The Future of South-East Europe in 2050: R&D Needs of the Region

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1. Where are we?

More than 25 centuries ago South East Europe (SEE) has been the cradle of science and democracy. Throughout history SEE has been the border among civilizations and a periphery of Europe. Presently, some countries in SEE are member states of the EU, some are candidates and some are in transition. This area constantly contributed to science, the humanities and education, but now not a single university in this area is among the top world 500 universities, area is plagued by brain-drain, it does not have a single major international centre of excellence, its contribution to world science estimated either through the percentage of the total number of publications (in 2001 it is estimated to be less than 1.5%, Greece itself contributes 0.62%) or as a percentage of a total number of citations (estimated to be less than 1%, again Greece contributes 0.41)[1)], and R&D is definitely not a top political priority.

As an example we will briefly summarize main accomplishments in research and development (R&D) and education in Croatia. Then, we will present indicators assessing education and R&D in SEE (providing more data on Croatia), and their social impact.

1.1. Brief history of R&D and education in Croatia

Benedictines arrived in Croatia already in the 8th century and established many educational centres. In the 12th century Hermanus Dalmata is a leading figure in transferring Greek and Arabian science to Europe. Bishop A. Kažotić performed a first education reform in the 14th century. First university was founded in Zadar in 1396 by the Dominicans. Archbishop Ivan Vitez and his nephew Janus Panonius founded universities throughout the Hungarian-Croatian kingdom. The University of Zagreb was founded in 1669. Croatia now has 6 universities: Zagreb, Rijeka, Split, Osijek, Zadar and Dubrovnik, 6 polytechnics and 17 certified public and private colleges, and 28 research institutes. The Academy of Sciences and Arts was established in 1861. A list of prominent scientists F. Petrić, F. Vrančić, M. Getaldić and M.A. de Dominis culminates with Ruđer Bošković (1711-1787) whom Nobel laureate Leon Lederman ranks among the greatest scientists ever. Important scientists in the late 19th and 20th centuries were: D. Gorjanović-Kramberger, discoverer of the Neanderthal man in Krapina near Zagreb in 1899, A. Mohorovičić who analysed the Zagreb earthquake in 1906 and proposed a discontinuity, now called moho-layer, and M. Milanković who formulated the mathematical theory of long-term climatic variation. Nikola Tesla was an outstanding inventor – a true genius of modern electricity and the unit of the magnetic induction is named after him. Tesla and M. Demerec worked in the USA. M. Demerec was one of the founders of molecular biology and the director of Woods Hall Institute in the USA. Two Nobel prizes in chemistry were awarded to Croats: Lavoslav Ružička in 1939 and Vladimir Prelog in 1975. Though both of them got their prizes while at ETH-Zuerich, Prelog is a founder of the Zagreb school of organic chemistry which at his time was the most productive group in organic chemistry in the world. Social impact of knowledge lists the introduction of the first quarantine in Europe in the Republic of Dubrovnik in 1377 and an obligatory vaccination of children against small pox in Dalmatia in 1807, second only to that of the canton of Aargau in Switzerland[2)]. (E. Jenner discovered it in 1796.) Andrija Štampar, well-known for his public health research, was one of the founders of World Health Organisation. Croatian scientists participated in the foundation of the International Pugwash Movement in the 50-ties, European Physical Society in 1969 and Academia Europaea in 1988.

Similar outstanding achievements could be described for other SEE countries from Slovenia to Turkey.

1.2. Quantitative assessment of R&D and education in SEE countries

It is claimed that the 20^{th} century is the first measured century[3)]. Currently, we are flooded with economic, social, political and R&D indicators. Importance of measurement in has been stressed more than a century ago by Lord Kelvin, but the question looming in all of the above indicators is how reliable these data are. Shortcomings of economic indicators, e.g. GDP and GDP/capita have been corrected by introducing purchasing power parity and more significantly by introducing human development index (HDI), which lumps some economic and some social indicators. Input R&D indicators are notoriously unreliable: e.g. the number of researchers includes sometimes those who are not scientifically active, gross expenditure on R&D (GERD) sometimes includes salaries for non-R&D related personnel and sometimes activities that have nothing to do with R&D or with education. Output R&D indicators, e.g. number of publications per researcher and impact factors are more reliable but as typical for output indicators are subject to time delay effects. More importantly, these scientometric indicators are statistical indicators and should not be applied to a small segment, i.e. they are instructive when applied to assess the entire country, reliable when assessing large cities and large institutions and become fully unreliable when addressing individuals or small group. Comparing various scientometric data should be done with utmost care, e.g. impact factors vary significantly from one to another scientific discipline. We will present some R&D indicators for SEE countries and we will try to compare them with the same indicators for other countries.

Economic indicators for Bosnia & Herzegovina (B&H), Croatia, Macedonia and Serbia & Montenegro (S&MN) are given in Table 1. Table 1[4)] summarises GDP/capita in € and in purchasing power parity in US$ (at that time - 2002 - euro and dollar were comparable), inflation in percentages, foreign direct investment as percentage of GDP and real GDP growth in percentages. All countries achieved GDP growth in 2002 of about 3-5% and reduced the inflation to a low level of less than 3% except S&MN. All four countries have large trade deficit and large foreign debts. Transition has led also to changes in the distribution of income. The ratio of the richest 10% to the poorest 10% of the population was 3 to 3.5 in year 1989 and it increased now to 8-10.

TABLE 1 Economic Indicators[4)]

Country	GDP/capita 2002 (€)	PPP*	GDP by sector Agri.	Ind.	Ser.**	Inflation 2003 (%)	FDI*** 2003	GDP growth (%) 2003
B&H	1383	1900	13%	41%	46%	0.4	4.9	3.5
Croatia	5420	8300	10%	33%	57%	1.5	6.2	5.0
Macedonia	1972	5100	11%	31%	58%	2.4	1.1	3.0
S&MN	2055	2200	26%	36%	38%	8.0	3.6	4.0

* expressed in purchasing power parity US$
** agriculture, industry, services
*** foreign direct investments as % of GDP

Most of the social welfare indicators in B&H, Croatia, Macedonia and S&MN have deteriorated from 1989 to 1999 (Table 2[5)]): GDP/capita fell 19% - 59% and employment per population between 15 and 59 years fell 10 - 15%. Slovenia is the only country from ex-Yugoslavia that has increased its GDP/capita and where the change in employment is minimal. There have been drastic demographic changes. The population below 17 year has decreased by 10% for Croatia, Macedonia, S&MN and

Slovenia, and by almost 30% for B&H. The fertility rate in Croatia in year 1999 has been 1.38, and it is projected to fall to 1.15, implying that the population of Croatia would fall from 4.47 millions now to 3.67 millions in year 2050. It is amazing that the under 5-mortality in all four countries have improved, by about the same amount as in Slovenia.

