INSTITUTIONS, INNOVATION AND KNOWLEDGE TRANSFER IN BOSNIA AND HERZEGOVINA

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Abstract: The paper investigates the institutional framework supporting policies to promote knowledge transfer from universities to the business sector in Bosnia and Herzegovina. The paper surveys the institutions and system of higher education in Bosnia and Herzegovina, its research and innovation capacity, reviews policies towards knowledge transfer and innovation, including the institutional framework to support technology parks and industrial clusters, and sets out a set of policy conclusions and recommendations. Based on in-depth analysis of the institutional and policy realities of Bosnia and Herzegovina, the paper identifies three key deficiencies in the knowledge transfer system. Firstly, the level of innovative activity is highly skewed towards the public sector in research institutes and universities. Secondly, policies to support technology parks and business incubators have failed to generate substantial spin-off activity. Thirdly, Bosnia and Herzegovina has been far less successful than other countries in the region in its policies to develop technology networks and innovation clusters. The paper concludes that future success in knowledge transfer policies will depend upon improvements to the institution setting, on an increased ability of universities and the business sector to collaborate in technology networks and innovation clusters, and on a greater mobility of researchers between the two sectors. The direction that BiH science and technology policy should take is to emulate elements of the science and technology policies that have been pursued in more advanced neighbouring transition countries.

KEY WORDS: Institutions; Knowledge Transfer; Bosnia and Herzegovina

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Introduction

Development processes in transition economies exhibit much heterogeneity. In these countries, interactions between firms and other relevant actors are complicated by the fact that fundamental institutional, regulatory and market conditions are unstable, underdeveloped, and unfavourable. Poorly functioning institutions and framework conditions have a negative impact on development processes. A further factor is the large influence of external impulses on transactions, resource allocation and, ultimately, economic growth and competitiveness. These impulses may come from international organisations, bilateral donors, creditors or transnational corporations.

Most transition countries have struggled with resource constraints and knowledge shortages. Their development depends greatly on several factors, including the quality of the institutional and regulatory framework and its implementation, the physical infrastructure, the sophistication and depth of financial markets, the quality of educational institutions and labour skills, and the protection of intellectual capital. In regard to SMEs and entrepreneurship, priorities for transition reforms include easing business start-up, easing labour regulations and improving labour market flexibility, improving contract enforcement legislation, facilitating access to credit, and improving legislation and practices for closing down or restructuring business (World Bank et al., 2003).

Conditions for innovation are similarly deficient. Mytelka and Oyeyinka (2003) identify five systemic weaknesses common to developing and transition countries:

- Organisational rigidities and inappropriate institutions hinder adjustments conducive to acquiring knowledge.
- Sub-optimal knowledge networks limit interactions between critical actors.
- Path-dependent systemic failure and inertia results from self-reinforcing obsolete networks that fear change.
- Weak connections between research and training facilities and the surrounding society make the supply of skills and knowledge production unresponsive to societal needs. Moreover, the competencies required for implementing policy reforms are largely absent.
- Fundamental institutions, transparent rules, enforcement of contracts, and intellectual property rights create gaps and inefficiencies in innovation systems.

Although the situation in many transition economies has changed dramatically since 1989, others are nevertheless still marked by their history of public ownership. While there is a legacy of substantial investment in basic science, education and training of certain kinds, access to other skills used to be withheld. There is also a common heritage of the massive expansion of heavy industries and huge conglomerate type of enterprises. Also, transition economies have a marked history of adverse sentiments in regard to entrepreneurship, although it existed and sometimes even flourished under harsh circumstances (Kornai, 1992). In some countries entrepreneurial structures persist among the survivors of the old rank and file, in others, it constitutes the young enterprises whose practices contrast sharply with the old ways. This has implications for trust and networking, and the viability of top-down versus bottom-up approaches (Smallbone and Welter, 2001).

Development assistance in the form of knowledge does not "travel" as well as money or material aid, but assistance should shift focus from transferring codified knowledge, which is often merely "the tip of the iceberg", towards improving tacit knowledge. Conventional economic theory suggests that knowledge transfer would take place spontaneously in a market

economy as knowledge and technologies are traded in competitive markets (Baumol, 2002). In this view there is a little need for government intervention for encouraging knowledge transfers and for the promotion of innovation. But, as Arrow (1971) pointed out long ago, information and knowledge are subject to market failure because investment in the production of knowledge and its acquisition is a risky activity. Businesses may under-invest in knowledge production and transfer, and the level of innovation and competitiveness in advanced market economies may be less than potentially achievable, and even more so in transition economies where uncertainty is so much greater.

In most advanced economies, science has become a more important source of innovation than was the case in the past. Under conditions of radically reduced costs for diffusion of information and an accelerating speed of accumulated scientific discovery, this influence is realised through intensified interplay between disciplines, technologies, entrepreneurial activities, and social and market needs. It has shown up, for instance, in a dramatically increased frequency of publication citations in patents over the last decades (OECD, 2003b). Concurrently, it is widely understood that scientific progress and industrial development is not a one-way street, but that progress in both requires interactions and exchanges. There has been a marked shift away from the traditional way of looking at science, technology and innovation in a linear fashion, towards appreciating the importance of networking and information exchanges in all directions and to regard the innovation process from a more systematic perspective.

The emergence of an innovation as a system is characterized by complex feedback mechanisms and interactive relations involving science, technology, learning, institutions, production, public policy and market demand (Edquist, 2001). National innovation systems have emerged as an approach to the study of innovations as an endogenous part of the economy. Through their innovative activities firms often establish relations with other firms (suppliers, customers, competitors) but also with universities, research institutes, investment banks, schools, government agencies, patent offices, and standard setting agencies. Differences in national economic performance can occur and persist because of differences in capacities for innovation and government polices to promote innovation and knowledge transfer (Braczyk, H-J. et al. 1998). Research into national and regional innovation systems has shown that differences in innovative capacities between countries and regions are linked to the institutions which promote learning and technology transfer, activities which in turn depend upon the existence of networks of institutions and firms that permit reciprocal exchange of knowledge and information (Morgan, 1997; Audretsch, 2005). Such reciprocal exchanges are facilitated where the institutional structure is flexible enough to permit interaction between universities and industrial enterprises

Attention has also focused on the experience of the countries in transition in Central and Eastern Europe, some of which have recently accessed the EU (Bartlett and Bukvič, 2003; Radošević, 2002; Bartlett and Bukvič, 2001; Dyker and Radošević, 2000; Bartlett and Rangelova; 1996; Bartlett and Prasnikar, 1995). In those countries economic growth in the early stages of transition depended largely on reallocation of resources from large state firms to more dynamic SMEs in the emerging private sector. Further improvements in economic growth in later phases of transition depend on the pace of innovation and the development of a knowledge-based economy (Bartlett, 2001; Radošević, 2004). In many transition countries, only a limited amount of research is undertaken in the private sector and universities and faculties are often marginalised. The key issue is how to combine a drive for academic excellence with openness to the development of increased interaction between universities and industry.

Bosnia and Herzegovina

Bosnia and Herzegovina is a unique transition case. The post-war period has been characterised by extensive reconstruction financed and directed by the international community. Although the country has recorded high levels of growth since the end of the war, GDP is still well below its pre-war level and is the second lowest in the region. Assistance will decrease in the coming years and this will further reduce growth levels. The reluctance to assume leadership has meant that essential reforms have not proceeded at the desired pace. The main challenges facing the country over the medium term are strengthening of the State of BiH, creating the conditions for the sustainable return, reinforcing the administration by creating a 'functional government', achieving self-sustained economic development, establishing an effective and accountable legal system and progressing in the European integration process. After $5.1 billion of aid has been spent, BiH has still not reached political, social and economic sustainability, as predicted by the World Bank already in 1997 (World Bank, 1997). Recovery of the GDP per capita is the lowest in the region, most of refugees and displaced persons have not returned to their homes, and slow progress is evident in the process of strengthening of state institutions, SMEs development, science and research development, and the development of national innovation system. There is an absence of willingness on the part of international community and non-existing political will of local actors to impose and implement the robust and integral management of transition. BiH was fully patronized by the international community - beneficiaries had a very limited influence on what was going on and what will be going on in their own country.

This paper analyses the institutional and organisational issues of BiH and high education sector, because institutional weaknesses and old-fashioned and teacher-oriented university structure are the main factors of economic failure. In the next section we review the innovation capacity of the economy of Bosnia and Herzegovina. Then we set out some basic facts about knowledge transfer and the outcomes of the policies that have been adopted. At the end, we draw some conclusions concerning the effectiveness of these policies and the role of institutions in promoting knowledge transfer and innovation.

