs, national vs. regional levels, etc. Hence, open innovation must be considered as a powerful tool for successful implementation of Smart Specialization particularly at regional level in developing countries involving SMEs.

[51]Petros Lameras, Denise Lengyel, Maurice Hendrix, Sara de Freitas, Brian More, "Research Review on Open Innovation: Literature Review and Best Practices", *Open Innovation Exchange, JISC*

3. Strategic goals

3.1. Sustainable development

The strategic aim of this platform is to reach the state in which economical development is intertwined with the wellfare of both citizenship and environment. Enhancing the life standard of the nation, and generally speaking, reaching wellfare, demands constant and sustainable development of productivity based on innovations both in business systems and in social communities in general. Currently, a large number of Serbian companies find their place at the world market on the basis of low prices, though the most successful ones already base their competitiveness on expertise and high productivity. To achieve and attain the wanted sustainable development on the national level it is necessary to change this relationship in favor of stategies of high productivity based on innovations.

3.2. Fostering university – business cooperation

One of strategic goals is to foster university business cooperation through:

- increasing overall level of demand by business for research,
- supporting communication in knowledge transfer,
- providing trained and motivated staff for technology transfer offices,
- involving more flexibility in distributing IP rights between universities and business,
- development of shared services in technology transfer on a regional basis,
- development of internship programs,
- development of lifelong learning programs,
- providing proper funding of university research and public-private partnership, and
- encouraging contract research, collaborative research and consultancy.

Demand for research from business - The main challenge for Serbia is not about how to increase the supply of commercial ideas from the universities into business. Instead, the question is about how to raise the overall level of demand by business for research from all sources. Measured against developed countries, the research intensity of Serbian business is low – and the position has been deteriorating in recent decades. This could have an adverse impact on the overall productivity of the Serbian economy.

Knowledge transfer - The best forms of knowledge transfer involve human interaction and encourage more frequent and easy communications between business people and academics.

Research collaborations would be made easier to agree if model contracts could be developed on a voluntary basis to cover the ownership and exploitation of intellectual property (IP).

Technology transfer - Serbian universities have a fairly strong science base, and there is significant potential to transfer this knowledge to business in the form of IP. These transfers take a range of different forms and could grow at a rapid pace in years that come. Most of Serbian universities plan to develop technology transfer offices, but the main problem would be lack of trained and motivated staff. However, there are a number of barriers to commercialising university IP. One is a lack of clarity over the ownership of IP in research collaborations. This makes negotiations longer and more expensive than what otherwise the case would be, and it sometimes prevents deals from being completed. Public funding for basic research and for the development of technology transfer offices is intended to benefit the economy as a whole rather than to create significant new sources of revenue for the universities. Most of the universities in Serbia tend to generate some amounts of money from their third stream activities, instead of acknowledging that their reason for engaging in technology transfer is to serve the public good. A considerable barrier to commercialising university IP lies in the questionable quality of technology transfer offices. Most universities run their own technology transfer operations, but only a few have a strong enough research base to be able to build high-quality offices on their own. Finally, it seems that there has been too much emphasis on developing university spinouts, a good number of which may not prove to be sustainable, and not enough on licensing technology to industry.

Intellectual property - It is important that the rewards from research collaboration should reflect the relative contributions of the parties to the partnership. Companies should have secure rights to the IP they want to commercialise, but it is also important that any deal on IP should not unreasonably constrain the university from publishing the results in a timely fashion, from doing further research in the same area, or from developing other applications of the same IP in different fields of use. It follows from both these points that there should be as much flexibility as possible in the distribution of IP rights between universities and business.

Regional issues - Universities are playing an increasingly important role in regional economic development, and governments are taking an active role in building bridges between business and universities across the regions and nations. The Government should encourage the development of shared services in technology transfer on a regional basis and improve the recruitment and training of technology transfer staff.

Funding university research and public-private partnership - Higher education needs to be properly funded. According to the Lampert's Review[52], the European Union countries currently invest about 1.2 per cent of their gross domestic product in this area. A figure nearer to 2 per cent would be required to make the EU an effective competitor with the best in the world. The important difference between Europe and just about every other developed economy is that private finance plays a very modest role in its university funding. Thus

[52]Lampert Review of Business-University Collaboration, HM Treasury, December 2003.

public funding for higher education represents about 1 per cent of GDP for the 25 EU countries; roughly the same proportion as in the US. But private funding in the US amounts to a further 1.4 per cent of GDP and the average in countries of the Organisation for Economic Co-operation and Development is 0.8 per cent, compared with only 0.1 per cent for Europe. If Universities are to be supported increasingly by private funding, from business, endowment, and third stream activity, it is important that the hard won autonomy from the state is not replaced by limitations imposed by private finance.

Skills and people - Companies are broadly satisfied with the quality of the graduates they recruit, although there are some mismatches between their needs and the courses offered by universities. Prospective students would benefit from clearer market signals about what was happening with graduates in terms of their employability and pay. Workplace experience is important to students, as is the opportunity to develop entrepreneurial skills. This suggests that universities could be doing more to provide continuing professional development to business employees.

Contract research, collaborative research and consultancy - are three forms of collaboration between business and universities. In contract research, the business pays the university researchers to undertake a specific piece of research on its behalf. The business will receive the results of the research but is not actively involved in the work other than in commissioning it. Companies often use contract research for specific pieces of near-market research and testing, and universities will tend to charge at least the full economic cost for this work. In collaborative research, the business and university researchers work together on a shared problem. Collaborative research tends to be more fundamental or pre-competitive in nature than contract research. Industry scientists and engineers will work alongside academic scientists and engineers on the research project. The research is co-funded by business and the university or a public sector body such as one of the Ministry of Education, Science and Technology. Consultancy takes the form of expert advice or analysis services. In practice the difference between consultancy and contract research is blurred – but the general distinction is that in consultancy the academic provides advice to the business rather than actually conducting research.

3.3. Recognizing central position for education, research and innovation in Serbian society

Research, education and innovation are three central and strongly interdependent drivers of the knowledge-based society. Together they are referred to as the "knowledge triangle". To realise ERA, research needs to develop strong links with education and innovation. The close interaction between research and training activities in universities is what gives them their unique and crucial role in the Serbian society. This is why it is so important to have modern, excellent universities.

In Serbia, there is still a need to improve management and organisation of universities and to give them more autonomy and accountability. This will allow universities to develop their own strategies, to be involved at European and international levels and to better link their activities with the needs of society and industry. In some cases, concentration and specialisation will be necessary to create centres of excellence competitive on the global scale. The mobility of graduate students and researchers is the necessary complement of such evolution.

Serbian universities have potential, but this potential is not fully harnessed and put to work effectively to underpin drive for more growth and more jobs. As a result, they are behind in the increased international competition for talented academics and students, and miss out on fast changing research agendas and on generating the critical mass, excellence and flexibility necessary to succeed. These failures are compounded by an insufficient funding. The clear sign of recognition of education, research and innovation as key drivers to overcome a deep crisis could be governmental support in founding and promoting and creative overlapping of these areas.