TABLE 2 Indicators of welfare change 1989-1999[5)]

Country	GDP/capita	Employment	Elderly dependency ratio		Fertility rate		Under 5 mortality	
			1989	2000	1989	1999	1989	1999
B&H	-	-	14.5	20.8	1.88	-	21.1	11.40
Croatia	-18.7%	-13.1%	26.7	29.9	1.92	1.38	13.7	9.20
Macedonia	-31.2%	-15.2%	17.7	22.6	2.45	1.75	38.2	15.60
S&MN	-59.1%	-10.1%	24.1	31.0	2.26	1.67	33.8	16.30
Slovenia	+9.7%	-3.1%	24.2	29.3	2.11	1.21	10.3	5.60

Table 3[6)] gives scores for achieving democratic and economic reforms as well as for

TABLE 3: Nations in Transition - 2001 Rating and Score Summary[6)]

Country	**PP**	**CS**	**IM**	**GPA**	**DEM**	**CLJF**	**CO**	**ROL**	**PR**	**MA**	**MI**	**ECON**
CONSOLIDATED DEMOCRACIES												
Poland	1.25	1.25	1.50	1.75	**1.44**	1.50	2.25	**1.88**	2.00	1.50	1.50	**1.67**
Czech R.	1.75	1.50	2.00	2.00	**1.81**	2.50	3.75	**3.13**	1.75	2.25	2.00	**2.00**
Hungary	1.25	1.25	2.25	3.00	**1.94**	2.00	3.00	**2.50**	1.50	2.25	2.00	**1.92**
Slovenia	1.75	1.75	1.75	2.50	**1.94**	1.50	2.00	**1.75**	2.25	2.00	2.00	**2.08**
Latvia	1.75	2.00	1.75	2.25	**1.94**	2.00	3.50	**2.75**	2.50	2.50	2.50	**2.50**
Lithuania	1.75	1.75	1.75	2.50	**1.94**	1.75	3.75	**2.75**	2.50	3.00	2.75	**2.75**
Estonia	1.75	2.25	1.75	2.25	**2.00**	2.00	2.75	**2.38**	1.75	2.00	2.00	**1.92**
Slovakia	2.25	2.00	2.00	2.75	**2.25**	2.25	3.75	**3.00**	3.00	3.25	3.50	**3.25**
Bulgaria	2.00	3.50	3.25	3.50	**3.06**	3.50	4.75	**4.13**	3.50	3.25	3.75	**3.50**
Croatia	3.25	2.75	3.50	3.50	**3.25**	3.75	4.50	**4.13**	3.50	3.50	3.75	**3.58**
TRANSITIONAL GOVERNMENTS												
Romania	3.00	3.00	3.50	3.75	**3.31**	4.25	4.50	**4.38**	3.75	3.75	4.50	**4.00**
FYROM	3.75	3.75	3.75	3.75	**3.75**	4.25	5.00	**4.63**	4.00	4.75	5.00	**4.58**
Moldova	3.25	3.75	4.25	4.50	**3.94**	4.00	6.00	**5.00**	3.50	4.25	4.25	**4.00**
Albania	4.00	4.00	4.25	4.25	**4.13**	4.50	5.50	**5.00**	3.75	4.50	4.25	**4.17**
Ukraine	4.00	3.75	5.25	4.75	**4.44**	4.50	6.00	**5.25**	4.25	4.25	4.50	**4.33**
Russia	4.25	4.00	5.25	5.00	**4.63**	4.50	6.25	**5.38**	3.75	4.25	4.50	**4.17**
S&MN	4.75	4.00	4.50	5.25	**4.63**	5.50	6.25	**5.88**	5.00	5.50	5.50	**5.33**
B&H	4.75	4.50	4.50	6.00	**4.94**	5.50	5.75	**5.63**	5.00	5.50	6.00	**5.50**
Kazakstan	6.25	5.00	6.00	5.00	**5.56**	5.75	6.25	**6.00**	4.25	4.50	4.75	**4.50**
CONSOLIDATED AUTOCRACY												
Belarus	6.75	6.50	6.75	6.25	**6.56**	6.75	5.25	**6.00**	6.00	6.25	6.50	**6.25**

Notes:
- Democratization Score (DEM)= average of Political Process (PP), Civil Society (CS), Independent Media (IM) and Governance and Public Administration (GPA) ratings

- Rule of Law Score (ROL) = average of Constitutional, Legislative and Judicial Framework (CLJF) and Corruption (CO) ratings
- Economic Liberalization Score (ECON) = average of Privatization (PR), Macroeconomic Policy (MA) and Microeconomic Policy (MI) ratings
- Rating and scores are based on a scale of 1 to 7 with 1 representing the highest level and 7 representing the lowest level of democratic development. The 2001 scores and ratings reflect the period July 1, 1999 through October 31, 2000.

achieving the rule of law (ROL): the smaller the value the better the country is. DEM assesses political process, civil society, independent media, governance and public administration. ECON assesses macro and micro-economic policies, social indicators (life expectancy, poverty, pension system, and unemployment) and privatisation. ROL is an average of constitutional, legislative and judicial framework and corruption ratings. B&H (DEM: from 5.45 to 4.9; ROL 6.0 to 5.6) and Croatia (DEM: 4.2 to 3.25, ROL: 5.0 to 4.1, ECON: 3.9 to 3.6) made progress from 1997 to 2001. Macedonia stagnated, while S&MN improved its DEM score, stagnated on ROL and deteriorated in ECON.

Table 4[7,8] lists various innovation and R&D indicators for selected countries. Though the percentage of the total GERD with respect to the GDP of Croatia is only somewhat lower than that of Slovenia, and higher than that of Hungary, Poland and Slovakia (0.68%), and much higher than S&MN (0.5%), Bulgaria (0.49%), Romania (0.39%), Macedonia (0.3%), and particularly higher than B&H (less than 0.1%) and Albania (less then 0.1%) and it might on a first glance appear as satisfactory, three features demonstrate its inadequacies. First, industrial R&D has almost disappeared, second, the overall structure of the industrial sectors of economy and export has not significantly changed for the last 25 years and is still dominated by the low-profit "Croatian traditional industries" like wood and textile industry, fishery, tobacco and shipbuilding, and third, the comparison of some selected indicators like the number of patents, ISO standards 9000, global competitiveness, rank of technology index and rank of innovation capacity, and Internet hosts reveals that Croatia doesn't only lag behind the developed countries, but also behind some of its neighbours[7,9].