Institutional and Organisational Issues

During the 1980s Bosnia and Herzegovina (BiH) was one of most dynamic republics of former Yugoslavia. Following the declaration of independence in April 1992 the country was plunged into a devastating war which continued until November 1995 and led to the displacement of an estimated 1.2 million people and extensive physical and economic destruction. The present structure of the State of Bosnia and Herzegovina is established under the General Framework Agreement for Peace, which brought the war to an end. Under the 'Dayton Agreement', signed in Paris in December 1995, the responsibilities and powers of the State of BiH are strictly limited. This has resulted in a weak state without many of the attributes associated with statehood. The presence and involvement of the international community has ensured that democratic principles have been applied in the elections held since 1996. According to the Dayton Agreement, BiH is a sovereign State which consists of the two entities, the Federation of Bosnia and Herzegovina (FBiH) and the Republika Srpska (RS). The Federation itself is divided into ten cantons which have a rather high degree of autonomy. The Dayton Agreement also defines the responsibilities of the institutions of the

Central State and of the entities. Thus, foreign policy, foreign trade policy, customs, monetary and immigration policies, and the operation of common and international communications facilities are among the main policy functions of the BiH State. A unique feature of BiH is the role played by the international community and in particular by the High Representative. In

the period until 2001 the authorities in BiH were unwilling to assume leadership and work together to build the country. During this period the Office of the High Representative (OHR) has been the motor of reforms in BiH. However, there are indications of an increasing willingness on behalf of some political leaders to take responsibility for the decisions which have to be taken.

The higher education system in BiH

As far as education is concerned, the responsibility is delegated to the two Entities – FBiH and RS - and the Brcko District. In FBiH, this responsibility is further devolved to ten autonomous Cantons. Altogether, it is represented by a highly fragmented education system consisting of several education management subsystems (RS, the ten Cantons of FBiH, the level of FBiH, Brcko District, inter-Entity level and state or BiH level). Institutionally, these subsystems are managed by a total of 23 organisations. At the state level, the responsibility for education is located within the Department for Education, Science, Culture and Sport of the Ministry of Civil Affairs. The overall competency, functions or services as well as the capacity of this Department in education area are very limited. One of its key functions is to ensure supervision over implementation of the Framework Law on Primary and Secondary Education in BiH. The Framework Law on Higher Education in BiH has been recently adopted by the House of Representatives and is awaiting adoption by the House of Peoples. The Higher Education Law will enable the improved mobility of students and professors as well as recognition of higher education diplomas and degrees within the European Higher Education Area. However, the implementation of this law is a prerogative of the Entities and in the case of FBiH – Cantonal ministries of education, as well as inter-Entity level institutions, such as the Standards and Assessment Agency. The Department has an equivalent of 1.5 fulltime employees in a position of assistant to the Minister. It is a civil service position appointed on the basis of public job advertisement by the state Civil Service Agency. The Framework Law on Higher Education in BiH foresees the establishment of a Centre for Information, Recognition and Quality Assessment, a body responsible for higher education and a body for recognition of academic qualifications[4].

In FBiH, the responsibility for education is allocated to each of the ten cantons that can decide to delegate certain functions to the Federal Ministry. In this set-up, the Federal Ministry of Education and Science is responsible for coordination among the cantons and for those education functions delegated to it by the cantons. As such, scope of functions of this Ministry is rather limited. At the level of FBiH cantons, ministries of education are responsible for educational functions. Altogether there are ten ministries of education (many of them have the responsibility for education, science, culture and sport). Their size and capacity to perform functions differ from canton to canton. Altogether, ministries in FBiH are responsible for 381 primary schools, 201 secondary schools, six state universities under the authority of the cantonal ministries of education (Sarajevo, Tuzla, Zenica, Bihać, East Mostar and West Mostar). This number can be further broken down into 65 faculties as legally independent entities within the six state universities of FBiH. All universities in FBiH, except for the University of Tuzla, consist of legally independent faculties (EUA, 2004).

During the last two years, both FBIH and RS have experienced a „flood“ of private universities and colleges throughout Bosnia and Herzegovina. According to the Nezavisne novine newspaper (04 March 2006) there are two private universities in Bijeljina alone -

[4] The issue of location of these bodies was the main reason for huge delay in adoption of law. According to the adopted proposal, location of these bodies will be on entity level.

"Slobomir P" with six faculties and "Sinergija" with five faculties, two private universities are registered in Banja Luka – the Paneuropean university for multidisciplinary and virtual studies "Apeiron", University of Business Studies, as well as several faculties: Faculty of Communicology, Faculty of Business Engineering and Management, Banja Luka College, Faculty of Political and Social Sciences, School of Cosmetology and Aesthetics. Prijedor has the School of Computer Sciency and Management, as well as the School of Enterpreneurship and Business. Gradiška also has the School of Business Management. In Sarajevo Canton there are also several private institutions of higher education: Sarajevo School of Science and Technology, Turkish International University, Filip Noel-Backer University, and the Faculty of Public Administration. Tuzla has the American College, and there are also private universities in Travnik, Mostar, Kiseljak.

Compared to FBiH, the public administration system of education sector of Republika Srpska (RS) follows a more centralized and coherent model. At the Entity level of RS, the responsibility for education is allocated to its Ministry of Education and Culture**.** The Ministry is responsible for general education policy in RS and is involved in implementation of all key public administration functions of education sector. Seven regions in RS – East Sarajevo, Banja Luka, Doboj, Bijeljina, Foča, as opposed to the FBiH regions, i.e. Cantons, have limited role in education. The Ministry is responsible for 202 primary schools, 86 secondary schools, and two state universities – one in Banja Luka and the other in East Sarajevo. Similarly to FBiH, this number can be further broken down to 39 faculties as independent legal entities. Academy of Science and Art of the Republic of Srpska is also under Ministry's jurisdiction.

The function of science and technology in RS is also within the Ministry of Science and Technology scope of competence. This ministry is responsible for administrative and other expert tasks related to science and research activities; strategy of demographic development of RS, policies and strategies of technology, incentive to basic and applied research; innovations, development and improvement of technology; acquiring of material rights; planning, preparation of programs and agreements on scientific and technological cooperation and other tasks in accordance with the Law and other regulations of the Republic of Srpska and Bosnia and Herzegovina.

Compared to both FBiH and RS, Brčko District has the smallest and the most concentrated model of education sector. The responsibility for education is allocated to its Department for Education within the District Government which is responsible for 16 primary and 4 secondary schools.

There is no coherent legal framework for higher education and research across BiH. Performance of functions of higher education remains regulated by rather incoherent legislation at Entity and Cantonal level. The various laws in force are mainly variations of the old Yugoslav system, which as a model is incompatible with modern development practice of universities (Council of Europe, 1999). Universities are mostly associations of legally independent faculties, which is outside the usual practice of organising higher education in most of the EU countries. Such a system has a negative impact on the homogeneity of academic standards and performance assessment of individual universities. This structure ties students to faculties, prohibits university-wide planning and consequently impacts on duplication of services and inefficient allocation of resources.

Secondly, planning of development of higher education is the responsibility of Entities and, in the case of FBiH, – Cantons. The state level Ministry of Civil Affairs has no functions in this regard. Therefore rational planning of scarce resources available to higher education cannot be carried out at the level of the state. Equally, accreditation of universities is a matter of RS,

Cantons, and technically, even Brčko District. It has also no functions that could ensure mobility of students and staff across BiH, as well as no appropriate mechanisms for academic and professional recognition. There is also no body responsible for standard setting for higher education (Tiplić and Welle-Strand, 2006).

As this report was being written, the Framework Law on Higher Education in Bosnia and Herzegovina was still awaiting adoption. In relation to functional deficiencies outlined above, the new Draft Law foresees abolishing the current practice of legally independent faculties within universities. It also foresees allocation of a number of competencies to the Ministry of Civil Affairs at the state level as well as setting up of two new bodies in the system of public administration of higher education – a body for coordination and a body for the recognition of academic qualifications.

In the absence of compatible statistics for education, research, and development activities in BiH, it is difficult to come up with an exact evaluation of education and research sector in BiH. The collection of statistics is carried out by the two Entities' Statistical Offices, with the consolidation of data being done by the State Agency for Statistics of Bosnia and Herzegovina. There has been some cooperation between the Federal Office and Republika Srpska Statistical Office, but not in the area of education and S&T activities. The Republika Sprska Institute of Statistics has not launched a survey on research and development statistics so far but it collects only education data, including higher education, following ISCED classification. Two years ago, the Federal Office of Statistics launched for the first time a survey on research and development activities in the Federation of Bosnia and Herzegovina. This was a pilot exercise, though not completely successful, and the data collected were not processed for publication. The guidelines supporting this survey were based on the Frascati Manual. All the work of adaptation, including the survey forms, was done internally at the Office. The survey was launched in three parts: for the business sector, for the State sector, and for higher education. It was also expressed that the area of S&T is not a current priority, both at the national level as well as from the perspective of the international community that has supported the stabilization process in BiH (Pereira, 2007).