Serbia needs to: a) allow for a continous enhancing of the quality of education, b) to stir up significant investments into research and development both on the side of economy and on the side of public sector, and c) allow for the functioning of an institution. As a necessary precondition, the innovative surrounding in the country needs to allow and in practice conduct the guaranteed rights to creativity, difference and freedom of making decisions. To justify the position of strategic relevance for innovations, education and research, it is necessary to ensure their efficiency. This target capability for creating new results is not possible to achieve in an isolated environment. The key regulatory factor is an innovation system led by the needs of consumers and users in the case of a private sector, but also citizens in the case of public institutions. The control role of customers can be achieved only on the basis of a free market helped by encouragement measures and innovation processes in which both producers and consumers take part. Encouragement measures and innovation capacity of an enterpreneur are key factors.

The brunt of the knowledge triangle is at Serbian universities which have to prepare themselves for incoming years through new partnerships with business community and readiness to provide the right mix of skills and competencies for the labour market.

Incentives for structured university partnerships with the business community

Structured partnerships with the business community (including SMEs) bring opportunities for universities to improve the sharing of research results, intellectual property rights, patents and licences (for example through on-campus start-ups or the creation of science parks). They can also increase the relevance of education and training programmes through placements of students and researchers in business, and can improve the career prospects of researchers at all stages of their career by adding entrepreneurial skills to scientific expertise. Links with business can bring additional funding, for example to expand research capacity or to provide retraining courses, and will enhance the impact of university-based research on SMEs and regional innovation.

To secure these benefits, most universities will need external support to make the necessary organisational changes and build up entrepreneurial attitudes and management skills. This can be achieved by creating local technology transfer offices serving as an interface with local/regional economic operators. This also implies that development of entrepreneurial, management and innovation skills should become an integral part of graduate education, research training and lifelong learning strategies for university staff.

While the public mission and overall social and cultural remit of Serbian universities must be preserved, they should increasingly become significant players in the economy, able to respond better and faster to the demands of the market and to develop partnerships which harness scientific and technological knowledge. This implies recognising that their relationship with the business community is of strategic importance and forms part of their commitment to serving the public interest.

Providing the right mix of skills and competencies for the labour market

In order to overcome persistent mismatches between graduate qualifications and the needs of the labour market, university programmes should be structured to directly enhance the employability of graduates and to offer broad support to the workforce more generally. Universities should offer innovative curricula, teaching methods and training/retraining programmes which include broader employment-related skills along with the more discipline specific skills. Credit-bearing internships in industry should be integrated into curricula. This applies to all levels of education, i.e. short cycle, Bachelor, Master and Doctorate programmes. It also entails offering non-degree courses for adults, e.g. retraining and bridging courses for students not coming through the traditional routes. This should extend beyond the needs of the labour market to the stimulation of an entrepreneurial mindset amongst students and researchers.

While the integration of graduates in the labour market is a responsibility shared with employers, professional bodies and governments, labour market success should be used as one indicator (among others) of the quality of university performance, and acknowledged and rewarded in regulatory, funding and evaluation systems.

3.4. Harmonization with EU strategic goals and regional strategies

The Republic of Serbia, as a European state, should accept both EU strategic goals and regional strategies harmonizing its own goals with them.

The Europe 2020 strategy highlights the key role of innovation in contributing to smart, sustainable and inclusive growth. Regions are important sites for innovation because of the opportunities they provide for interaction between businesses, public authorities and civil societies.

The mechanisms by which universities contribute to regional development

There is a range of ways in which universities can and do contribute to regional development and smart specialisation. However, within each of these roles there are a range of mechanisms which can be employed, either as individual projects or collectively as part of a wider programme or strategy to support a regional development agenda.

In reviewing these mechanisms it is important to make a distinction between the regional impact of 'normal' university activity financed as part of the core business of teaching and research and purposive regional interventions initially funded from a source outside higher education and then hopefully 'mainstreamed'. Individual mechanisms can vary in their complexity. At one end of the spectrum are fairly straightforward 'transactional' services in response to the stated need or demand; at the other end of the spectrum are more developmental or 'transformational' activities which recognise latent or unstated needs.

Why universities are important for regional development

At the most basic level, universities can be anchor institutions in local economies as major employers across a wide range of occupations, purchasers of local goods and services, and contributors to cultural life and the built environment of towns and cities. Regional investment in the infrastructure of a university to support its core business of research and teaching can therefore have a significant passive regional multiplier effect even if the university is not actively supporting regional development.

More active contributions that universities can be broken down into four areas – business innovation which is closely linked, although not exclusively, to the research function of the university, human capital development linked to the teaching function and community development linked to the public service role of universities. The fourth area is the contribution of the university to the institutional capacity of the region through engagement of its management and members in local civil society. These are the four areas covered in the OECD reviews of the universities and regions. Where these four domains are integrated, the university can be seen to be occupying a "proactive" and not just "passive" role in the regional development process.

Pivotal role to play in the social and economic development

Universities have potentially a pivotal role to play in the social and economic development of their regions. They are a critical 'asset' of the region; even more so in less favoured regions where the private sector may be weak or relatively small, with low levels of research and development activity. Successful mobilisation of the resources of the university can have a disproportionately positive effect on their regional economies and achievement of comprehensive regional strategies.

In order to effectively engage universities, public authorities need to understand the principles underlying why universities can be important agents in regional development. There is also a range of mechanisms available to support engagement, many of which are already being deployed. However it is the strategic coordination of these within a wider policy context that will produce the maximum impact.

It is important to recognise that there may well be a series of complex barriers and challenges to be overcome, both internal to the universities and in the wider enabling environment. If public authorities and the key regional partners understand the principles, practices and barriers and how to overcome them, the potential for maximising the contribution of universities is almost boundless. Achieving this is a long term objective and will require a staged approach moving from simple projects to more integrated collaborative programmes.

Following the adoption of the SEE 2020 and the endorsement of high-level regional headline targets for growth by the SEE region's Ministers of Economy, the Regional Cooperation Council (RCC) and its partners initiated the development of a regional SEE 2020 strategy, as the main regional framework for growth. The strategy is based on five pillars:

a) Integrated growth - through deeper regional trade and investment linkages and policies that are non-discriminatory, transparent and predictable and enhance the flow of goods, investment, services and persons within the region,
b) Smart growth - through a commitment to innovate and compete on value-added rather than labour costs in the long run,
c) Sustainable growth - through raising the level of private sector competitiveness, entrepreneurship and a commitment to greener and more energy-efficient development,
d) Inclusive growth - through skills development, employment creation and labor market participation by all, including vulnerable groups and minorities, and
e) Governance for growth - through improving the capacity of public administrations to strengthen the rule of law and reduce corruption so as to create a business-friendly environment for growth.