The relationship between scientific productivity and industry-research interconnection is illustrated by the following examples. First, in 1989, Ruder Boškovic Institute, the leading Croatian scientific institution earned 40% of its revenue from the business sector and published 0.75% of a scientific paper per employee. In 1999, only 13% of revenue came from businesses while publishing activity is reduced to 0.68% of a paper per employee[10]. Similarly, Radosevic[11] finds that, in socialism, the Croatian R&D system was a mixture of different activities: in 1989, 52% of the total revenue of R&D system came from research, 37% from the production and 11% from the services rendered. It is estimated that today only about 10% of the revenues of the research institutes and only about 6% of the universities comes from the contract research with the industry[12]. The cooperation between research and industry was better during the socialist period: almost 30% of the revenues of the research institutes and 23% of universities came from contracts with industry[13]. First guidelines of the innovation policy in Croatia have been outlined in 1996[14] and comprised the government support for the establishment of the business-innovation and technology centres. Technology parks have been established and supported by government in Zagreb: Centre for technology transfer (1996), Rijeka: Technology and Innovation centre (1997), Split: Technology centre (1997), Osijek: Technology innovation centre (2001), Dubrovnik: Research and Development centre for Mari-culture (2001), and Centre for production processes, again in Zagreb (2001).

The cooperation with Italy resulted in the establishment in 1998 of the Business Innovation Centre of Croatia – BICRO. It was a coordinating body of the technology network the primary aim of which was to create the financial instruments (venture, risk and seed capitals) for the support of the innovative entrepreneurship. BICRO has outlined its Program for the establishment and the promotion of the production based on new technologies with the aim to support 200 companies in 4 years. It has to be stressed that the government supported businesses were established throughout countries in transition but with almost no positive effect[15)]. The Program of Innovative technological development – HITRA started in 2001[16)] and it marks a turning point in science policy since it is the first program that created and implemented measures paving the way for the new paradigm of economic growth. HITRA consists of TEST, focusing on technology projects financing the pre-commercial development of new products, processes and services in the public and private R&D sectors. The outcomes are to be commercialized through RAZUM (Development of Knowledge-Based Companies), aimed at supporting commercial entrepreneurial projects (start-up, development and expansion of companies) based on new technologies and/or cooperation with research institutes and universities.

TABLE 4: R&D and innovation indicators for selected countries in 1999[7,8)]

Indicators	**Croatia**	**EU**	**OECD**	**Finland**	**Nordic countries**	**Poland**	**Hungary**	**Slovenia**	**Bulgaria**	**Romania**
The Global Competitiveness report										
- Rank of GDP per capita (2001)	44			14		38	30	25		
- Rank of national competitiveness	58			2		51	29	28		
- Rank of technology index	43			3		36	21	25		
- Rank of innovation capacity	42			3		35	28	25		
GERD	1,19	1,85	2,21	3,19	-	0,75	0,68	1,51	0.49	0.39
% of GERD performed by business	44,4	65,6	72,4	70,0	69,2	41,4	45,4	55,0		
% of GERD performed HE and public labs	51,2	34,4	27,6	26,0	30,8	58,6	54,6	45,0		
% of GERD financed by business	44,5	54,7	63,2	65,0	62,8	38,1	38,5	56,9	30.0	48.0
% of GERD financed by the State	52,7	36,0	29,8	30,0	30,0	58,5	53,2	56,9	70.0	43.0
BERD	0,43	1,20	1,54	2,18	-	0,31	0,28	0,84	-	
Public expenditures on R&D as % of GDP (GOV+HE)	0,55	0,64	0,61	0,99	-	0,44	0,37	-		
R&D expenditures per capita (USD)	70	415	500	-	690	60	90	220	-	9
Researchers in business sector (%)	17,3	49,8	64,9	-	50,5	18,3	25,9	34,8		
Researchers in public sector (%)	82,7	50,2	35,1		49,5	81,7	74,1	63,6		
Researchers per 1000 labour force	3,2	5,2	6,1		8,1	3,3	5,7	8,9		
PhD in science and technology (aged 25-34)	0,17	0,55	0,47 (USA)	0,97	-	-	-	-		

Source: S. Radas 2003; Strategy of Development, "Croatia in 21st century- Science", (Official Gazette, 108/2003), The Global Competitiveness Report, 2002-2003, Annual Competitiveness Report of Croatia, 2002, NVK, 2003

Sums of GERD by business and by state do not necessarily add up to 100%, since there are other contributions to GERD, e.g. from other national sources as well as from outside sources. It is useful to study the changes in structure of GERD. For instance, in Turkey the contribution to GERD from the business sector increased from 31% in 1993 to 43% in 2000.

As an illustration of the unreliability of input R&D indicators we quote that ex-Yugoslavia at the end of the 80-ties claimed to have over 30,000 researchers, precisely 30,564 full-time equivalent researchers, with the total GERD of 881 millions US$, resulting in 28,844 US$ per researcher. For comparison, in the period 1981-1984 Spain had declared 14,227 full-time equivalent researchers, Portugal 3475 and Austria 6712. GERD of these countries have been quoted as 1.35, 0.2 and 1.026 billions US$, respectively, resulting in 83,707; 57,669 and 110,741 US$ per researcher, respectively. Personnel engaged in R&D in Yugoslavia steadily increased from year 1960 and in year 1990 reached 78,000[17)]. All scientometric indicators demonstrate that ex-Yugoslavia did not have more than 10,000 active researchers[2)]

Assessment of the social impact of scientific activity in a country starts with the evaluation of scientific productivity, particularly with major breakthroughs. The next measure of scientific productivity is the number of scientific publications in selected journals. The share in scientific literature for several Central-east European countries (CEEC) is given in Table 5. The data are from the Institute for Scientific Information Web of Science in 1999[18)]. Table 5 contains only few of the CEEC. When all CEEC are included then each column adds to 100%. The data are more useful to assess the scientific activity in various disciplines within each country than comparing various countries, since data are not normalised to the number of inhabitants.

TABLE 5 Share in scientific literature of each CEEC in 1999[18)]

Country	Medical research	Chemistry	Physics	All fields
Czech Republic	7.8	13.1	9.7	11.9
Hungary	12.2	12.3	8.8	12.1
B&H	0.1	0	0.1	0.1
Croatia	4.1	3.2	2.9	3.1
Macedonia	0.2	0.3	0.3	0.3
Yugoslavia*	3.2	3.1	4.5	3.8

*The name Yugoslavia is used because at that time this was the name of the federation of Serbia and Montenegro. The use of the name Yugoslavia increases uncertainties.