The political and territorial division predominantly defines organisation and structure of the education and research sector in BiH. Such a division has caused differences across the country in respect to collection of funds, distribution mechanisms, budgeting procedures, and to the final extent, to development of specific financial schemes throughout BiH. The education sector is regularly funded from the budgets of various levels (the State, the Entities, the Cantons, Brcko District, and municipalities). These levels contribute in different proportions. Consequently, administrative and financial obligations are not under the auspices of a single level of authority that is taking full responsibility and accountability for the education sector. Significant disparities in per student spending at all levels have been identified across all jurisdictions responsible for education in BiH, with the highest spending areas spending more than twice per student at all levels than the lowest spending areas. Private sources of funding are becoming more and more significant, but the flow of private funds is not transparent. In addition, there is no continuous monitoring of the households' spending on education.

Public expenditure on education would be analysed in relation with the GDP trend and GDP per capita over the last several years (Table 1). The trend shows that after 1999, when the growth of 10% was recorded, there has been a continuous average growth of GDP around 4% in the period 2000-2004. The trend of education expenditure shows nominal increase over the last three years, between 2002-2004. Total public education expenditure in 2002 was 4,7 %

and 2003 was around 5,0% of GDP, while in 2004 it was around 5.3 % of GDP, and total public higher education expenditure in 2002 was 0.73 % and 2003 was around 0,85% of GDP, while in 2004 it was around 0.9 % of GDP (IBF, 2005). However, the data on public education expenditure/GDP ratio does not give the full picture on financial flows within the sector.

Table 1: Total public expenditure according to level of education (in KM millions)

	2002	**2003**	**2004**
Primary	306	329	372
Secondary	155	172	191
Higher	85	100	115
in % of GDP	0.73	0.85	0.90
Total:	**547**	**602**	**678**
in % of the GDP	4.69	4.95	5.30

Source: IBF (2005)

Table 2: Total public expenditure for higher education (in KM thousands)

Authority	***2002***	***2003***	***2004***
Brcko District	0	0	0
FBiH	1.000	1.038	927
RS	21.048	22.565	26.364
Cantons			
Una-Sana	4.647	5.720	6.597
Posavina	400	300	350
Tuzla	12.193	20.697	27.686
Zenica-Doboj	2.148	2.577	3.567
Bosnian-Podrinje	0	0	0
Central Bosnia	2.000	2.000	2.800
Herzegovina Neretva	5.121	6.906	6.580
West Herzegovina	1.800	1.800	1.800
Sarajevo	34.242	36.252	37.900
Canton 10	445	500	600
Total:	**85.046**	**100.358**	**115.171**

Source: IBF (2005)

The main feature of the existing model of higher education financing is non-transparency. The ministries cover the full expenditure of salaries and allowances (Tuzla and Banja Luka Universities), or the larger part of it (Sarajevo University) and a part of material expenditures. In total revenues of the universities, the public revenues make 48% (Mostar University), 59% (Sarajevo University), and 72% (Tuzla University). Total public expenditure for higher education in BiH is increasing over the above-mentioned 2002-2004 period (Table 2). Another problem with public revenues stems from the fact that the calculation of funds is made on the basis of the number of first time enrolled students for specific school year, while the percentage of those who repeat their years of studies in Sarajevo University is 34%.

The universities also receive significant amounts of funds from private sources. Such private funds make up around 26% of the total funds available to the Tuzla University, to around 47% of the funds of the Mostar University. Those sources are: full-time students' fees, part-time students fees, fees for students of parallel studies – studies entailing the same right as regular studies, but where the students finance their own education themselves, fees paid by the foreign students, post-graduate studies fees, exam fees, revenues from scientific and research work.

The current financial mechanisms to fund the higher education system are unsustainable in the long run. They are focused on financing of salaries and allowances, neglecting other costs of the schools, which diminishes and brings into question the quality of education. The reasons could be the following: (i) - the depreciation costs are not financed at all, while the small amount of funds is assigned for capital investments; (ii) - procurement of equipment, if there is any, is most frequently financed out of income of the educational institutions, (iii) - funds for capital investments were mostly provided by international donations. In a situation of constant shortage of financial resources, priority has been given to the payment of salaries and allowances: (iv) - materials costs have been paid from what has been left and frequently this amount is not sufficient to meet the operational and maintenance requirements of educational institutions; (v) - the costs of salaries and allowances are the biggest budget item within the education expenditure. The salaries and allowances are the biggest portion of the budget 57-77% for higher education.

The size of higher education sector in BiH for 2004/2005 teaching season is presented in Table 3, and the dynamics of higher education in Federation of BiH in Table 4. In FBiH there has been a substantial increase in the number of enrolled students, graduated students; masters and specialists and PhDs, but, ironically, number of professors and assistants absolutely decreased during last nine years. A similar trend has been observed in the Republika Srpska.

Table 3: Higher education in BiH, 2004/2005

	Total BiH	**Federation BiH**	**Republika Srpska**	**District Brcko**
Number of institutions	113	69	43*	1
Enrolled students	84.475	58.834	24.528	1.113
Regular	62.233	42.894	18.683	658
Part-time	22.242	15.940	5.845	475
Enrolled students per 1000 inhabitant	21,68	25,22	16,58	
Graduated students, 2005	8.127*	5.941	2.168	n.a.
Masters of Science and specialists	298*	270	28	n.a.
PhDs	91*	79	12	n.a.

*- Including District Brcko

Source: Agency for Statistics of BiH, Education statistics, first release,13.9.2006

Table 4: Dynamics of the higher education in Federation of BiH, 2004/2005

	1997/ 98	**1998/ 99**	**1999/ 00**	**2000/ 01**	**2001/ 02**	**2002/ 03**	**2003/ 04**	**2004/ 05**	**2005/ 06**
Number of institutions	55	59	62	64	64	65	65	69	72
Students enrolled	34.477	39.273	43.839	47.242	48.866	51.711	54.425	58.834	62.546
Teachers	1.556	1.652	1.817	1.007	942	981	1.012	1.044	1.091
Assistants	1.297	1.359	1.431	980	975	984	982	1.081	1.141
External co-workers	n.a.	n.a.	n.a.	1.685	2.124	2.386	2.522	2.412	2.487
Graduated students	2.700	2.461	2.364	2.820	3.442	3.178	4.730	5.203	5.941
MSc and specialists	49	73	67	122	153	181	170	254	270
PhDs	40	29	27	46	40	52	47	62	79

Source: Federal Office of Statistics, Statistical Yearbook 2006.

We will conclude this section with the assessment of funding of research activities. According to the 2004 statistics prepared by the Academy of Sciences and Arts of BiH, total public funding of research activities (excluding salaries of university staff) amounts to approximately 7 million KM (3.5 million euro) at most.[5] These funds are usually used to buy equipment and to allow the basic operation of research institutes. One must also take into account the salaries of university staff paid through university budgets (budget allocated by ministries, plus probably a fraction of student fees going towards university budgets). Several Science and Education (or Science and Technology) Ministries at the level of the BiH Federation and of some of its cantons (Sarajevo Canton in particular), and of Ministry of Science and Technology of the RS have recently established small and micro research funds for supporting projects. There does not yet exist any funding at the level of the BiH State.

According to statistics often cited by official reports (the report of the Academy of Sciences and Arts of BiH and the report prepared for the SEE-ERA.NET network, for example), and some BiH officials (Tanović, 2005; Matic, 2006), the ratio of national expenditure on R&D in BiH to the GDP could amount to 0.05 per cent as compared with 1.5 per cent in 1990. It is difficult to agree on exact figures in this domain, but this ratio is underestimated. The GDP of BiH amounting approximately to 12.8 billion KM in 2004, a ratio of 0.05 per cent would represent only the research funding granted by various ministerial entities; it thus does not probably take into account the fraction of salaries of academics corresponding to research activities according to Frascati standards, nor of full-time researchers in institutes and industry.[6] Then, this amount must thus be corrected probably by a factor of 3 to 4 (Papon and Pejovnik, 2006). Even with this correction, it appears that the ratio of BiH R&D expenditure to GDP (0.15-0.2 per cent) would not greatly change the picture of research in BiH, since the funding of R&D activities is, without doubt, far below the level attained by almost all European countries. Let us make just a few comparisons: the average share of R&D national expenditure in GDP for the EU (25 Member States) is close to 1.9 per cent; within the larger Member States R&D expenditures are equal to or above 2 per cent of GDP (Italy being an exception with a ratio of only 1 per cent); differences between the ten new Member States (R&D expenditure/GDP ratios) are rather significant: Slovenia (1.57 per cent), Czech Republic (1.30), Hungary (1.0), Poland and Slovakia (0.6), Cyprus and Latvia (< 0.5 per cent).[7] Let us also record that the EU has recently set itself (in Barcelona, 2002) an ambitious objective for 2010: investment of 3 per cent of GDP of Member States towards R&D activities.

Research and Innovation Capacity in B&H

Under the socialist system in former Yugoslavia, Bosnia and Herzegovina, although one of the undeveloped republics, had been able to establish a network of public infrastructure and a significant industrial base. BiH had and still has important natural resources: coal and iron ore deposits, a forest that has long been exploited, and water resources capable of providing hydroelectricity and safe drinking water. Heavy industries (steel and aluminium) were developed after World War II and half of the Yugoslav defence industry was settled in BiH. The University of Sarajevo has been officially established in 1947 and scientific research was developed in academic laboratories, as well as in autonomous institutes dedicated to applied

[5] CD Rom: Academy of Sciences and Arts of B&H: „Strategy of Science and Technology Development of Bosnia and Herzegovina“ , September 2006, Chapter 3, Funding policy.