Although the development of a regional SEE 2020 strategy was largely inspired by Europe 2020, it was evident that the regional strategy is going to differ considerably from the EU framework in two main aspects:

1. Focus: from the regional point of view, the three pillars of Europe 2020 strategy (smart, sustainable and inclusive growth) although relevant, required considerable customization to fit with the regional context. The main alterations were envisioned along two main axes: a different emphasis within the three pillars (along with realistic and credible targets), and the need for a fourth and fifth pillar - integrated growth and governance for growth - relating to the deepening of the regional common market within a good governance framework.

2. Governance: To be able to successfully engage with SEE 2020, the region would need to develop its own version of the governance mechanisms and processes that exist in similar EU-level initiatives. Employing such mechanisms (e.g. open method of coordination), implies determining common policy goals and reform targets that are both regionally relevant and consistent with Europe 2020 priority areas. Non-binding guidelines were to be developed to help shape the transposition in national policies, and specific benchmarks and indicators were to be agreed upon to help measure progress. Finally, RCC would embark on regular monitoring and evaluation of the results achieved. Similar to other areas of regional cooperation, no enforcement mechanisms could exist or be needed, given that the entire process would serve to continuously support policy makers in comparing developments in the region and exchanging best practice.

The process of associating various stakeholders with the pillars of SEE 2020 and the strategy implementation requires a de-centralized approach in strategy development. Bringing together the relevant contributors within each of the pillars is the first step envisioned in the strategy development process. The Republic of Serbia, as a Western Balkan Country, participated in the development of Regional R&D Strategy for Innovation in the Western Balkans region, where the implementation of the following initiatives was recognized as goal:

Research Excellence Fund. Its main objective will be to strengthen the level of research and its quality through competitive grant funding for collaborative regional research, in key scientific domains and connecting local scientists with the large Diaspora of emigrated scientists and entrepreneurs. The aim of the fund is to enhance the quality of science in the region and enable for a better participation of scientists in the region within programs Horizon 2020.

Centers of Excellence Program. These research centers will focus on research areas with comparative regional advantage to enable a regional "**smart specialization**". It will also be an instrument to foster research training and promotion of joint research. The centers will host and manage research networks in their corresponding fields. They will provide research training and promote joint (intra-regional) research.

Technology Transfer Facility. A regional technology transfer facility will help manage the regional research pool and outcomes and their transfer to industry. This facility will assist national technology transfer offices (TTOs) in the development of skills and facilitate access to technology transfer services.

Innovation Facility. This facility would work with local and international investors in the financing of regional start-up companies; provide training and business support to particularly startups, and serve as a bridgehead for the deal flow in the region through a variety of business development services and instruments.

Implementing Body. This entity will supervise and govern the implementation and updating of the strategy and its action plan. It is also envisaged that this organization would gradually also coordinate the different donor activities in the region, improving governance and effectiveness in the field of research and innovation.

4. Recommendations

The platform bridges three knowledge and policy domains – education, research and innovation - the so called knowledge triangle. Public authorities seeking to mobilize universities in support of regional development need some knowledge of all three domains, in particular national and regional policy makers involved in designing and delivering innovation strategies for smart specialization. In order to effectively engage universities, public authorities need to understand the principles underlying why universities can be important agents in regional development.

The recommendations given in the Section 4 are based on the previously presented material in sections 2 and 3 of this document. Comprehensive presentation of the state of the art in three areas with focus on their intersection along with setting of goals for the next two decades according to the relevant European documents and two Serbian strategies (Education Development Strategy in the Republic of Serbia until 2020[53], Strategy of Scientific and Technological Development of the Republic of Serbia in 2010-2015[54]) resulted in the list of recommendations for Serbian authorities, policy makers, researchers and members of the academic community.

The recommendations are aligned with major directions as stated in the conclusions of the Council of the Representatives of the Governments of the EU Member States[55], which is an official EU document that considers the role of the fully functioning knowledge triangle. In other words recommendations are oriented towards the fulfilment of the following objectives which were set by both EU and Serbian documents:

- Address major economic and societal challenges Serbia and Europe faces and contribute to the delivery of the Europe 2020 Agenda.
- Align and co-ordinate with relevant Serbian and EU policies as well as with the existing initiatives under Horizon 2020 and Erasmus for All.
- Be able to mobilize investment and long-term commitment from the business sector; have an existing market for its products or be able to create new ones.
- Create sustainable and systemic impact, measured in terms of new educated entrepreneurial people, new technologies and new business.
- Bring together a critical mass of research, education and innovation stakeholders, which would otherwise not unite.
- Require trans-disciplinary approaches and the development of new types of education across the boundaries of disciplines.

[53] http://www.srbija.gov.rs/extfile/sr/179119/strategija_obrazovanje026_cyr.zip
[54] http://www.mpn.gov.rs/images/content/strategije/strategija_naucno-tehnoloski_razvoj0224_cyr.doc
[55] Conclusions of the Council and of the Representatives of the Governments of the Member States, meeting within the Council, of 26 November 2009 on developing the role of education in a fully- functioning knowledge triangle

Having the above in mind we propose recommendations aligned in six directions:

- developing more coherence between policies in the fields of education, research and innovation,
- accelerating pedagogical reform,
- partnership between universities and business and other relevant stakeholders,
- measures to develop an innovation culture in universities,
- creating incentives for universities to develop transferable knowledge and
- new approaches to quality assessment.

Let us note that the aligning of recommendations in six directions/groups should not be considered in a strict manner, because many of recommendations from different directions lead to the fulfilment of the same goals.

4.1. Developing more coherence between policies in the fields of education, research and innovation

There is a need for more coherent policy-making fully integrating the three components of the knowledge triangle. Policies within the fields of education, research and innovation should be mutually reinforcing to ensure the development of a fully functional knowledge triangle and to speed up the transition towards a true knowledge-based economy and society.