The number of scientific publications per 100,000 inhabitants for 1990 and 2000 is given in Table 6[19)]. All countries except B&H show increase in the number of publications. Slovenia has made a considerable progress increasing its scientific productivity by 2.6 times and now outperforms Croatia by a factor of 3, while that ratio has been 1.6 in year 1990.

TABLE 6 Number of scientific publications per 100,000 inhabitants [19)]

Country	1990	2000	2000/1990
B&H	1.95	0.61	0.31
Croatia	18.4	26.0	1.41
Macedonia	2.36	5.24	2.22
Serbia	11.92	11.34	0.95
Slovenia	29.63	76.84	2.59
Turkey	1.54	11.2	7.3

The number of scientific publications published in Turkey in CC and SCI increased from 400 in 1982 to 9303 in 2002.

The scientific productivity[18-21)] of scientists from ex-Yugoslavia normalised to the number of inhabitants in the 70-ties has been comparable to that of Hungary, Spain, Ireland, Austria and Greece. It decreased during the late 80-ties and has been below all of these countries and comparable to Portugal, Romania and Bulgaria[2)].

The assessment of scientific activities for 1999[21)] reveals a grouping of countries according to the number of publications per 10,000 inhabitants: UK, USA, France, Germany, Japan, Spain and Italy have between 4 and 9 publications/10,000, Slovenia, Greece, Hungary, Estonia and Slovakia have between 2 and 4, Portugal, Croatia, Bulgaria, Poland and Cyprus have between 1 and 2, while S&MN is in a group between 0.5 and 1, and B&H and Macedonia in the group below 0.3.

The number of ISI Web of Science articles published from 1991 till 2003 is compared in Table 7:

TABLE 7 Science citation index articles published from 1991 till 2004[19)]

Country/City/Institution	Number of CC articles from 1993	Number of ISI articles from 1991
Hungary	40,170	54,721
Slovenia	12,092	14,702
Finland	83,123	
Yugoslavia	9639	18178
Macedonia	1397	1779
B&H	346	453
Croatia	11505	14272
Zagreb	11108	
"R.Boskovic" Institute	3731	

CC includes 7500 journals and ISI 8500 journals. Table 7 shows that scientific activity for Hungary and Slovenia are comparable when normalised to the number of inhabitants. The scientific productivity of Finland is outstanding, and it is interesting to note that a change in Finland occurred during a 10 year period, and that in late 70-ties scientific activity per capita of Finland has been comparable to those of Hungary and Yugoslavia. Data show that in spite of the fact that Croatia has 6 universities and 28 research institutes spread rather evenly throughout the country, there is a strong concentration just in one city – Zagreb, which represents about one fifth of the population. One institute – The Ruđer Bošković Institute with 350 Ph.D. researchers, which is 5% of the number of Ph.D.'s in Croatia accounts for one third of total Croatian scientific productivity.

The impact factor data for several countries are summarised in Table 8[22)]. Impact factor is equal to the number of citation received by e.g. Croatian scientific publications divided by the number of Croatian publications. It can be inferred that Croatian scientific impact is strongest in medical and natural sciences and quite weak in social sciences. It is relevant to note that the impact in social sciences now in Slovenia and in Croatia is weaker than it was in ex-Yugoslavia. Just when most needed there are no breakthroughs in social sciences in countries in transition.

Table 8 Impact factors for five research domains for the periods 1981-85 and 1997-2001[22)]

Country	Natural	sciences	Technical	sciences	Medical	sciences	Biotechnical	sciences	Social	sciences
	1981-1985	1997-2001	1981-1985	1997-2001	1981-1985	1997-2001	1981-1985	1997-2001	1981-1985	1997-2001
Switzerland	5,18	7,2	1,47	2,52	4,79	7,75	1,37	2,99	0,45	1,25
USA	4,95	7,02	1,94	2,21	5,13	7,36	1,48	2,66	1,19	1,95
UK	3,98	6,17	1,23	1,71	4,51	6,6	1,91	2,91	0,8	1,19
Netherlands	3,9	6,32	1,79	2,01	3,93	5,96	1,65	3,21	0,52	1,31
Sweden	3,86	5,49	1,56	1,79	4,33	5,61	2,21	2,59	0,79	1,02
Germany	3,64	5,77	1,1	1,72	3,45	5,71	0,88	2	0,38	0,81
Belgium	3,39	5,08	1,31	1,83	4,07	5,85	0,71	2,65	0,57	1,2
France	3,3	5,27	1,3	1,8	3,49	5,76	1,16	2,5	0,61	1,11
Finland	3,12	4,97	1,04	1,69	2,94	5,61	0,9	3,03	0,43	1,4
Austria	2,92	5,01	1,09	1,71	3,04	5,55	1,02	1,81	0,49	1,32
Japan	2,64	4,23	1,19	1,25	2,82	4,35	1,62	1,87	0,4	0,94
Ireland	2,58	4,97	0,81	1,47	2,82	5,96	1,33	2,82	0,54	0,84
Italy	2,55	4,53	1,11	1,69	2,92	5,7	0,86	2,04	0,34	1,25

Portugal	2,09	3,39	0,71	1,36	2,48	3,88	0,69	1,9	0,14	0,94
Hungary	1,91	3,45	1,21	1,53	2,75	3,84	0,37	1,13	0,69	0,86
Spain	1,84	4,13	1,04	1,47	1,85	4,19	0,82	2,21	0,37	0,85
Greece	1,75	3,34	1,02	1,19	2,15	3,69	0,47	1,71	0,18	0,6
Romania	1,74	2,79	0,7	0,85	1,53	3,88	0,25	1,03	0,11	0,68
Poland	1,65	2,87	0,8	1,05	2,31	2,89	0,8	1,37	0,26	0,65
SFR Yugoslavia	1,52		0,74		2,03		0,28		0,53	
Slovenia		2,87		1,17		2,3		1,35		0,43
Croatia		2,28		0,89		2,92		0,83		0,23
Czeckoslovakia	1,24		0,58		1,38		0,32		0,08	
Czech Republic		2,9		1,39		3,28		0,78		0,28
Bulgaria	1,16	2,05	0,61	1,02	1,53	2,31	0,75	1,43	0,28	0,46
Turkey	1,11	2,15	0,75	1,09	1,67	1,95	0,1	1,13	0,28	0,35
Soviet Union	0,53		0,46		1,07		0,24		0,21	
Russia		2,13		0,77		3,03		0,72		0,31

Impact factor for period 1986-1990

SFR Yugoslavia	1,67		0,7		1,94		0,58		0,31	

It is possible to obtain a better assessment by focussing on a narrower time interval starting after 1997 and selecting a city for the affiliation. The results for a four year time interval are: Ljubljana and Zagreb 4400 articles, Belgrade 3400, Novi Sad 833, Maribor 500, Split 475, Rijeka 394, Sarajevo 280, Niš 239, Osijek 213, Rovinj 30, Dubrovnik 15 and Pristine 10.