[6] According Federal Office of Statistics Statistical Yearbook 2006, in 2006 in the private and industrial research firms were employed 1.148 persons (361 with higher educations, 30 PHD and 40 MSc or MAs. Average net salary where 674 KM).

[7] Observatoire des Sciences et des Techniques. *Indicateurs de la science et de la technologie*, Economica, 2005.

research. Industry had developed its own research quite intensively during this period, often in cooperation with academic research.

One of the most important characteristics of the structure of BiH economy prior to 1991 was a high level of production and export concentration. Twelve huge enterprises produced 35 percent of total GDP, and four of them generated more than 40 percent of total export. Developing and applied research were mostly realized by institutes and R&D centers of these enterprises (for example the company Energoinvest, the largest enterprise in pre-war Yugoslavia and its larger exporter, was heavily involved in research, with many PhDs, MScs and several hundred engineers and technicians working in its own laboratories). As opposed to other republics of former Yugoslavia, BiH had not developed strong public R&D structure. The main carriers of R&D were industrial institutes. Unfortunately, most of these assets (in higher education, research and industry) collapsed during the 1992-1995 war. Major damage was inflicted on industrial facilities; scientific research came to a standstill due to destruction of industry and leading enterprises. Many of the researchers from the industrial laboratories and universities emigrated to foreign countries.

According to the World Economic Forum (WEF) competitiveness is defined as the collection of those factors, policies and institutions which determine the level of productivity of a country. A more competitive economy is one that is likely to grow faster over the medium to long term (WEF, 2006). The World Economic Forum has been measuring national competitiveness over two decades. Over the years, the specific methodology used to measure competitiveness has evolved. Since 2001, methodology has been improved by introducing a new model developed by Jeffrey Sachs and John McArthur, called the Growth Competitiveness Index. In order to capture a broader set of factors crucial for understanding the determinants of economic growth, WEF has recently introduced a new approach, developed by Xavier Sala-i-Martin. This new index, called Global Competitiveness Index is built around nine different pillars, each of which is key to driving productivity and competitiveness in national economies (Institutions, Infrastructure, Macro-economy, Health and primary education, Higher education and training, Market efficiency, Technological readiness, Business sophistication and Innovation).

Table 5: WEF Global Competitiveness Index 2006, 125 countries

	Overall global competitiveness index 2006-2007		***GCI: Efficiency enhancers***				***GCI: Innovation factors***			
			Higher education and training		***Technological readiness***		***Innovation factors***		***Innovation***	
Country	*Rank*	*Score*	*Rank*	*Score*	*Rank*	*Score*	*Rank*	*Score*	*Rank*	*Score*
Albania	98	3.46	92	3.24	104	2.56	121	2.57	125	2.04
B & H	89	3.67	86	3.44	108	2.52	99	3.08	104	2.68
Croatia	51	4.26	44	4.43	47	3.68	50	3.81	45	3.45
Macedonia	80	3.86	66	3.96	91	2.71	87	3.24	86	2.98
S & M	87	3.69	61	4.09	73	3.16	83	3.27	71	3.11
Slovenia	33	4.64	26	5.07	29	4.51	34	4.18	34	3.71

Source: WEF (2006)

Table 5 shows the results of measuring of competitiveness for 2006. The GCI of Bosnia and Herzegovina are located in the lowest fifth of the 125 countries, with no significant changes in rankings in comparison to the previous year. Bosnia and Herzegovina ranked especially low in the categories of Institutions, Infrastructure, Higher education and training, Technological readiness and Innovation, which are all key growth factors.

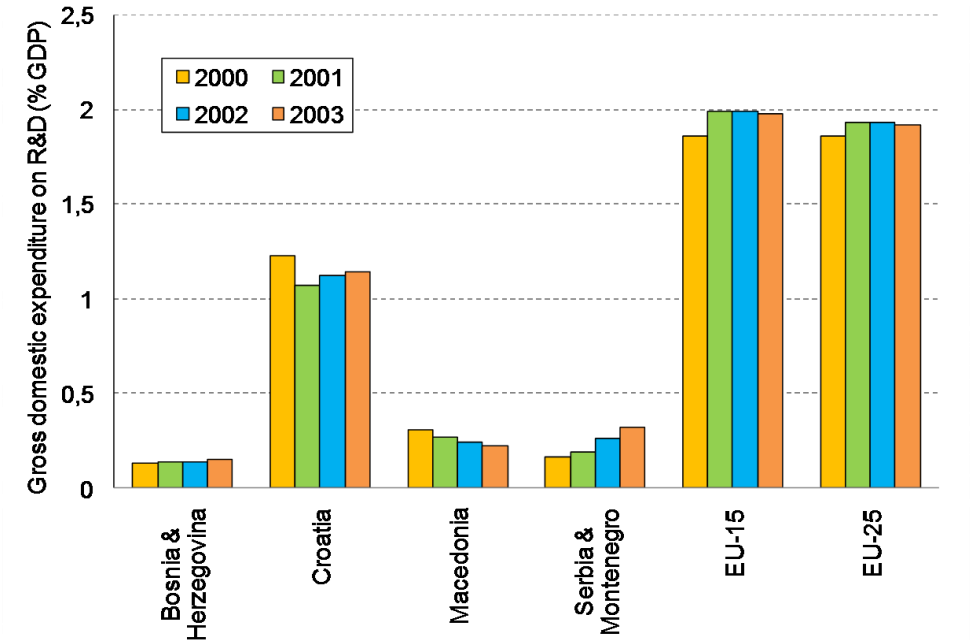
As we mentioned earlier, reconstruction of the science and technology potential and technology infrastructure in Bosnia and Herzegovina was not considered a priority by political authorities and by the international community. As a result of such policy, only a very limited number of R&D institutions and laboratories have been able to maintain research activity. In general, the existing universities have maintained research activities: in social sciences (economics, sociology) and humanities (history, political science); and in a few areas of engineering and physical sciences through contracts with a limited number of industrial companies. By and large, universities have lost their critical mass in science (only a few of them have old-fashioned PhD programmes with an excessive number of students, mostly in the social sciences and humanities).

Generally speaking, the effect that the downfall of the former Yugoslavia has had on this particular segment was probably more dramatic in Bosnia and Herzegovina than in any other SEE country. Unfavourable political and financial circumstances, combined with an utterly indifferent donor community, have blocked the much needed reforms in this field. As a consequence, the country's scientific and technological base remained obsolete, with no serious research activities or deeper involvement into international R&D network. All-embracing, unrelenting brain drain has seriously weakened the R&D base and escorted many leading researchers to better paid jobs. The loss of its top experts, as well as the scarcity of mid-generation researchers and negative selection, have significantly altered the R&D base of Bosnia and Herzegovina.

Investments in R&D, and spending on education, are regarded the major forms of investment in knowledge, in addition to spending on information and communication technologies (ICT) (EC 2003a, b). The volume of R&D investment reflects the economy's efforts in creating and accumulating new knowledge, which is essential to modern knowledge-based economies. In the EU-15, R&D expenditure as a percentage of GDP has been stable at around 1.9%, (though with substantial variations across countries; in the Nordic countries, it is around 3%) and an additional 1.4% of GDP is spent on tertiary education. It might be interesting to look into available statistics regarding expenditure in these two main areas in individual SEE countries.

Given that statistics on R&D expenditure is not reported systematically for all the SEE countries in publications of major international organisations, an attempt was made to collect data from national sources. What was actually obtained, however, is very partial information (also regarding other S&T indicators). National statistics on investment in R&D in SEE countries are not always readily available, in some cases they are incomplete, and the data are not mutually comparable because of different concepts used, non-standard systems of reporting, even different definitions of macroeconomic aggregates. The national data on S&T indicators sometime also vary from source to source, depending on whether it is reported in national statistics, in annual reports of the relevant Ministries, or in documents of specialised government institutions. The information that has been gathered is reported in the Figure 2.

Figure 2. Gross domestic consumption on R&D, 2000-2003



Source: Uvalić (2005, 2006)

There are other parallel indicators that well illustrate current grave situation in the field of science and technology (Šlaus and Pisk, 2006). According to ISI Web of Science, Bosnia and Herzegovina's share in scientific literature output of the entire transition region in 1999 amounted to as little as 0.1% (Croatia 3.1%, Macedonia 0.3%, Serbia and Montenegro 3.8%, Hungary 12.1%, Czech Republic 11.9%); the number of scientific publications per 100.000 inhabitants in 2000 was 0,61 (Croatia 26.0, Macedonia 5.24, Serbia and Montenegro 11.34; the number of ICI Web of Science articles published from 1991 until 2004 was only 453 (Slovenia 14.702, Hungary 54.721, Serbia and Montenegro 18.178, Macedonia 1.779 and Croatia 14.272), and the number of patents from 1995 until 2005 was 105 (Croatia 2.715, Macedonia 71, Serbia and Montenegro 583 and Slovenia 3.061). Such a disappointing situation in the field of science and technology has multiple developmental and social dimensions, which will be discussed in greater detail in the fourth part of this paper.