To develop more coherence between policies in the fields of education, research and innovation, aiming strategic coordination and maximum impact, the following recommendations are proposed:

- The impact of investments in the three forms of activity - education, research and innovation should be improved by systemic and continuous interaction.
- Joined-up policy-making and cooperation between the fields of education, research and innovation at all levels are necessary for the full integration of knowledge triangle.
- For education to fulfil its role in the knowledge triangle, research and innovation objectives and outcomes need to feed back into education, with teaching and learning underpinned by a strong research base, and with teaching and learning environments developed and improved through greater incorporation of creative thinking and innovative attitudes and approaches.
- The traditional academic culture in universities needs to be complemented by an awareness that it also has a key role in delivering a more highly skilled, enterprising and flexible workforce which will form the foundation for economic growth and prosperity, as well as the improved quality of life, in the years to come.
- The cooperation between Universities and Research Institutes has to be strengthened with aim to provide “critical mass” of researchers in certain areas.
- The researchers from the Research Institutes should be involved in teaching and educational process at master and doctoral level.
- The knowledge triangle must be taken into account when developing lifelong learning strategies at national, regional and institutional level so that universities become more involved in the upgrading of skills relevant for the knowledge economy and admission rules to sufficiently recognise the value of prior learning and working experiences.
- New ideas and innovations are born from the coming together of different kinds of knowledge and through the curiosity-driven search for new knowledge. This is why, in addition to science and technology, it is crucial to recognise that quality education and research in social sciences and humanities play an important role in innovation.
- While this platform focuses on what the region can ‘get’ from its universities, it should be recognized that this is a two way process and the university benefits from its presence in the region as well. Universities should appreciate and maximize the potential of the opportunity that their region presents, not least as a ‘living laboratory’ for their research.
- Simplification is one of the most important demands for the new cohesion policy. It should be achieved through different methods, such as harmonisation of rules for several

funds, increased flexibility, increased proportionality, clarification of rules to improve legal certainty, and digitalization of documents and processes.

- The governance of research systems should imply meritocracy and transparency in grant funding; accountability, evaluation and monitoring practices, transparency and performance evaluation in terms of contributions to knowledge, local economic and social needs, and growth.
- Institutions should have a clear rationale between institutional funding – which ensures stability and project-based funding.
- Research development and innovation strategy (R&DI), should adopt stable and effective policies, practices, and funding for university performed R&D and graduate education so that the nation will have a stream of new knowledge and educated people to power our future, helping us meet national goals and ensure prosperity and security.
- Universities should review the existing academic programs from the perspectives of centrality, quality, and cost-effectiveness, adopting modern instructional methods, and encouraging greater collaboration among research investigators and institutions, particularly in the acquisition and utilization of expensive research equipment and facilities.
- Increase university cost-effectiveness and productivity in order to provide a greater return on investment in research.
- In order to increase researcher capacity the Government should increase the number of researchers – first and foremost in the area of the science and technology – coming from PhD training, and within this – at the time of forming training proportions – shall take into account the expected demand for experts in each of the professional fields.
- The Government should take stock of the proposals in the review of research assessment and in the review of the sustainability of university research. It should consider the conclusions of these two reviews together when deciding on the future direction of research funding and policy.
- There should be significantly more business input into the priority setting, decision-making and assessment panels of both of the peer review processes.
- The processes should be flexible and dynamic, capable of supporting new ideas and talent wherever they are found.
- Funding should be allocated in a way that actively supports multi-disciplinary research.
- The processes should be as simple and unbureaucratic as possible and should support the long-term sustainability of the research base.
- More attention has to be devoted to disseminating of research results to a wider audience outside academia in an accessible format.

- To promote a 'road map' for Serbian PhD students just starting out on a research career:

- start developing their network of potential consortium partners	year 0
- (send emails to other international scientists, present research at int. conferences, ask international scientists for short visits, etc.)	year 1
- write a short proposal for local funds for a small project	year 1
- write a proposal for a small bilateral international project	year 2
- write a proposal for an IPA or other international project	year 2
- join a suitable COST Action to increase networking opportunities	year 4
- be invited to be a partner in someone else's H2020 project	year 5
- become a Work Package leader in a Horizon 2020 project	year 7
- eventually write their own EU "Horizon 2020" project proposal	year 10

4.2. Accelerating pedagogical reform

Higher education based on research is the basic precondition for social, economic, and cultural development of a society. Recently developed Education Development Strategy in the Republic of Serbia until 2020[56] contains recommendations that are aimed towards the circling of knowledge triangle, and among which the following are recognized as important:

- The change of organizational structures, the way of financing and incentive measures for integration are to ensure that research and innovations development to an appropriate degree are always an integral part of higher education.
- Research within the system of higher education is to be directed towards areas that are priorities for the development of Serbia. To support applied research relying on fundamental research that in turn is directed towards priorities and which can serve as a basis for innovations. To encourage integral programs that comprise directed fundamental and applied research, the development of innovations and the necessary entrepreneurial activities of the new and the existing companies.
- To increase the share of higher education experts dealing with research and innovations in higher education institutions, institutes and companies, and thus reduce negative effects caused by demographic factors – up to the year 2020 the number of students will decrease as a fewer number of children is born, and so the number of present research associates – teachers (due to their retirement).
- To encompass a significantly larger number of associates (lecturers and assistants) by organized research work at all universities, regardless of their size or ownership structure. With strategic measures for upgrading research work at universities to encompass sources of financing, obligatory self-investment into research in proportion with the amount of revenue, international cooperation, cooperation with economy, conditions for advancing and the election of teachers and the organization of research within doctoral studies.
- To establish applied research at academies of vocational studies as one of the foundations for their forming and development. Applied research at those academies to be conducted

[56] http://www.srbija.gov.rs/extfile/sr/179119/strategija_obrazovanje026_cyr.zip

in cooperation with economy, over budget co-financed projects in the area of technological development within the framework of the support to innovation projects.

- To support the concept of 'entrepreneurial university' as it allows for such universities to be nuclei of making a new industry based on knowledge. Higher education institutions need to enable students for self-employment and to create conditions for lifelong support of their education, innovative entrepreneurship. All higher education institutions, through the teaching process or projects that student would do, should enable students for the development of innovations and entrepreneurship.
- With a special program help and encourage a higher education institution to found business incubators in which teachers and graduate students can establish firms for commercialization of their ideas and innovations development. The state will support founding of funds of risky capital due to the necessary support to entrepreneurial initiatives coming from higher education institutions; it will give incentive grants to newly established companies, pay at least a part of necessary advisory services and develop other incentives.
- In order to attract foreign companies to realize their research and development centers in Serbia, or to cooperate with higher education institutions and their research centers, there is needed a special program of support for the development of centers of research-education-economy excellence which include, according to the good practice in the world, the institutions of higher education.
- In the education of adults, higher education institutions should offer educational programs that enable fast reorienting of the employees to other fields of work, especially to those that allow for self-employment.

Additionally, the following recommendations should follow already proposed recommendations taken from the Strategy[57]:

- With the aim of further development of educational system it is necessary to develop a research approach, methods and techniques of data base, especially with research in the field of industry and determining the necessary qualifications for its development.
- Determining the educational policy for the oncoming period, identification and development of qualifications; determining the network of educational institutions is a process that needs to be based on systematic research.
- The Government should encourage education and training institutions to ensure that curricula, as well as teaching and examination methods at all levels of education, including doctoral level, incorporate and foster creativity, innovation and entrepreneurship.
- In order to provide excellency in research and high quality of the third level of higher education, the development of Inter-University PhD schools should be supported.
- The Government shall regularly measure the performance of PhD schools. In order to improve quality it should support the development of worthy doctorate schools and new

[57] http://www.srbija.gov.rs/extfile/sr/179119/strategija_obrazovanje026_cyr.zip

doctorate candidate research centers primarily located in doctorate schools carrying out successful research and training.