It is known that R&D has a profound economic impact. Information on all US granted and applied patents, European granted and applied patents, German granted and applied patents, WIPO and Japan from January 1995 till today are given in Table 9.

TABLE 9 Information on patents – granted and applied[22)]

	B&H	Croatia	Macedonia	Yugoslavia*	Slovenia
Number of patents	105	2715	71	583	3061

*The heading Yugoslavia is listed since the search has been done under that name.

The number of patents for each country is always a match found among 39 million patents searched. The system is not free of multiple-counting. It provides a very rough insight into a part of an economic impact of science. An insight in the usefulness of patent data is best given by analysing data for a given country. The status of intellectual property in Croatia[23)] shows that from 1992 till today the total number of patent applications filed in Croatia is 11,437, of which 4,340 by residents of Croatia and 7097 by non-residents. Currently there are 1780 valid patents in Croatia, only 396 by residents, 41 belonging to two large companies: PLIVA and INA. While PLIVA has now 29 valid patents in Croatia, four pharmaceutical trans-national companies have 193 valid patents in Croatia. In Bulgaria an average of 16.4 patent applications per year in the period 1985-1989 dropped to 7.2 in 1990-2000. The US Patent and Trademark office granted 27 Bulgarian patent in 1990, but only 1 in 1995. In Romania patent application to European patent office increased from 1990 to 17 in 2002. A relevant indicator is the high tech trade export/import – but the data are very unreliable. There is an indication that in Bulgaria the balance of high tech trade was negative in 2000. In Romania high tech export represent 5% of the total country export.

The social impact of science is multi-pronged and multidimensional, and it is beyond the scope of this article to assess. A way to obtain insight into this impact is through various indicators: ESI[25)]– environmental sustainability index, HDI[26)] – human development index, GCI[27) -] growth competitiveness index, GI – globalisation index for 2003[28)] and – in the same column if a second value is listed it is for 2005[29)] and HLS[30)] – happiness and life satisfaction index. These indicators are given in Table 10 for SEE countries and for few other countries. All indicators except GCI and GI have specified ranges, and the larger the value the more advanced the country is in that indicator. GCI and GI give the ranking.

TABLE 10 Various indicators assessing social impact of R&D

Country	**ESI[25)]**	**HDI[26)]**	**GCI[27)]**	**GI[28) 29)]**	**HLS[30)]**
Range	0-100	0-1	Ranking	Ranking: 62-1	0-100
Slovenia	58,8	0,879	31	25 20	69,5
Croatia	62,5	0,809	53	22 16	66,0
B&H	51,3	-	-	-	61,5
S&MN	-	-	-	-	61
Macedonia	47,2	0,772	81	-	56
Romania	-	0,775	75	40	59,5
Bulgaria	-	0,779	64	-	45,0
Greece	50,9	0,885	35	26	-
Albania	59,7	0,733	-	-	-
Italy	47,2	0,913	41	24 27	84,5
Austria	64,2	0,926	17	8 9	81,5
Hungary	62,7	0,835	33	23	65,0
Czech Republic	50,2	0,849	39	15 15	69,5
Turkey	50,8	0,742	65	53	72,0
Other countries					
USA	53,2	0,939	2	11 4	89,5
Ireland	54,8	0,925	30	1 2	90,5
Finland	73,9	0,930	1	10 10	91,5
Sweden	72,6	0,941	3	3 8	91,0

Nordic countries: Finland, Norway and Sweden have the best ESI, Austria is on the 7th place, Croatia on the 12th, and the Netherlands on the 34th together with Laos. Ireland and Singapore lead the globalization ranking, the USA made a significant progress from the 11th to the fourth place, Croatia from the 22nd to 16th, and Slovenia from 25th to 20th.

In 1999 the Bologna Declaration was adopted and European countries pledged to reform the structure of the higher education so as to create European Higher Education Area (EHEA) by year 2010, to complement European Research Area (ERA). The main goals of EHEA are to improve the mobility within Europe, to attract foreign students and to assure high quality of higher education.

In the Communique of the Conference of European Ministers responsible for higher education, Bergen 19-20 May, 2005 it is stated[31)] "We underline the importance of higher education in further enhancing research and the importance of research in underpinning higher education for the economic and cultural development of our societies and for social cohesion. We note that the effort to introduce structural change and improve the quality of teaching should not detract from the effort to strengthen research and innovation. We, therefore, emphasize the importance of research and research training in maintaining and improving the quality of and enhancing the competitiveness and attractiveness of the EHEA. With view to achieving better results we recognize the need to improve the synergy between the higher education sector and other research sectors throughout our respective countries and between EHEA and ERA." This Communique is based on the Message[32] of the council of Europe to this meeting and on Commission Recommendation[33]. "EHEA cannot aim at less than equal opportunities for all its members. It cannot aim at less than being socially cohesive area in which all individuals have the opportunities to fully develop their abilities and their potential. Our societies cannot afford to do less than give all Europeans the opportunity to put their abilities, skills and knowledge at the service of others."[32] and in addition "Sufficient and well developed human resources in R&D are the cornerstone of advancement in scientific knowledge, technological progress, enhancing the quality of life, ensuring the welfare of European citizens and contributing to Europe's competitiveness....The Member states endeavour to undertake the necessary steps to ensure that employers or funders of researchers develop and maintain a supportive research environment and working culture where individuals and research groups are valued, encouraged and supported and provided with the necessary material and intangible support to enable them to fulfil their objectives and tasks."[33]

Bologna process imposes on European universities large challenges because the figures show an alarming situation even in EU countries: only 21% of the EU working age population has achieved tertiary education, compared with 38% in the USA, 43% in Canada, 36% in Japan and 26% in South Korea. In the EU about 52% of the age group is enrolled in higher education which is higher compared to 49% in Japan, but lags behind 59% in Canada, 81% in the USA and 82% in South Korea. EU has 5.5% researchers per 1000 employees which is marginally less than Canada or South Korea, but well below the 9.0 in the USA or 9.7 in Japan[34]. All SEE countries joined the Bologna process, but the present status is very far from satisfactory. EHEA is aimed at development of human resources and human resources are in reality neglected in SEE countries.