Let us look at the performances of some important segments of information and communication technologies (ITC), which are of particular relevance for the innovation process (Table 6). The expansion of ICT indicates an extent to which knowledge and innovation have diffused through the economy. The more the ICT expands, the larger is the space for interactive innovations and learning (Radošević, 2001). Even though the statistics on ICT indicators is not on a satisfactory level, there are some ICT indicators that generally point to a progress that all SEE countries have achieved during the past five years. In general, SEE countries have shown better results in 2005 than the countries in the lower-middle income group.

Table 6: Indicators of information and communication technologies, 2005

	Bosnia and Herzegovina	Serbia and Montenegro	Croatia	Slovenia	Lower-middle income group
Telephone main line (per 1,000 people)	248	332	425	408	205
Mobile subscribers (per 1,000 people)	408	585	672	879	306
Internet users (per 1,000 people)	206	148	327	545	95
Broadband subscribers (per 1,000 people)	3.5	0.0	20.2	85.0	23.1
Internet bandwidth (bits/ person)	40	87	1,074	1,258	116
E-government readiness index (scale 0-1)	0.40	0.20	0.55	0.68	0.38
Secure Internet servers (per mio people)	4.3	2.4	48.4	95.6	2.3

Source: World Bank country data

According to the World Bank data, Bosnia and Herzegovina is by most ICT indicators markedly behind Slovenia and Croatia, but ahead of Serbia and Montenegro, Macedonia and Albania. Other sources, however, give different assessments. The UN, thus, estimates that the number of Internet users per 1,000 inhabitants in 2001 was 163 in Croatia, 60 in Serbia and Montenegro, 34 in Macedonia, 24 in BiH, and 2.5 in Albania. The same source compares the e-government readiness of the five Western Balkan contries', using a composite index comprised of the web index, telecom capital index and human index. By all three indices, Croatia occupies a dominant position, whereas the positions of Bosnia and Herzegovina differ: web index – 3rd position, telecom capital index 4th position (ahead of Albania) and human index 4th position (ahead of Serbia and Montenegro) (UN, 2003).

Knowledge Transfer and Innovation

Strengthening SMEs' technological capacity: Technology Parks and Centres

Science and technology (S&T) policies generally include a range of measures to strengthen SMEs technological capacity through university-industry linkages (OECD, 2002), and through establishing technology parks[8] and technology incubators. In several countries,

[8] A technology park is special form of incubator aimed at enterprises with high technology requirements which facilitate the valuation and commercialisation of academic research activities. A few explicitly seek to catalyse experimentation by firms and organisations to upgrade their appreciation and governance of such assets, e.g., through public campaigns or in the context of public procurement.

changes to patent legislation and to the distribution of intellectual property rights between institutions and individuals have been made in recent years to strengthen conditions for science-industry links and the commercialisation of research. The extension of patent protection to publicly-funded research in the United States has had a significant impact on technology transfer (Jaffe and Lerner, 1999).

In recent years many universities have set up programmes to encourage academics and students to establish spin-off companies to commercialise the results of their scientific inventions. Such companies are typically small high-technology companies. The commercialisation of scientific research through spin-offs is a direct means of transferring knowledge from higher education institutions to the private business sector. But the use of spin-offs as a mechanism of knowledge transfer is not without its drawbacks and difficulties. Degroof and Roberts (2004) studied spin-off policies of the eight largest academic institutions in Belgium and at 47 companies which had been spun off from them. They concluded that spin-off policies should be highly selective, and that a high level of support is needed especially in those cases where the entrepreneurial infrastructure and culture are weak. In the absence of adequate support, spin-offs may remain stuck at a small scale of operation.

University based start-ups and spin-offs are high-risk ventures. Typically, spin-offs may find it hard to raise either equity capital or loan funds to finance their activities. Equity investors may be reluctant to invest because of information asymmetries between the academic entrepreneur and the investor. Banks may be reluctant to invest because of adverse selection problems (high risk-adjusted interest rates discourage all but the most high-risk borrowers). Because of these risks, investors are likely to be attracted to spin-offs only if they are able to control a majority equity stake leaving only a minority stake to the university. If research institutions are not allowed to retain the right to patents in inventions that they make, and if they are constrained by restrictive regulations and bureaucracy there is even less chance that their spin-off activities will be successful (Lerner, 2005).

SMEs' technological capacity is one of the most critical issue for development of SMEs in Bosnia and Herzegovina. It is essential for competitiveness and innovation and is slowly being strengthened. However, the dissemination of new technologies, the creation of links between SMEs and research centres to foster co-operation, the establishment of research and technology parks, incubators or centres, and initiatives to encourage the formation of clusters in key economic sectors are all still only in their early stages.

Unlike Slovenia where three technology parks have been established and Croatia that has five (Bartlett and Cučković 2006), Bosnia and Herzegovina does not have a single technology park. The co-operation between universities and companies is generally at a very low level in terms of technology innovations and transfer. Efforts have been made at entity level to try to change this situation. Republika Srpska organised support for innovation, co-ordinated by the Republic Ministry of Science and Technology. With the ministry's support, the Centre for Technology Transfer and Centre for Quality have been recently formed. Some regions have demonstrated a trend towards more regionally-based technology centres, which are donor-supported. In particular, Tuzla, Banja Luka and Zenica are the only places that are trying to develop and organise such centres. The ideas on promoting technology parks and centres in Sarajevo appear to be forgotten, even though it accommodates the largest number of faculties, institutes and donor organizations.

EXIT - Information Technology Business Support Centre - is a non-governmental organization established in Banja Luka to create a critical mass of IT entreprneurs and IT companies that could respond to upcoming demands of the future BiH information and

knowledge based economy. The project has been supported by European Commission and Royal Norwegian Embassy, and many other international and local donors. IT BSC staff of 11 people works with entrepreneurs, potential entrepreneurs and university experts, providing the wide spectrum of business services (information, IT news, seminars and workshops on IT related issues as well as the information about governmental IT initiatives), and consultancy service (legal and economic issues and Intellectual property rights).

The Business Innovation and Technology Centre Ltd (BIT centre) was established in Tuzla in 2005 by the Norwegian research company SINTEF; the Norwegian Innovation company SIVA, Tuzla Municipality, and the University of Tuzla. The BIT centre has established a business incubator targeting ICT entrepreneurs, a business service office targeting market development and commercialization of R&D projects for ICT businesses in the Tuzla region, and a training program for entrepreneurs.

The most ambitious approach to technology support issues is expressed by the Regional Development Agency for Central Bosnia (REZ RDA) in Zenica. Based on underutilized business premises and production facilities, as well as the newly established Zenica University and willingness of Zenica-Doboj Canton Government, a Technology Park Feasibility Study has been drafted. REZ RDA has already established the Wood Excellence Centre which aims to increase the competitive capacities of wood and furniture in Zenica-Doboj Canton. It is located within the Faculty of Mechanical Engineering in Zenica. In addition, a TEMPUS project under CARDS 2006 will introduce training courses for institution building and establish a Centre for Entrepreneurship and Innovation at the University of Zenica. The partners in project are Polytechnics Faculty, Torino, University Incubator Primorska, Koper, World University Service Bosnia and Herzegovina – SUS BiH, Sarajevo and Ministry of Civil Affairs of Bosnia and Herzegovina, Sarajevo.

Bosnia and Herzegovina is a party to number of important Intellectual Property Rights (IPR) conventions (e.g. the Paris Convention for the Protection of Industrial Property, the Madrid Agreement, the Bern Convention for the Protection of Literary and Artistic Works), but it does not yet have the capacity to implement or enforce them. The Law on Establishment of the Intellectual Property Institute has been adopted, but it does not fully meet international standards. Within the organisational structure of this Institute, the Department for Intellectual Properties has been formed to co-ordinate action to enforce IPRs.

Industrial Clusters

Today, industrial clusters are recognized as an important instrument for promoting industrial development, innovation, competitiveness and growth. Although primarily driven by the efforts made by private companies and individuals, clusters are influenced by various actors, including governments and other public institutions at national and regional levels. The policy dimension in clusters remains controversial.

Connections between regional space, interaction between economic actors, and innovation were gradually appreciated in industrial organisation literature. Ideas were picked up in the 1980s with the interest in industrial districts in "third Italy" (Becattini, 1990; Brusco, 1990).[9] The performance of the industrial districts of Italy inspired other economists to examine properties in industrial organisation that facilitate flexible structures and specialisation. The focus was on the role of SMEs (Sengenberger and Pyke, 1990). Some examined the situation

[9] The concept described the thriving firm structures witnessed in the Northeast and centre of Italy, which contrasted with the stagnation in the poor South ('second Italy') and a recession in the traditionally rich Northwest ('first Italy').

in individual countries such as Germany (Semlinger, 1993), the United States (Saxenian, 1994), and increasingly, developing countries (Nadvi, 1995; World Bank, 1999).