- Changes in the national qualification framework, which would involve transversal competences, with appropriate forms of assessment, formal recognition, and awards.
- Curricula should be developed on an ongoing basis in cooperation with research institutions, industry and other stakeholders, as appropriate. The whole education and training system should support the fostering the key competences necessary for a well-functioning triangle.
- Adequate collaboration with the alumni (ex-students of an institution of higher education) in order to improve the study programs and advance the area of education and keep pace with the national and worldwide trends.
- Ministry of Education, Science and Technology Development should require universities to publish information in their prospectuses on graduate and postgraduate employability for each department. This information should include: employability statistics and first destination data – to allow students to see whether particular courses are likely to be useful for specific careers; Starting salary data – to give students an indication of the value that employers place on graduates from particular courses.
- The new teaching and learning paradigms in higher education should imply:
  - new relationships regarding access to teachers, and a wider range of communication and collaborative working through learning platforms,
  - bridging teaching and research more intensively,
  - re-thinking of student workload and teaching load,
  - continuous upgrading in pedagogy, use of technologies, assessment models aligned with student-centred learning,
  - creating of innovative learning platforms,
  - providing guidance and tutoring to students with new means and methods,
  - assessing impacts and documenting effectiveness of the teaching delivered.

4.3. Partnership between universities and business and other relevant stakeholders

Active contributions that universities can make could be broken down into four areas: 1) *business innovation* - which is closely linked to the research function of the university, 2) *human capital development* - linked to the teaching function, 3) *community development* - linked to the public service role of universities, and 4) *contribution of the university to the institutional capacity of the region* - through engagement of its management and members in local civil society. Where these four domains are integrated, the university can be seen to be occupying a "proactive" and not just "passive" role in the regional development process.

The recommendations regarding the partnership between universities and business and other relevant stakeholders are the following:

- Government should respond promptly to enhancing partnerships between education and businesses and social partners.
- In the context of developing closer links between universities and the communities which they serve, particular attention should be given to the development of incentives for staff mobility between the university and business sectors, including staff exchange programmes.
- Mobilising universities needs to be addressed in a 'holistic' way and not just by focussing on transactional interventions such as consultancy services for local companies. It is tempting to focus on transactional mechanisms as they have clear outputs such as the number of firms assisted.
- More developmental programmes such as contributing through teaching to a regional human capital development programme linked to research based support to regional companies.
- The partnership established in the region should specifically address the issues of engagement between universities and regions and particular attention should be given to ensuring the sustainability of partnerships in the longer term, independently of funding cycles.
- Universities should work together with regional authorities to attract and retain the talents.
- Universities should play a key role in defining regional smart specialisation strategy by contributing to a rigorous assessment of the region's knowledge assets, capabilities and competencies, including those embedded in the university's own departments as well as local businesses. According to ***smart specialization strategy (S^3)***[58] "the identification of the knowledge intensive areas for potential growth and development are related to the role of certain classes of players (researchers, suppliers, manufacturers and service providers, entrepreneurs, users) and the public research and industry science links. The players are regarded as being the agents who use the knowledge acquisition facilities and

[58] Philip McCann and Raquel Ortega-Argilés (2010).Smart Specialisation, Regional Growth and Applications to EU Cohesion Policy.

resources (human capital, ideas, academic and research collaborations) to scan the available local economic and market opportunities, to identify technological and market niches for exploitation, and thereby act as the catalyst for driving the emerging transformation of the economy".

- Research, science and technology policy at national level is increasingly emphasising the importance of collaborative research between universities and the public and private sectors.
- Universities should work with regional authorities to further exploit potential to move from being located in a region to being part of the region by taking action to make contributions to the design and implementation of smart specialisation strategies in the local learning and capacity building process.
- In order to develop the ability and readiness of domestic research centers and companies towards international cooperation, international knowledge and technology transfer, as well as the mobility at international level must be promoted.
- As many Serbian researchers as possible should participate in the international cooperation networks and engage in research of new global challenges. The attracting force of the domestic R&D&I sector should increase for the young generation of researchers.
- Government should promote the connecting of Serbian researchers into international networks, as well as their access to large international research installations.
- Essential, and not formal, acquisition of international and intercultural competences.
- Government should seek ways of directing a higher proportion of its support for business R&D towards SMEs.
- A priority should be to identify non-collaborating SMEs that have the potential to gain significant benefits from working with universities.
- Regional Development Agencies (RDAs) should be established to promote building business-university collaboration. They should set a specific milestone for building business-university links.
- The Government should build a region's infrastructure for collaborative R&D projects with universities.
- It is recommended that a partnership is established in the region to specifically address the issues of engagement between universities and regions and particular attention is given to ensuring the sustainability of partnerships in the longer term, independently of funding cycles.
- It is recommended that Regional Partnerships consider participating in the OECD programme of regional reviews in order to help identify their current strengths and areas that may require capacity building and consider carefully the findings of EUA and ESMU programmes.

4.4. Measures to develop an innovation culture in universities

Government should straighten the existing measures and develop new ones to encourage universities to accelerate their efforts to develop an 'innovation culture' through more dynamic and interactive learning environments and incentives to staff to engage in projects with an innovation dimension. The recommendations regarding the measures to develop an innovation culture in universities are the following:

- The methodological approach to implementation of such measures should be demand driven, bottom-up and pull versus push.
- Funding arrangements and incentive structures at institutional level could be developed to foster a 'cultural change' so that cooperation with industry is recognized as an important factor for career advancement.
- Potential contribution of the Arts, Humanities and Social Sciences to regional development and innovation should not be neglected.
- It is recommended that Managing Authorities and Universities adopt a broader definition of innovation to acknowledge the role that arts, humanities and social sciences can play, especially in responding to mechanisms that draw on the expertise and contribution from these disciplines to issues like regional entrepreneurship, creativity and social inclusion which form key dimensions to territorial development.
- Education for entrepreneurship should be introduced into the educational system because of its great relevance for the development of entrepreneurial spirit and the positive attitude towards entrepreneurship with young people, which has been recognized as one of the priorities in the developmental policies of EU.
- Systematic approach is required in introducing entrepreneurial learning, as a key competence, into all levels of the formal educational system, not only of higher education, but also lower, general higher education and higher education.
- Higher education system is required to develop modules that enable young professionals to manage the entire cycle of enterprise development and implementation of new technologies. From the initial idea development, implementation of necessary technology and research, through creating action strategies, credible marketing and sales materials, construction team of employees, partners and investors, to production management, finance and operations.
- Promoting three main thematic areas deployed by universities to support entrepreneurship among students and recent graduates:
    - training in the skills of 'being enterprising',
    - providing business experience through placements in local SMEs,
    - supporting them in the creation of new ventures and the exploration of new business opportunities. This support can include things like: assistance with compiling a business plan, free office space and equipment, free access to meeting and administration areas.