Summarizing the present status of R&D and education in SEE countries one concludes that major problems are:

1. Higher education system in SEE countries is characterised by overwhelming majority of students taking longer than normal time to complete their degree, and there is also a high drop-out rate. For instance in Serbia, each year 33,000 students enrol, and only 12,000 are awarded their first degree. The distribution of students shows preference for social sciences (30%) and engineering (24%). There are few interdisciplinary and inter-faculty studies. Since enrolment in higher education is low and since the current number of persons with degrees in higher education is low, it is disturbing that the effort in adult education is almost nonexistent in SEE countries.
2. There is a large brain-drain and even more serious brain-waste, which demoralises everybody. For instance, in Albania more than 1000 of about 1600 university professors (Albania has ten universities) left the higher education system during the last decade[8].
3. The absolute number of persons with PhD degree as well as the percentage of PhD holders compared to the total population of those older than 35 years is quite small. For instance, in Croatia there are only 7443 persons with PhD degree, and 280,000 with Baccalaureate degrees. The percentage of Baccalaureate degrees holders in Croatia is below 13% of the corresponding population, and in Serbia even less. Although 6504 of PhD holders in Croatia are researchers, 16.3% of them did not publish a single paper during 1991-98. In Croatia the most productive age group of researcher are those between 53 and 63 years of age. Similarly, 68% of the total number of researchers in Bulgaria are older than 45.

The situation in Kosovo - in spite of considerable improvement - is even worse. For instance, 55% of the Kosovo population was illiterate in 1953, with as many as 72% female illiterates. By 1981 the illiteracy shrunk to 18% (9% male and 26% female), with 34% of the population completing primary education, and only 17% of teenagers completing secondary education.

4. Many active researchers do not participate in education. While the Bulgarian Academy and most research institutes participate in higher education at all levels and are accredited to supervise PhD students, in Slovenia, Croatia, S&MN, B&H and Macedonia this is not the case. It should be mentioned

that 20 years ago their research institutes had the same right and responsibility as the Bulgarian Academy still has, and it is not clear why this was changed.

5. The number of R&D personnel in most SEE countries has considerably shrunk after 1990. For instance, in Romania the decrease is by a factor of six, in Bulgaria by a factor of two, and in Croatia by 30%. Starting from the fact that over ten thousand researchers are currently financed by GERD in Croatia, and that Croatia does not have – according to any scientometric indicator – more than about 2000 researchers, it is clear that additional reduction of the R&D personnel in Croatia would not be unreasonable. However, Croatia, and equally all SEE countries need many more researchers that they have today.

6. There are no major international centres of excellence in any SEE country. Centres of competence in high technologies and large infrastructures for high technologies are also lacking. The support for international cooperation is inadequate particularly for participating in major international collaboration using international research facilities. There is no adequate support for internationally recognised scientific research. The EU and the USA support for various collaborative projects in the 80-ies were considerably larger than are the current support through Framework 5 and 6 programmes.

7. The strength of the R&D potential in SEE countries - with the possible exception of Greece and Slovenia - is currently below the threshold for achieving national priorities. For instance, Croatia needs at least 30,000 Ph.D.s, 800,000 with higher education degree and at least 20,000 active researchers.

8. Domestic venture capital is weak, and little is done to stimulate foreign investment in domestic R&D. There is no adequate capital for start-up and technology based small and medium enterprises.

9. The triple helix - intertwining knowledge, economy and governance – is reduced to the so called commercialization of knowledge which is mainly political interest driven rather than driven by fundamental research.

10. The mobility of researchers and experts between industry and research institutions goes only in one direction – toward academia. Those researchers who participate in decision making rather quickly leave research and turn into "professional politicians".

2. Knowledge Society

We face many threats and dangers, but also many opportunities. It is expected that R&D will decouple economic growth from resources consumption, allowing exploration of resources to become more efficient. Improved transport technologies combined with global position systems and ICT based logistics will lead to a declining transport cost. New materials and nano-technologies will provide opportunities for dematerialization of products and productions. Also, some old sectors of economy are reappearing in new forms - REconomy: re-use, repair, re-manufacture, and re-cycle, re-condition. Increased knowledge and ICT are dramatically changing human habits and quality of life as witnessed by the marked increase in the average human life span in the last 100 years.

Knowledge is the necessary tool in addressing problems, dangers and threats facing the contemporary world. It is the only approach how to realize the opportunities we are being offered. What do we understand under the concept of knowledge? Knowledge is science and technology including nano-, cognitive and information-communication technologies (ICT), ongoing and planned research and technological development (R&D), and education. An important caveat is required. While R&D, science and technology are global and can be standardized, the sum of them all - knowledge is understood and contextualized within a specific cultural system, thus giving it a local meaning[35)]. Culture is a collective response developed to face threats, diminish weaknesses, maximize strength and increase opportunities. Therefore, a variety of different cultures are needed. Knowledge is therefore a unique link, which connects global and local, and gives individual cultures global meaning.

There are over five thousands different cultures in the world, and cultural diversity is as essential for humankind as is the biological diversity. The environment moulds the biological species through evolution. Cultures are formed and evolve in constant interactions among themselves. Sometimes we belong to more than one culture. No culture is complete without these interactions. Though preservation of many different cultures is essential, it is neither possible nor desirable to maintain a culture unchanged. We argue that all cultures should change. Of course, most cultures have been constantly changing, however, not necessarily enough and sometimes irrelevantly or in a wrong direction. The modification of cultures while simultaneously preserving their essence (a question «what is their essence» has to be explored and tested) is a major task facing contemporary society. A modification, a change is an imperative, but also a risk. We argue that in order to minimize the risk any change of culture should satisfy the following four conditions: first, recognition and respect of individual human rights and responsibilities, second, compatibility with globalization and knowledge society, third, its own uniqueness and fourth, the capacity to change without loosing its value.

The concept of civilisation has been used in various ways, either as one single human civilisation or in the phrase of "a clash of civilisations". In the European, Arabic and Persian (*madaniyya, tammadon*) languages the word civilisation is derived from "city life" and laws relevant to living in a city. By contrast, in Chinese and Japanese the words are *wen ming* (Chinese) and *bun mei* (Japanese) and they suggest learning and enlightenment. While a clash between systems governed by different laws is certainly possible, the concept underlining learning and enlightenment leads to a knowledge society.