A major breakthrough for the cluster concept was Porter's *Competitive Advantage of Nations* (1990) which, conversely to the prevailing US local development objective of promoting diversified economies, advocated specialisation according to historical strength by emphasising the power of *industrial clusters*. Porter highlighted the multiple factors beyond the ones internal to the firm that may improve its performance. His concept of clusters was related to the "competitiveness" of industries and of nations.[10]

Theories around clusters have widened the approach from being an analytical exercise aimed at examining functional or spatial phenomena, towards operational tools for regional development and involving multiple actors. Seven elements have been adopted as key to notion of clusters: (i) geographical concentration: firms located in geographic proximity due to hard factors, such as external economies of scale, as well as soft factors such as social capital and learning processes; (ii) specialisation: clusters are centred around a core activity to which all actors are related; (iii) multiple actors: clusters and cluster initiatives do not only consist of firms, but also involve public authorities, universities, members of the financial sector, and institutions for collaboration; (iv) competition and co-operation: this combination characterises the relations between these interlinked actors; (v) critical mass: is required to achieve inner dynamics; (vi) the cluster life cycle: clusters and cluster initiatives are not temporary short-term phenomena, but are ongoing with long-term perspectives, and finally (vii) innovation: firms in clusters are involved in processes of technological, commercial and/or organisational change (Andersson at al, 2004).

Potential benefits from cluster initiatives do not in themselves suffice as rationale for policy intervention in clustering processes. Individual firms and organisations are the prime actors in cluster processes, and cluster policy is about consistently paving the way for conditions that are conducive to people's engagement in joint efforts, and the realisation of mutual benefits.

The realisation of an identified policy objective does not necessarily require a public policy measure. In some instances, private actors will, and should, undertake these roles spontaneously (bottom-up approach policy).

However, in many countries there are three main rationales for policy involvement, related to market failures, government failures, and systemic failures. While all need to be taken seriously, cluster policies should adopt a comprehensive approach. Given the presence of multiple imperfections in markets and prevailing institutions, there is a potential for policymaking to generate benefits by creating conditions that are favourable for the formation of new clusters as well as the reengineering of old ones (top-down approach).

Cluster experiences in developed countries have created a strong interest among policy makers in various countries which have introduced public policies to support the creation of clusters involving both companies and institutions of higher education such as the cluster policy introduced in Slovenia in 2001. The Slovenian programme for developing industrial clusters involving both companies and research institutes began with a pilot programme in 2000-2003. One of the aims of the cluster policy was to promote knowledge transfer from research institutes to the companies in the cluster. The programme provides co-financing of the costs during the initial phase of creation of clusters initiative, for the preparation of a joint

[10] "Clusters are a geographically proximate group of interconnected companies and associated institutions in a particular field linked by commonalities and complementarities. Clusters encompass an array of linked industries and other entities important to competition including governmental and other institutions – such as universities, standard setting agencies, think tanks, vocational training providers and trade associations. (Porter, 1998).

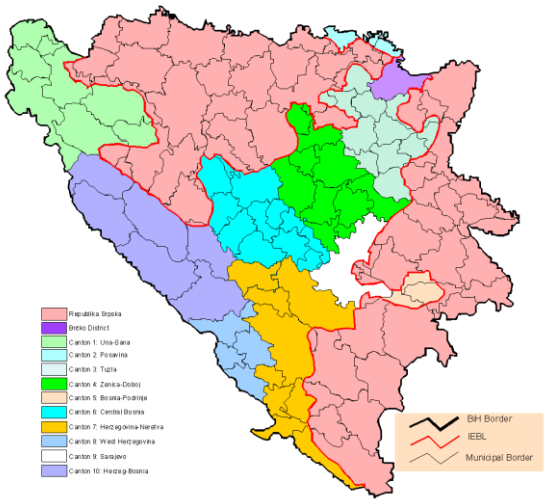
development strategy, and for the costs incurred during the first two years of their operations. However, in Bosnia and Herzegovina cluster development is still mainly a result of donor initiated and financed projects, with little indication of sustainability or of major (if any) governmental support. BiH benefits from two main cluster development programmes supported by donors (USAID and GtZ).

USAID provides technical assistance through the Cluster Competitiveness Activity programme (CCA), amounting to $16 million (2004- 08). The overall goal of CCA is to advance economic growth and job creation in Bosnia and Herzegovina by supporting the development of competitiveness of the wood processing and tourism industries. CCA provides technical assistance to promote the development of industry clusters, i.e. private sector firms, financial providers, and government and non-government agencies that support the operation of an industry. This project also informs cluster companies about global market trends and gives advice on improving product quality and operational productivity, and tries strengthens connections among cluster companies and their links to export markets. It plays a leading role in co-ordinating the international community's activities in regard to forestry reform, aimed at sustainable management of Bosnia and Herzegovina's forests. The project manages the $1.5 million Competitiveness Implementation Fund and promotes a $31 million DCA Loan Guarantee facility for the wood processing, tourism and agri-business sectors. The participation of BiH universities in cluster activities has been only symbolic, mostly in the form of occasional lectures and business skills.

GTZ supports a growing automotive component cluster, comprising companies from throughout the country. The automotive cluster started in April 2004. Originally, the objectives of cluster were ambitious: representation of the members' interests within policy-makers and governments, support in developing international cooperation projects, R&D in the automotive sector, exchange of ideas and information within members as well as with relevant national and international stakeholders, organizing and hosting the seminars, workshops and conferences, promote exchange of know-how and experiences between entrepreneurs and scientists, setting up and moderating horizontal and vertical networks within the value chain, consulting and other services in the framework of the cluster objectives to increase the competitiveness of the members.

The AC-B&H cluster is a top-down approach financed by the donor community and implemented by a foreign agency (membership fees are very low: 2000 euro in average for automotive producers and 250 euro for universities, chambers and other participants), without the involvement of any governing bodies, chambers, banks, and without specific supporting policies. It is a prime example of the weakness of donor-sponsored projects based on reliance on the efforts of the private sector alone. AC-B&H started with 28 members. In 2003 turnover of AC-B&H members was around €65 million. By July 2005, the AC B&H had about 6,000 employees in 26 members (JICA, 2005). Today, AC B&H has only 18 members, including three faculties (Faculties of Mechanical Engineering from the Universities of Sarajevo, Tuzla and Banja Luka). The most dynamic and propulsive firms have stepped out of the cluster, whereas the university has only a spectator role.

Further assistance of international donors is to start with local cluster initiatives through the EURED 2 programme and within the framework of EU formed and implemented regional development agencies. This approach would be also top-down approach, with little involvement of research and development organizations and universities. It remains to be seen whether the lack of support in the form of coordinated governmental policies would still allow for a move away from the existing strategies and international donor policies.

EU RED economic region	Political setting
	

Within EURED and EURED 2 programes, five so-called authorised regional development agencies have been established: SERDA – for the Sarajevo macro-economic region, NERDA – for North-Eastern Bosnia region (Tuzla), REDAH for South-Eastern Bosnia region (Mostar), REZ for Central Bosnia region (Zenica) and ARDA for North-Western Bosnia region (Banja Luka). The geographic areas which are covered by these agencies do not coincide with the administrative constitution of BiH, both at the central political and administrative level (entities) or the cantonal level. Under such circumstances, it is hard (almost impossible, in fact) to provide a consistent policy of support to the development of SMEs and the development of cluster initiatives.

Conclusions and Recommendations

In this paper we have carried out an audit of three main functional areas which are crucial for sustainable development of Bosnia and Herzegovina: institutional settings, development of business sector focusing on SMEs, and the science and research sector including universities. Our general assessment of the existing state of affairs is rather pessimistic: there are many external and internal factors that hold Bosnia and Herzegovina deep in a zone of hopelessness, lack of prosperity, poverty and uncompetitiveness. In order to finally move on and catch up with the neighbouring countries, it will be necessary to introduce deep institutional reforms in all three audited areas. Such reforms should aim to create conditions for the revival of entrepreneurship, transformation of HEIs and the transition from strictly educational to a combined educational and research approach, which would facilitate their inclusion into the European Research Area and create conditions for promotion of knowledge transfer between HEIs and the business sector.

As far as science, research and technology institutions, and higher education institutions are concerned, the paper has indicated many constraints and problems. Most research infrastructures are obsolete, libraries are not able to pay subscription fees to scientific journals, connections to the international communication system is slow, the younger generation in universities lacks opportunities to be trained in research activities, and the majority of industrial research has been dismantled due to war destruction, the collapse of

many economic sectors and the self-centredness of international donor community. The latter, unwilling to cooperate in building the capacity of the domestic science and research sector, has nevertheless granted substantial funding for these purposes to their own international consultant and research organizations.