4.5. Creating incentives for universities to develop transferable knowledge

Government should examine whether there are adequate incentives for universities to develop knowledge which can be transferred to the wider economy for development into innovative goods and services. Where legal provisions, governance structures or financial provisions prevent institutions from making a profit from such knowledge development and transfer, government should seek to adjust the framework within which their institutions operate so that such barriers are removed and universities are given sufficient autonomy.

The recommendations regarding creating incentives for universities to develop transferable knowledge are the following:

- Investment in people development within the university and its regional partners should be permanent.
- The Government should establish Knowledge Transfer Partnerships programmes and market them to businesses. Increasing the regional focus of the scheme would allow it to be tailored more closely to the needs of local businesses.
- The Government should increase the level of funding for technology transfer and knowledge transfer training to stimulate the development of new training courses.
- Capacities for creation of transferable knowledge should be critically assessed (both internally through self-evaluation and externally through expert peer review processes).
- Universities, business communities and other public sector authorities should demonstrate their commitment to the process by investing in their own development.
- Design and provision of training programmes in direct response to employer needs can have a significant impact on the regional economy.
- Moving beyond traditional delivery models to tools such as distance learning, on-site teaching, modular programme design, new approaches to accreditation and better use of private sector in design and delivery of training programmes.
- Development of labor market intelligence and future skills forecasting.
- Universities and Technology Transfer Offices in Serbia should establish a database of academics with relevant qualifications who are interested in becoming non-executive directors on company boards and should arrange training for them in this role.
- The Ministry of Education, Science and Technology Development and the National Council for Science and Technological Development of the Republic of Serbia, in consultation with universities, industry representatives, should agree upon a protocol for the ownership of IP in research collaborations. Concerning the IP protocol:
  - The common starting point for negotiations on research collaboration terms should be that universities own any resulting IP, with industry free to negotiate license terms to exploit it.
  - If industry makes a significant contribution it could own the IP.
  - Whoever owns the IP, the following conditions need to be met:
    1. The university is not restricted in its future research capability.

2. All applications of the IP are developed by the company in a timely manner.
3. The substantive results of the research are published within an agreed period.

- The protocol should recommend flexibility where possible to help ensure that the deal is completed.
- The Ministry of Education and Research and Technology Development and the National Council for Science and Technological Development of the Republic of Serbia should require universities to apply the protocol in research collaborations involving any public funding.

4.6. New approaches to quality assessment

In particular for higher education, all stakeholders should be involved in the development of 'knowledge triangle' criteria for assessing the quality of their institutions, which should focus on how successfully research and innovation have been integrated with teaching and core educational functions and how successful the institutions are in creating learning environments that stimulate creativity and entrepreneurial approaches to harnessing knowledge and in preparing its students for their future social and economic lives.

The recommendations regarding to the quality assessment are:

- Harmonization of standards with changes in European Standard Guidelines[59].
- Development of subject-specific standards.
- Improvement of standards for doctoral studies.
- Improvement of external quality control procedures to include follow-up.
- Involvement of international experts.
- Continual improvement of expertise of administrative officers.

[59] http://www.eqar.eu/application/requirements/european-standards-and-guidelines.html

5. Best practice examples

5.1. Business Technology Incubator of Technical Faculties Belgrade

The Business Technology Incubator of Technical Faculties of Belgrade, L.L.C. was established in 2006 as partnership between four technical faculties of the University of Belgrade (Civil Engineering, Mechanical, Electrical and Technological/Metallurgical), the Municipality of Palilula and the Democratic Transition Initiative. The project was supported by the Organization for Security and Cooperation in Europe based on an international experiences and best practice examples. Objectives of BITF establishment:

- To encourage and support young and educated people in starting up their own business and to keep them in Serbia
- To create the conditions for commercialization of the results obtained through science and research activities of university professors and their associates, by spinning of private enterprises
- To facilitate the creation of new Hi-Tech SMEs


The BITF has achieved very impressive results for the first 5 years of operation:

- **600** m^2 of renovate business space
- **500** students has passed the different trainings programs on entrepreneurship
- **200** young people engaged and employees in incubator and in tenant companies (including 15 returnees from abroad)
- **35** small enterprises tenants of the incubator
- **25** new technologies/services developed in innovation projects, 2^{nd} phase currently developing
- **1**service center was developed (set of legal, accounting and financial services, business plan, protection of intellectual property and project center)

Over 70% of income of these companies comes from export. And especially emphasize that a number of companies in the Incubator opened returnees from abroad.

5.2. Best Technology Innovation Competition

In order to stimulate others to create entrepreneurial ventures and ease their first innovative steps into business, a team of professors and assistants from the Faculty of Engineering started The Best Technology Innovation Competition[60] (first at the University level in 2003, and later on at the national level since 2005). The most important pillar of this Competition is education of innovators on how to create a market for their innovations. The results gained through the competition are (more than) 70 established high-tech companies (not all of them reported after the competition is finished), 3612 researches, innovators or companies were educated, 529 business plans and 176 market plans were written. The Best Technology Innovation Competition is in its ninth year, organized by the Ministry for Education, Science and Technology Development of the Republic of Serbia, with the support of the Faculty of Engineering of the University of Novi Sad, Serbian Chamber of Commerce, Radio and Television of Serbia, and Intellectual Property Rights Office of Serbia, as well as the Ministry for Science and Technological Development of the Republic of Srpska. The whole process begins in February and finishes in December. During that period, teams of innovators prepare application, business plan, executive summary, power point presentation and elevator pitch in different stages of the competition. Finals are directly broadcasted on the national TV (prime time, just before the New Year's Eve) when six of the best are competing for the first place.

In order to accomplish each stage of the competition, teams receive different sets of trainings which help them better fulfill their tasks. Trainings are interactive, skill oriented and provided with Serbian innovative start-up examples.

Competition targets three categories of participants: researchers/students, innovative SMEs and individual inventors. Only teams of minimum three persons may apply. They need to fulfill different criteria for different categories.

The results of the previous eight years of the Competition for the Best Technology Innovation are: more than 70 newly established high-tech companies; database of 3990 innovators/innovative companies in Serbia; 3612 trained researchers, high-tech companies, students, innovators, etc.; 529 teams made the business plan, and 176 teams made the marketing plan; 250 reviewers (2/3 of them coming from Serbian diaspora with long time experience in market economies all around the globe); 337 trainings held throughout Serbia (Belgrade, Novi Sad, Kragujevac, Kraljevo, Niš, etc); 62.000.000 dinars awards from the Ministry of Science and Technology Development of the Republic of Serbia; 8,515,000 dinars awarded as special prizes from other organizations; the rating of the finals on the national television RTS (20 hours total on RTS2): more than 800,000 viewers (14% of the total) in peak time; support of the EAR - European Agency for Reconstruction in 2007 (financing of additional promotional and educational training, publishing 1,500 copies of the book "Guide for innovative entrepreneurs", and four episodes of innovative entrepreneurship in Serbia); cooperation with the Ministry of Science and Technology, Republic of Srpska

[60] www.inovacija.org

(Bosnia and Herzegovina) from 2007; and cooperation with the GTZ, Serbian network of business angels (SBAN), SIEPA, VIP, and VIK in 2010 - preparation of selected companies for business angels.