3. How do we build a knowledge society?

Our history is marked by a dominant resource used at a specific time, e.g. iron in the Iron Age, land and physical labour during feudalism, capital and labour during early capitalism, oil in the 20th century. Possession of these resources meant political power and since all of these resources are relatively scarce, history has been characterized by continuous fight for them. The essential resource of today's world is knowledge. However, this is very different from any resource we have depended on so far. Knowledge is inexhaustible and increased by sharing. Furthermore, the emphasis is not on the knowledge anybody has, but on the knowledge one produces. This is a fundamental difference further augmented by the fact that while other resources existed independently and separately of people, knowledge resides exclusively in people. Therefore, it is clear that the greatest wealth of any nation, of any society is its people, its citizens. This is a vastly underused resource, which offers the opportunity for any country to make a major breakthrough, and catch up with countries presently more developed. In the knowledge society no country should consider itself resource-less[35)].

Knowledge is a dominant political power. A. Toffler argues[36)] that we are witnessing a political power shift: from political power dominated by military, and then by military and wealth and then more and more depending on knowledge, it is now almost exclusively dominated by knowledge. A political strategy should be to increase knowledge. Unfortunately, it is not - though almost everybody today speaks about building knowledge society and knowledge-based economy. A term triple helix - signifying society, science and economy intertwining - has been introduced[37)].

The concept of the knowledge society is not well defined. Many crucial components are overlooked, specifically interactions between knowledge, and decision making, public and policies/politics. Building a knowledge society is left to individual countries or to the influence of globalization. Both approaches are limited. Can we develop a new paradigm? A new paradigm has to emphasize science more than technology, knowledge - implying understanding of complex phenomena - rather than only computer models, free market rather than merely market. It has to appreciate that nothing – neither free market, nor science, nor democracy, nor knowledge alone - can solve all the problems. It has to intertwine knowledge with decision-making and governance. It has to emphasize solidarity and compassion rather than only competition, wealth and profit. Its goal should be increasing human options, increasing freedom. Freedom - as emphasized by Amartya Sen - is an essential ingredient of development[38)]. A new paradigm emphasizes *to be* rather than *to have*.

Recent history demonstrates a significant progress in technology, in political development and particularly in science. However, knowledge and political processes are not adequately intertwined. Frequently, politics is short-term focused and aimed to obtain and maintain political office, ignoring appreciating the long-term behaviour of complex systems. Prime minister of India Manmohan Singh recently emphasized: "Politics cannot be merely a ticket for power, it has to rediscover, actually find its role as a purposeful instrument for managing and stimulating social change"[39)]. Though the contemporary political processes have many successes, particularly in Europe, they are obviously inadequate and this is reflected in the fact that various current studies find that citizens do not trust them. Gallup International's 2002 Voice of the People survey[36)], conducted from July to September 2002, included face-to-face and telephone interviews with 36,000 citizens across 47 countries on six continents. With this sample, results are statistically representative of the views of 1.4 billion citizens. The respondents have been asked to rate their level of trust in 17 different institutions: parliaments, governments, UN, World Bank, IMF, WTO, legal system, armed forces, education system, religious institutions, police, health system, media, trade unions, NGOs, TNC and large national companies. The results are shocking. Around the world the principal democratic institutions - parliaments - are the least trusted. In the same survey people said that their countries were not governed by the will of the people. Similar results have been recently found in the Puls poll in Croatia[40)]. A very systematic survey by National Science Foundation performed from 1973 till now[41)] shows that people trust scientists more than they trust politicians. Public confidence in scientific community stays constant at 40%, while confidence in leadership of all other institutions is below: government (20% and decreasing to 15%), congress (20% decreasing to 13%), press (25% decreasing to 14%), system of education (40% decreasing to 25%). The only institution ranked higher than scientific community is medicine, but even it decreased from 55% to 44%.

Unfortunately, the academic-research systems in most of the countries of the world, but particularly in SEE countries, is not adequately leading their countries in building a knowledge society. The academic-research systems frequently refrain from issues that could displease their respective political leadership[42)]. The possible reasons of an inadequate socio-political impact of the academic-research system in SEE countries are compartmentalization of the systems, weak interdisciplinarity and transdisciplinarity, no advisory role to government and/or socio-economic-political institutions, weak participation in decision-making and absence of any political strength.

SEE countries are faced with many problems that require intertwining of knowledge and decision making, i.e. these problems can be solved in a knowledge society. Some examples are: low productivity, low employment (e.g. Croatia about 50%), low percentage of population with higher education, large drop-out rate and long time to complete higher education, large percentage of retirees vs. employed persons (in Croatia 1.1 vs. 1.4 millions), enormously large percentage of pensions in the GDP (in Croatia 14%), and in general a climate dominated by fear of initiative and of change. These problems are interconnected. All SEE countries with the exception of Albania and parts of FYRO Macedonia are characterized with number of persons older than 60 being comparable to those younger than 18. Similar situation is throughout Europe. This phenomenon known as demographic transition results in a large number of retirees who are still capable of active work. A concept of counter-ageing[44]) (Italian: svecchiamento) has been introduced by Orio Giarini, emphasizing that today a person of 70 has a longer life expectancy and a better quality of life than a person of 55 had a century ago. Therefore, old persons can be usefully employed and it is best to employ them in jobs requiring risk taking based on their credentials and experience, and such jobs are in high demand today in all areas, particularly in research and in all creative endeavours. Opening new jobs requires initiatives, innovation, knowledge and proper political action. However, jobs are open in a global market influenced by migration and outsourcing. This implies that each country has to find its specific niche of excellence and at the same time secure to export their products. Though in knowledge-based economy education, research and health-care require large human resources, jobs have to be open in various activities and this is where the bottom-up creativity is manifested. It has to be allowed to flourish and it has to be supported. Each one of SEE countries has to establish and maintain an innovative, creative, competitive climate and this requires political action which is culture sensitive.

The process of establishing a knowledge society would be facilitated if one would define benchmarks, indicators providing quantifiable measurements indicating whether we are going in a right direction and how far we have progressed. The art of progress is to assure order among changes and to preserve changes amid order. Attempts to compare various indicators have been done[45)] and it has been argued (though many would disagree) that globalization and ESI are positively correlated. Globalization and inequalities as well as globalization and low wages are not positively correlated, but globalization and freedom are positively correlated, and globalization increases citizens' happiness. The World Bank has recently developed the knowledge assessment methodology and scorecards[46)]. They formulate the set of 69 variables as proxies for four areas that they consider essential in the development of a knowledge-based economy:

- economic and institutional regime to provide incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship,
- an educated and skilled population to create, share and use knowledge well,
- a dynamic information infrastructure to facilitate the effective communication and processing of information, and
- an effective innovation system of firms, research centers, universities and other organizations.