The division of political and administrative responsibilities between the various political entities inherited from the Dayton Peace Agreement is a serious obstacle to defining and implementing a science and technology policy. In a competitive world such a policy needs to be defined at the State level, in close cooperation with all the actors in the innovation systems (entities, cantons, universities, research institutes, industry). To address all these issues, institutional tools have to be established. Today, there is no "voice" for BiH science and technology on any level of authority, including the international donor community. In early 2004, under the pressure of World Bank and EC, governmental authorities decided to draft two laws on the state level: (i) – higher education law and (ii) – law on science. The first law is still in parliamentary procedure, but the second one has not yet even been drafted.

It is now high time for a new "road map" for Science and Research sector in B&H, including universities and research institutes, with objectives and priorities similar to objectives and priorities in most advancing countries in South East Europe, and especially in Slovenia which has a common heritage and good policy transfer possibilities. Three main short-term objectives (until 2012) could be:

- *Institutional settings:* In most countries, science and technology policy is a state responsibility. Thus, the definition of a such policy at the state level is necessary in order to rebuild BiH economy and society, and to integrate BiH science and technology into European Research and Education Area. The tools for a science and technology policy would be created by the Science Law; a Ministry of Science and Technology and Higher Education, a National Agency for science and technology and a research network (state, entity and cantonal fund for R&D).
- *Quick "change" package:* (i) raise public awareness about the importance of the knowledge-based economy, recognizing the key role of innovation and technological progress, and the strong link between S&T and economic development; (ii) train a new generation of scientists; (iii) rehabilitate the existing research infrastructure; (iv) launch a "third cycle" doctoral studies according to Bergen declaration based on original research; (v) utilize existing technologies and knowledge to create new business opportunities, so-called "fast follower innovation strategies" aimed at making full use of existing technologies; (vi) access to international research and science associations (UNESCO, ROSTE, ISO, IEC, ESF, COST, IMA, CIGRE, etc); (vii) access to European programmes for exchange of students and professors (Erasmus, Erasmus-Mundus); (viii) re-establish BiH academic networks; (ix) enable access to R&D data bases (Current Contents, Science Citation Index, WEB of Science etc.) and electronic science journals (EBSCO etc.); (x) support editing of scientific journals which could be accepted by international reference data bases
- *Develop university-business linkages*: (i) open multilateral and bilateral donor programmes and projects for universities (EU-CARDS programmes, especially RED
- programmes, USAID cluster initiative project etc); (ii) open state (all levels) strategy projects for domestic research and universities; (iii) return to entrepreneur role of universities and university research institutes; (iv) establish partnership with private sector.

In the long term (until 2020), the strategic goals should aim at the investment of 2% of GDP in R&D activities, with a goal of private sector participation of 50% and at the full integration of BiH science and research in ERA. Besides, HEI, and especially universities, should radically change the way they have been functioning so far. Today, when universities play a leading role in knowledge-based society, BiH universities should shift from their traditionally static role in which government dominates, from top-down bureaucratic coordination with a 'large project' mentality, and from the accent on the university not as a primarily teaching institution towards a new role as research universities with many research groups and centres and as entrepreneurial universities with links to new firms and networks. The University of the Future will thus have three major functions: (i) incubation, which will be integrated into academic units; (ii) research, which will take place in hybrid centres comprising academic, industry and government researchers; and (iii) teaching, which will involve virtual classes including on-campus and off-campus participants.

Regarding research and development for SMEs, Bosnia and Herzegovina is one of most isolated countries in transition. The BiH Competitiveness Analysis as well as the exogenous character of business sector development, only support this assessment. In comparison to Slovenia and Croatia (Bartlett and Bukvič, 2006; Bartlett and Cućković (2006), as well as the other Western Balkan countries (EC 2007), knowledge transfer between HEIs and business sector in Bosnia and Herzegovina is extremely weakly developed. The situation in BiH in the area of business sector can be summarized as follows:

- Small enterprise policy has received relatively little attention in BiH. The focus of governments has been on consolidating macro-economic stabilisation, on managing the recovery and restructuring processes and on privatisation of large companies. Only limited support has been available for small enterprises.
- Enterprise policy has largely been established on the entity level. The country lacks an SME strategy, as well as a policy design and implementation capability at the state level.[11] There is a need to establish a system for regular information exchange, and to create synergies among locally managed programmes on the state level.
- Different governments, different donor initiatives have been launched, even at the level of the local governments. This has resulted in a complex, poorly organised situation where SMEs do not know where to start and who exactly to contact for what service. SMEs also often complain of the voluminous amount of paperwork and the time-consuming project approval processes.
- A key priority is the creation of an appropriate institutional setting at the state level to support SME development, consisting of an SME Development Council, an SME Development Agency and an SME Development Fund. Uniform standards, better coordination, enhanced visibility of policies and activities should be achieved through a virtual Business Development Network consisting of all stakeholders at all levels and from all sectors.
- Among existing providers, special attention should be given to the establishment of incubators, clusters, co-operatives and to all forms of business cooperation. It is extremely important that the government implements a single central policy and organization to support, coordinate and stimulate research and development in BiH.
- A coherent innovation policy and a relevant legal framework is needed at a national level, and an agency for Innovation and Technology development should be organized either on

[11] National Bosnia and Herzegovina SME Strategy was drafted in 2005 (IFC/SEED, 2005). Public hearings were delayed because of disagreements among the entities.

the national or entity level. Considering EU best practices, it is evident that such agency should co-ordinate innovation and R&D activities. The National Agency for Innovation and Technology Development should make HEI-SME knowledge transfer a central aim of its activities to promote innovation and boost the proportion of innovative SMEs in BiH. It should assist institutions such as HEIs, technology centres, technology networks and technology parks to access EC funds to promote innovation and knowledge transfer activities.

- Before the war in BiH there was a strong link and network of cooperation between science and research centres within the universities and large enterprises. This cooperation is nowadays very weak, and between SMEs and science and research centres almost non-existent.
- The structure of universities should be reformed to encourage applied research for the SME sector. Universities should be given a greater degree of autonomy to commercialize innovations and to react to opportunities to transfer knowledge to the private sector which arise through for example the development of industrial clusters. Universities should boost their business incubators to provide more support to researchers to commercialize their research through the creation of new spin-off enterprises.
- Incubators and technological parks should be established the ongoing process of cluster formation should be strengthened. What is missing is an innovation policy or strategy, which would define the roles of universities and research organizations.
- The "cluster concept" is relatively new in BiH, and the identification of cluster possibilities is assisted by international donors. However, there are no programs to promote knowledge transfer from HEIs to the business sector. There are no development projects for development of innovative clusters. Also, there no programmes for development of an environment supportive to innovation.
- It is evident from many reports that SMEs have little interest in R&D and innovation issues. For this reason, more efforts should be given to introduction of training programmes as early as in secondary schools, and certainly on university level, as well as training programmes for current managers. The awareness campaigns are also a very efficient tool to reach a broad audience.
- Inter-firm clusters and networks, together with business incubators, have proven to be effective tools for fostering technological development and spreading innovation. Governments should change the orientation of the existing clusters from traditional sectors to ones with higher value added. They should also promote closer links among clusters, incubators and universities and target support to innovative companies. Industrial clusters should be encouraged to internationalize and develop an outward exporting orientation and link up with international systems of innovation.
- There is a need for strong co-ordination of the whole agenda of technological co-operation, intellectual property rights, business incubators, cluster-development, and skill-development. This requires a high level of co-ordination among government institutions, private sector, universities and research institutes. Governments should create an
- institutional setting to ensure that information exchange and inter-agency co-ordination is regular and effective.
- Governments should devote more resources to the enforcement of IPR legislation through communication campaigns, training of officials, and monitoring of IPR cases to ensure results. Serious technology transfer from foreign investors to SMEs will be limited until the issue of IPR enforcement is truly addressed.

References

Acemoglu, D., Johnson, S. and Robinson, J. (2001), The Colonial Origins of Comparative Development: an Empirical Investigation., *American Economic Review* 91(5), 1369-1401.

Andersson, T., Schwaag Serger, S, Sörvik, J. and Hansson, E.W. (2004). *The Cluster Policies Whitebook,* Malmö: IKED - International Organisation for Knowledge Economy and Enterprise Development

Audretsch, D. (2005), "Mansfield's missing link: the impact of knowledge spillovers on firm growth", Journal of Technology Transfer, 30(1/2): 207-210.

Arrow, K.J. (1971), "Economic welfare and the allocation of resources for invention", in: Lamberton, D.M. (ed.), *Economics of Information and Knowledge*, Harmondsworth: Penguin Books, pp. 141-159.

Bartlett, W. (2001), "SME development policies in different stages of transition", *MOCT-MOST: Economic Policy in Transition Economies*, 11: 197-204.

Bartlett, W. and Bukvič, V. (2001), "Barriers to SME growth in Slovenia", *MOCTMOST: Economic Policy in Transition Economies*, 11; 177-195.