5.3. UNESCO Chair for Entrepreneurial Studies

UNESCO Chair for Entrepreneurial Studies (UCES)[61] was established at the University of Novi Sad in 2006 as a part of UNITWIN programme with the aim to promote and encourage education, research and exchange of academic staff and to create a platform for information exchange in all the most important UNESCO activities.

UCES aims to become a centre of excellence in teaching and research in the field of entrepreneurship and tends to work on capacity building at different levels: 1. Professional and personal development of both students and teachers (regional and international conferences, summer schools, workshops organized together with regional international partners in the field of entrepreneurship); 2. Development and promotion of entrepreneurial culture among students and young staff as well as in the wider environment (organization of public lectures on entrepreneurship and other forms of lifelong learning at UNS; workshops, seminars, conferences, training organized together with chambers of commerce, NGOs and other stakeholders; publications, textbooks and different materials for entrepreneurship promotion); 3. Investment in educational and research resources (from infrastructure to teaching/learning materials, databases, software, books, journals); 4.Development of career guidance services for students; 5. Enhancement of the university - alumni relationships by involving alumni in teaching and research projects as learning resource (through shared experience and good practice) as well as funding source (based on a "giving back" approach).

UCES has the support of the Serbian National Commission for UNESCO.

Together with the UNESCO Chair for Entrepreneurship Studies at the University "J.J.Strossmayer" in Osijek, Croatia, UCES is the only Chair of that kind in the region of South - East Europe.

UCES actively works in two parallel fields. One field has been Regional one year long Master studies in Entrepreneurship (in English). We have three generations who finished our master studies. Second field of work has been delivering trainings for SMEs developed through HELP (Higher Education Learning partnership) project. The HELP project is linking education and business in the Great Plain region of Serbia, Croatia, Romania and Hungary. In each of the partner countries the project has established a Higher Education Learning Partnership (HELP). The main objective of the HELP project is to initiate dialogue between the education and business sectors on the status of skill shortages at the local level. A hundred participants received business skill trainings with the certificate of the University.

[61] www.unescochair.uns.ac.rs

5.4. Technology incorporation at the University of Novi Sad

Technology transfer is a modern paradigm implying the possibility to license IPR from research institutions to companies, either existent or new. Experience shows that Technology transfer offices have little if any success, and that the costs of their maintenance are usually higher than the income they provide. On the other hand, Technology Incorporation, as introduced by the Silicon Valley example, shows tremendous earnings when a newly developed IP is incorporated into a company whose founders have the tacit knowledge (know-how) needed to transform it into a marketable product. At the same time, researchers are not born managers, and usually make errors during the growth period of the company.

Researchers should be enticed to try the entrepreneurial venture, in order to market their inventions. On the other hand, they should be aware that as soon as the new company takes off at a larger extent, they should engage a professional manager and slowly exit from the business with a profit. Their home institutions should participate in the profit as well, and should seek their sustainability through this process.

The University of Novi Sad has fully grasped the idea. Professors/researchers have an active role in establishing companies upon their research. As a result, 77 spin offs are established at the University of Novi Sad, which produced 44.40 million Euros in 2011, and created 1267 direct jobs, as well as more than 800 indirect ones (honorary engagements, internships, fellowships, contracted R&D, etc.). Predominately, these spin offs are in the ICT sector and come from the Faculty of Engineering (aka Technical Sciences).

The most successful of these companies were established during the turbulent times of nineties (embargo, hyperinflation, etc.) or soon after. In order to be profitable in those times, they turned to ICT sector, since this sector requires low investments, renders income from day one, and in the long run yields scalable products, where effort made once can be turned into successful sales a large number of times.

Research process and knowledge-based innovations has an important role in their success. These spin offs have became a benchmark for new researchers at the University of Novi Sad and more widely.

Table 5.4.1. UNS hidden champions[62]

Name	Market leadership definition	Revenues 2011 (in M €)	Revenues 2000 (in M €)	Average employees 2011
RT-RK	For the last 4 years leader on EU, USA, Turkish, Israeli and Russian markets in providing cost efficient software and hardware solutions for the automatization of functional testing of multimedia devices, especially set top boxes and TV sets.	8	0.5	250
EXECOM	Leader in Custom Software Solutions Market in Western Europe for the past couple of years	2.2	0.04	55
Schneider Electric DMS	Undisputed #1 worldwide leader on the market of software for power distribution companies	16	0.2	470

In order to fully support this technology incorporation process, a high-tech incubator which has so far started the incubation of 12 companies in its limited premises (just 400 m2).

The wisdom underlying all these activities is an inspiring vision, the belief in one's work and focus on how to live off own knowledge in Serbia.

[62] Company feedbacks and www.apr.gov.rs/

5.5. Nis Cluster of Advanced Technologies - NiCAT

History

The cluster was established in 2011. as a bottom up (initiative of SMEs in Nis region) and top down initiative (international SECEP project) with the Vision of making the region of Southeast Serbia the center of development of Advanced Technologies in the Balkans.

Who we are

- 25 successful domestic and foreign SMEs
- Faculty of Electronic Engineering, Faculty of Mechanical Engineering
- Regional Development Agency South, Regional Chamber of Commerce Nis, Business Incubator Center Nis

Fields of Operation

- Electromedicine
- Electronics and Automation
- Mechanical Engineering
- ICT
- Optoelectronics

Our Goals

- Increasing the turnover of the cluster members on both national and international market
- Strengthening the capacities of the companies for technological development and innovations and for the development of new technological products and services
- Promoting the City of Nis as a favorable location for business operations in the field of advanced technology

Successes

NiCAT members have been recording permanent growth since 2010. in number of employees and in their turnover and on domestic and international markets. The number of NiCAT members has increased from 13 to 25. Numerous trainings and educational programs have been realized and the Cluster Academy is in the process of establishing. Several projects are being implemented, independently and with partners (Ni-KAT InterSTART, Center of Excellence and Innovations, cross-border ATM Integration project, Application for TEMPUS). The roadmap to EU funds has been developed and is currently being implemented, a vast network of contacts around the world has been achieved, and a model of systemic cooperation with universities has been initiated. Advanced technologies have been identified as key priority for the development of the region; several changes at higher levels have been ensured through lobbying. Likewise, partnership and cooperation has been established with numerous international development programs and leading clusters in the country and abroad, and the cluster manager has been invited to several conferences in the country and the world by the organizers to present NiCAT as an example of good practice. NiCAT is ready for collaboration and open to partnerships.