Indicators include:

- performance (e.g. average annual GDP growth, human development index, tariff and non-tariff barriers, unemployment rate),
- human resources (adult literacy rate, secondary and tertiary enrollment, intellectual property protection),
- innovation system (researchers in RTD, manufacturing trade as percentage of GDP, scientific articles per million people, technology assessment index, royalty and license fees payments, research collaboration between companies and universities),
- institutional regime (regulatory framework, rule of law, government effectiveness, corruption control, press freedom) and
- information infrastructure (e.g. telephones and TV sets per 1000 person).

The comparison has been done for 100 countries including most of the OECD countries and about 60 developing economies. Similarly, Spangenberger et al[47)] propose a preliminary set of knowledge and ICT indicators for the sustainable knowledge society based on a coherent set of indicators. They specify one-dimensional indicators: economic (e.g. main innovation diffusion speed), social (rate of functional literacy, turnover of arts and culture), environmental (integration of environment in all policy areas), institutional (education expenditure) and inter-linkage indicators, e.g. socioeconomic (distribution of education per income group) and economic-institutional (free access to basic and higher education). These indicators show that the USA and West Europe are closer to the knowledge society than Russia and Bulgaria, which are ahead of India and Iran, and leave Ethiopia quite behind. Two very important indicators have been omitted.

First, scientific breakthroughs, and it is by these breakthroughs that it is possible to catch-up[2)]. Admittedly, it is difficult to measure them promptly, but an estimate is provided by the percentage of most cited scientific publication[1)]. The percentage of top 1% highly cited publications by scientists in China more than doubled in 4 years from 1993-97 to 1997-2001 its share of the world top 1% increased from 0.44% to 0.99%. Similarly, India increased its share from 0.32 to 0.54. Similar achievements have been obtained by South Korea, Brazil and Taiwan. These increases require both improvement of the research potential and an appropriate political decision and therefore, demonstrate the progress these countries achieved toward building the knowledge society (albeit, one has to appreciate that the percentages are small and that all these countries start from the low shares of the world 1%). Though EU has now a comparable economic strength and a comparable scientific productivity to that of the USA, it still considerably lags behind the USA in number of top 500 universities and in the percentage of top 1%

cited scientific publications: the USA: 62.8%, EU: 37.3%, albeit showing a considerable increase in a 4 year period.

Second, intertwining of knowledge and governance to assure freedom and appropriate decision making.

To measure a degree to which a country has progressed toward a knowledge society it is necessary to analyze complex characteristics determined by the interplay of numerous variables studied by multivariate statistics allowing the simultaneous analysis of large numbers of, at first glance perhaps, not particularly correlated variables. Building of knowledge society depends on:

1. human resourcs, i.e. healthy, educated and creative individuals. Travel, communication, and modern life styles are just incompatible with anybody, much less a majority getting inadequate health care, as it was and to a large extent still dominates the world pattern. A very sophisticated, high level science-based health care has to be provided to almost everyone. The same situation is with education. Education is no longer a privilege of a few, it must be extended to everyone. One could say that we have excellent methods of educating first rate physicists, biologists, lawyers, physicians, engineers, etc, based on essentially the same educational methodology that we had developed for several centuries. On the other hand, we are still not able to adequately educate a person to be able to live in a modern world. Living in a modern world requires constant learning of new phenomena and of new "things", it requires new methods of coping with different situations. At the time of enormous increase in knowledge a very broadly educated person with a good understanding of global and local issues is needed.
2. knowledge, i.e. stronger and stronger R&D, life-long education encompassing everybody and assuring their adequate employment. The full and adequate employment will not come from increasing service sector, which now lumps too many different jobs, but mainly from healthcare, education and R&D.
3. increasing human freedom, increasing the number of choices.
4. leadership – both democracy and science generate and need leaders and the true leadership increases rather than decreases freedom.

Each country should develop its own path to sustainable knowledge society. The way to this goal is not free of dangers and threats. Enormous progress has been achieved: in 1893 only New Zealand could be[44] considered to be a true democracy, in[6] 1972 there were 43 free, 38 partly free and 69 not free countries, while in 2002 there were 89 free countries, 56 partly free and 47 not free. However, a huge repertoire of our political decision-making processes and actions are old fashioned and unsuitable for coping with present problems. Politics, just like science is an art of soluble[49] and one could be tempted to say that a political activity should be modeled after the scientific one. After all, science is the most successful human activity. Parallel has been drawn between science and democracy[50]. Freedom is essential both in science and democracy and we concur with A. Sen's concepts[38] of freedom as development and freedom as universal value, but much more has to be done to formulate successful strategies for developing political processes, leadership and governance for and in a sustainable knowledge society. Though the model of science is certainly useful, the political process is a much more complex and more complicated endeavour and the model of scientific endeavour has to be enriched.

We argue that the most efficient approach for most SEE countries is to increase the number of active researchers and the number of PhD holders, and simultaneously to build, develop and strengthen knowledge – governance intertwining. To achieve this intertwining we propose to build a structure, a network[51] KNOWGONET. KNOWGONET includes centres of excellence in SEE and it is imbedded in the European and international system by incorporating members of all European academies in SEE countries, the SEE Division (SEED) of the World Academy of Art and Science (WAAS) and international non-governmental organisations: The Club of Rome and Pugwash. This network is aimed to address the problem of presently insufficient and inadequate use of existing "islands of knowledge" and their neglected role in governance, to contribute to develop knowledge base by networking and reinforcing the research capacity in the region and their intertwining with governance which will bridge the existing gap between them, and enhance the role of knowledge in solving social, economic, and political problems. The quality of the network capacity is assured by testing it through designing human resources development, analysing and understanding the fear of change and frustration due to unfulfilled rising expectations and designing measures of overcoming them. KNOWGONET is a collective learning network. It intertwines knowledge and governance, it strengthens the triple helix: research – society – economy and therefore, contributes to establishing knowledge economy and knowledge society. KNOWGONET breeds creative, interdisciplinary and socially engaged young generation with a freedom to doubt, to undertake risks and to practice synergy. It mingles them with most inspiring senior leaders. KNOWGONET is a think tank and an action aimed task group through its international nature and links.

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