Bartlett, W. and Bukvič, V. (2003), "Financial barriers to SME growth in Slovenia", *Economic and Business Review*, 5(3): 161-182.

Bartlett, W. and Bukvič, V. (2006), "Knowledge transfer in Slovenia: promoting innovative SMEs through spin-offs, technology parks, clusters and networks", *Economic and Business Review for Central and Eastern Europe*, 8(4):

Bartlett, W. and Cučković N. (2006), Knowledge transfer, institution, and innovation in Croatia and Slovenia. *Social Research*, 15(3): 371-400, Zagreb

Bartlett, W. and Prašnikar, J. (1995), "Small firms and economic transformation in Slovenia", *Communist Economies and Economic Transformation*, 7(1): 81-101.

Bartlett, W. and Rangelova, R. (1996), "Small firms and new technologies: the case of Bulgaria" in: R. Oakey (ed.) *New Technology-Based Small Firms in the 1990s*, Vol. 2, London: Paul Chapman, pp 66-79.

Baumol, W.J. (2002), *The Free Market Innovation Machine: Analyzing the Growth Miracle of Modern Capitalism*, Princeton: Princeton University Press.

Becattini, G. (1990), "The Re-emergence of Small Enterprises in Italy", in Sengenberger *et al.* (1990), *The Reemergence of Small Enterprises: Industrial Restructuring in Industrialised Countries*, ILO, Geneva.

Braczyk, H-J., P. Cooke and M. Heidenreich (eds.) (1998), *Regional Innovation Systems*, London: UCL Press.

Brusco, S. (1990), "The idea of the industrial district: Its genesis", in Pyke, F., Sengenberger, W. and Becattini, G. (eds.), *Industrial districts and inter-firm cooperation in Italy*, International Labour Office, Geneva.

Council of Europe (1999), *Education in Bosnia and Herzegovina: Governance, Finance and Administration*

Culahovic, B. (2006), Exports of Western Balkan countries into European Union: major problems and recommendations, *Ekonomski anali*, Beograd, god LI, br. 168, pp 49-72.

Degroof, J-J. and Roberts, E.B. (2004), "Overcoming weak entrepreneurial infrastructures for academic spin-off ventures", *Journal of Technology Transfer*, 29: 327-352.

Dyker, D.A. and Radošević, S. (2000), "Building the knowledge based economy in countries in transition œ from concepts to policies", *Journal of Interdisciplinary Economics*, 12(1): 41-70.

Edquist, C. (2001a): *Systems of Innovation for Development*, UNIDO World Industrial Development Report (WIDR), May 2001

EC (2003a), *Third European Report on Science and Technology indicators -2003 - Towards a Knowledge-based Economy*, DG for Research, Brussels.

EC (2003b), *Towards a European Research Area - Science, Technology and Innovation - Key Figures 2003-2004*, DG for Research, Brussels.

EC (2007), *Enterprise Policy Development in the Western Balkans: Report on the Implementation of the European Charter for Small Enterprises in the Western Balkans.* European Commission (EC), Directorate General for Enterprise and Industry (EC), Organisation for Economic Co-operation and Development's

Investment Compact for South East Europe (OECD), The European Training Foundation (ETF) and European Bank for Reconstruction and Development (EBRD)

EBRD (2007), *Transition Report 2006 Update*. London: European Bank for Reconstruction and Development.

EUA (2004), *EUA institutional evaluations of seven Universities of Bosnia and Herzegovina: Cross cutting summary report*, 23 September 2004, Council of Europe

IBF International Consulting and the British Council (2005), *Functional Review of Public Administration of Education Sector in Bosnia and Herzegovina: Final Report*. March 2005

Jaffe, A. and Learner, L. (1999), "Privatizing R&D: Patent Policy and the Commercialisation of National Laboratory Technologies", *NBER Working Paper* 7064, NBER, Cambridge, MA.

JICA (2005), Survey on Auto Components Sector in Bosnia and Herzegovina. Sarajevo: Japan International Cooperation Agency ,September 2005.

Kornai, J. (1992), "The Affinity between Ownership and Coordination Mechanisms: The Common Experience of Reform in Socialist Countries", in Poznansik, Z. (ed.), *Constructing Capitalism: the Re-emergence of Civil Society and Liberal Economy in the post-Communist World*, Westview Press, Boulder and Oxford, 97-116.

Lerner, J. (2005), "The university and the start-up: lessons from the past two decades", *Journal of Technology Transfer*, 30(1/2): 49-56.

Matic, B. (2006), *Necessity to adopt a science policy in B&H Science Policy in Bosnia and Herzegovina*, International Conference and Ministerial Round Table: "Why invest in science in South Eastern Europe?", 29 – 30 September 2006, Ljubljana

Morgan, K. (1997), "The learning region: institutions, innovation and regional renewal", Regional Studies, 31(5): 491-503.

Mytelka, L. and Oyeyinka, B. (2003), *Competence Building and Policy Impact through the Innovation Review Process: A commentary*, IDRC-UNESCO, paper presented at the joint workshop on Future Directions for National Reviews of Science, Technology and Innovation in Developing Countries, UNESCO, Paris.

Nadvi, K. (1995), Industrial Clusters and Networks: Case Studies of SME Growth and Innovation, *UNIDO Discussion Paper*, Vienna. http://www.unido.org/doc/Publications.htmls

OECD, (2002*a*), *Benchmarking Science-Industry Relationships*, Paris.

OECD (2003*b*), *Science, Technology and Industry Scoreboard*, Paris.

Papon, P., and Pejovnik, S. (2006), *Guidelines for a Science and Research Policy in Bosnia and Herzegovina*, Science Policy Series n° 2, Venice: UNESCO Regional Bureau for Science and Culture in Europe.

Pereira, T. S. (2007), *Enhancing Science Policy and Management in South Eastern Europe: Science and Technology Statistics and Indicators Systems*, Science Policy Series n^{o} 4. Venice: UNESCO Regional Bureau for Science and Culture in Europe (BRESCE).

Porter, M. E. (1990), *The competitive advantage of nations,* The Free Press, New York.

Porter, M. E. (1998), *On Competition*, Harvard Business School, Boston.

Radošević, S. (2001), *Science and technology indicators and innovation surveys in 'catching up' economies: their relevance, results and policy issues*, Paper presented at the OECD conference, Pretoria, November.

Radošević, S. (2002), "Regional innovation systems in Central and Eastern Europe: organizers and alignments", *Journal of Technology Transfer*, 27: 87-96.

Radošević, S. (2004), "(Mis)match between demand and supply for technology: innovation, R&D and growth issues in countries of Central and Eastern Europe", in: J. Svarc, et al. (eds.), *Transition Countries in the Knowledge Society*, Zagreb, Institute of Social Sciences, pp. 83-100.

Saxenian, A. (1994), *Regional Advantage. Culture and Competition in Silicon Valley and Route 128,* Harvard University Press, Cambridge, MA.

Semlinger, K. (1993), "Small Firms and Outsourcing as Flexibility Reservoirs of Large Firms", in Grabher, G. (ed.), *The Embedded Firm*, Routledge, London, 161-78.

Sengenberger, W. and Pyke, F. (1991), "Small Firm Industrial Districts and Local Economic Regeneration: Research and Policy Issues", *Labour and Society* 16(1).

Šlaus, I. and Pisk, K. (2006). "The future of South-Eastern Europe in 2050: R&D needs in the region.", in (ed) Gajdusek, Mayr and Polzer, *Science policy and Human Resources Development in South-Eastern Europe in the Context of European Integration*, Vienna: Federal Ministry for Education, Science and Culture.

Smallbone, D. and Welter, F. (2001), "The Disincentives of Entrepreneurship in Transition Economies", *Small Business Economics* 16(4), 249-61.

Tanović, L. (2005), 'Science and Technology Status in Bosnia-Herzegovina', in Kobal, E., and Radosevic, S. eds., *Modernisation of Science Policy and Management Approaches in Central and South East Europe*, IOS Press, Amsterdam.

Tiplić, D. and Welle-Strand, A. (2006), The Bosnia-Herzegovina's Higher Education System: Issues of Governance and Quality. *European Education* , Volume 38, Number 1/Spring 2006

Uvalić, M. (2005), *Science, Technology and Economic Development in South Eastern Europe*, Science Policy Series nº1, Venice Science Policy Series nº 4. Venice: UNESCO Regional Bureau for Science and Culture in Europe (BRESCE).

Uvalić, M. (2006), *Science, Technology and Economic Development in South Eastern Europe*,International Conference and Ministerial Round Table: "Why invest in science in South Eastern Europe?", 29 – 30 September 2006, Ljubljana

World Bank (1997), *Bosnia and Herzegovina: From Recovery to Sustainable Growth*, The World Bank, Washington

World Bank (1999), *Knowledge for Development*, Washington DC.

World Bank (2003), *Doing Business in 2004: Understanding Regulation*, Washington.

WEF (2006), *The Global Competitiveness Report 2006-2007*, London: Palgrave Macmillan