5.6. University of Kragujevac in knowledge triangle integration

Within the Tempus project WBC-VMnet (**www.wbc-vmnet.kg.ac.rs**) efficient and effective mechanisms and structures for collaboration between key actors in the knowledge triangle have been established and implemented throughout the WBC (Western Balkan Countries) region.

The most important result of the project is the development and implementation of the new **WBC regional model of university-enterprise cooperation**, as a product of a joint activity of 13 project partners from 7 countries (Italy, Slovenia, Denmark, Serbia, Croatia, Montenegro and Bosnia&Herzegovina.

The network of four Collaborative Training Centers (**www.ctc.kg.ac.rs**) was established in 2009 in the WBC region (Kragujevac, Rijeka, Banja Luka, Podgorica). One of the activities of CTC centres within the project was the development of methodology and the implementation of a comprehensive **TSNA analysis** (Training & Service Needs Analysis), which was carried out in the WBC region. CTC offers 18 customized trainings for enterprises and unemployed. A total of 300 trainees sucessfully finished trainings in the past.

Establishing communication between the key actors in the knowledge triangle goes through **VMnet network** (**http://cevip.fink.rs**), which now has more than 1400 members from WBC region (enterprises, SMEs, institutes, faculties, universities, development agencies, managers, students, young researchers, etc.) and 18 experts from WBC region.

In 2011 Collaborative Training Center of University of Kragujevac established **VRPM** (Virtual/RapidPrototyping/Manufacturing, **https://cordis.europa.eu/partners/web/vrpm-group#**) group at CORDIS portal, with the aim to propose and implement joint FP7/HORIZON projects with enterprises, SMEs, in the area of rapid and virtual product development and manufacturing. The VRPM group has 72 members from more than 20 countries, gathering 12 SMEs from Serbia and 15 Serbian researchers and R&D groups.

In order to improve the existing practical placement realization at WBC engineering area, WBC-VMnet project developed and implemented **Practical Placement Program** (PPP) providing the opportunity for students to gain practical experience and further develop their professional, technical and interpersonal skills. During the period 2010-2012, 10 students realized PPP in EU countries, 12 in other WBC countries and more than 200 PPPs were realized at a local/national level.

Also, CTCs developed and implemented **Industrial fellowship program** (IFP)as one of the proven good ways for the efficient transfer of knowledge and technology, and commercialization of the research results.Since established in 2011 within four CTC centers in the WBC region, the total of 30 industrial fellows have participated within different areas, in accordance with their companies' needs.

Comparing the state in the area of knowledge triangle integration in the WBC region before the project and now when the project is finished, the following **positive changes** can be stated:

- Introduced new WBC Regional model of university-enterprise cooperation,
- Established four CTCs that act as support organizations for domestic SMEs,
- Rapid product development concept based on VM technologies introduced, applied and verified through case studies and bilateral R&D projects with enterprises,
- VMnet network gathers 1400 members from academic, business and government community,

- TSNA methodology developed and implemented for advanced services and trainings,
- Customized specialized trainings fit well to expected learning outcomes of trainees leading to improved graduate employability and better position at labour market,
- Set of trainings at EU institutions has improved in trainees knowledge and skills,
- Students had an opportunity to gain new practical knowledge and skills within PPP,
- Industrial Fellowship Program is mutually beneficial to the fellow, enterprise sponsor and university,
- New and unique equipment and software for application of VM technologies in rapid product development generates collaborative environment among CTCs and enterprises in WBCs.

5.7. CAPINFOOD project at Faculty of Agriculture, University of Belgrade

Cofounded by European Union through the South East Europe Transnational Cooperation Programme, CAPINFOOD project (2012-2014) aims to improve the enabling environment for food innovation by capacity building of the supporting institutional framework and by promotion of public awareness on benefits of innovations in the food sector through transnational cooperation. CAPINFOOD consortium comprises 13 experienced partners from 11 countries: Belgium (UGENT), Bosnia-Hercegovina (ESU), Bulgaria (PU), Greece (SEVT), Hungary (BZN, CCH, SZT), Italy (UMIL), Montenegro (SED), Romania (IBA), Serbia (UB), Slovenia (GZS) and Ukraine (UZH). The Faculty of Agriculture, University of Belgrade, is responsible institution for the implementation of the CAPINFOOD project in Serbia.

To accomplish the mentioned major aim, the Faculty of Agriculture, as the project partner, is performing the following activities:

- the development of national innovation strategy following a common framework for improving the competitiveness of food sector, particularly SMEs, to help the economic growth, creation of jobs and ensure sustainable development;
- the completing of the preparatory activities and launching of the National Technology Platform (NTP) “Food for Life”;
- the improvement of the coordination mechanism of efforts for enhancing innovation through new approach of collaboration of governance institutions and other stakeholders within the NTP, exploiting the potential in transnational collaboration of NFTPs;
- the development of the skills of supporting institutions in using effective tools to foster innovation: food chain management, transdisciplinary collaboration with ICT sector, knowledge transfer and practices of using industry panels, based on collective learning and shared costs;
- the promotion of the use of ICT based tools for fostering innovation;
- the development of the pilot systems for institutions for provision of collective innovation support services for food SMEs;

- the improvement of the recognition of food innovation and entrepreneurship by the public through delivering a campaign and access to young people to encourage them to join the food sector and develop entrepreneurial spirit. One of the activity in this scope, which will be organized for the first time in Serbia in 2013, is national competition ("EcoTrophelia Serbia") for the student's teams in the creation of eco-innovative food products that potentially can be interesting for the market. The best student's team will be invited to represent Serbia at European competition "EcoTrophelia Europe", that will be held at the world's leading food fair Anuga, Cologne, in October 2013;
- the dissemination of the results to a wider community and also beyond the food sector;
- the establishment of an SEE regional forum for concerting efforts and sharing; successful approaches of different types of food innovation supporting, research and education institutions and organizations.

Capacity building tools for improving governance (national innovation strategies, operating industry innovation panels, best practice guides, ICT solutions) and tools for increasing public awareness (communication campaigns, virtual forums) for the support institutions are in the last stage of development. Train the trainers courses on food chain management, using ICT based solutions in the food sector and knowledge transfer have been provided for the key project staff. After the end of the project the SEE forum, which is already established in 2013, will be performed for transnational collaboration in order to enhance innovation in SEE by exchange of experience and integration of knowledge.

Coordinator of the CAPINFOOD project in Serbia is Prof. Dr. Viktor Nedovic, Coordinator of Serbian National Technology Platform "Food for Life" and President of the Serbian Association of Food Technologists (SAFT).

CAPINFOOD

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