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Guidelines for a Science and Research Policy in Bosnia & Herzegovina

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Guidelines for a Science and Research Policy in Bosnia & Herzegovina

N°2

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ABOUT THE AUTHORS

Pierre Papon is Professor of Thermical Physics at the l'Ecole Supérieure de Physique et Chimie Industrielles (ESPCI) in Paris, France. He was President of the Observatoire des Sciences et des Techniques in Paris, President Director-General of the Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), and Director-General of the National Centre for Scientific Research (CNRS) in France. He was Chair and member of various national and international scientific councils and committees, including the Executive Board of the European Science Foundation and the Independent World Commission for Oceans. Pierre Papon authored a significant number of scientific articles, studies, and dozen of books on subjects related to the role of science in society, science policy, foresight: *Le temps des ruptures. Aux origines culturelles et scientifiques du XXI^{ème} siècle* (Fayard, 2004), *Physics of Phase transitions* (Springer, 2002), *Pour une prospective de la science* (R. Laffont, 1983), *Les logiques du Futur* (Aubier, 1989), *Économie et politique de la science et de la technologie* (with R. Barré, Hachette, 1993), *Le Sixième continent - Géopolitique des océans* (Odile Jacob, 1996). Pierre Papon was also a contributor to the UNESCO World Science Report 1996.

Stane Pejovnik is Dean of the Faculty of Chemistry and Professor of Materials Science, at the University of Ljubljana (Slovenia). He has lectured at the North Carolina State University and at the Technical University of Graz (Austria). From 2000 to 2003, Prof. Pejovnik was State Secretary for Higher Education at the Ministry of Education, Science and Sports of Slovenia. During this period, he was a member of many national and international committees and working groups at the European level, mainly devoted to the implementation of the Bologna Process for the establishment of a European area for higher education and of the Lisbon Convention on the Recognition of qualifications concerning higher education. Stane Pejovnik authored or co-authored more then 200 refereed publications in scientific journals, 30 technical reports, and is the co-editor of six volumes of proceedings. He also holds five patents and four technical innovations.
Stane Pejovnik has actively participated in various committees and conferences on issues related to the interplay between science, technology and society. He is co-chairman of the International Association 'FORUM Bled' and main organizer of the International Conference 'FORUM Bled' devoted to science policies and technological transfer in Europe.

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Foreword

The UNESCO Office in Venice has been involved for a number of years in actions aimed at the reconstruction of scientific cooperation in South East Europe, involving many experts from EU and non-EU countries. A conference held in Venice on 24-27 March 2001 launched the process. Since then, the UNESCO Office in Venice has taken several initiatives, and in 2004 it was decided to organize an expert mission in Bosnia & Herzegovina with two main objectives: to assess the scientific potential (and in particular the research infrastructure) of the country; and to make recommendations for its future development and integration into the international and European research communities. UNESCO Office in Venice felt that it was its duty to contribute to the reconstruction of the scientific potential of a country which has been severely damaged during a war, and to the development of international cooperation for this purpose. This initiative was fully endorsed by the BiH political authorities and received the personal support of Dr Safet Halilović, Minister of Civil Affairs of Bosnia & Herzegovina, and H.E. Željana Zovko, Ambassador of BiH to France and Permanent Delegate to UNESCO.

Accordingly, three missions to BiH were carried out by two UNESCO consultants, Prof. Pierre Papon (France) and Prof. Stanislav Pejovnik (Slovenia). Ms Iulia Nechifor, Programme Specialist also joined one of the missions, all of which took place in 2005 (on 14-19 March, 16-21 May, 30 June-1 July). During the visits, extensive discussions and consultations were carried out with political authorities (at the State, entities, and cantons levels), diplomats, representatives of the scientific community (universities, research institutes), and industrialists. A list of all institutions visited, and a summary of views aired there during the discussions, may be found in the Annex I to the present text. The missions were greatly helped by the support of local authorities and by the UNESCO Project Officer in Sarajevo, Mr Sinisa Sesum.

After a brief introduction describing the present situation of the country ten years after the signing of the Dayton Peace Agreement, the authors, Prof. Pierre Papon and Prof. Stane Pejovnik, present conclusions on the state-of-the art of the scientific potential of Bosnia & Herzegovina and the role of the various institutions in the country, and propose objectives and guidelines for a future national science and research policy. We sincerely hope that its publication and distribution will contribute to a process by which Bosnia and Herzegovina and its scientists will be able to play an active part in the European Research Area of tomorrow.

Howard Moore
Director

Executive Summary

UNESCO Office in Venice commissioned an expert mission in Bosnia & Herzegovina (BiH) with two main objectives: to assess the scientific potential (in particular research infrastructures) of the country; and to make recommendations for its future development and integration into the international and the European research communities. This initiative was fully approved by the BiH political authorities and in particular by Dr Safet Halilovic, Minister of Civil Affairs of Bosnia & Herzegovina. Three missions were undertaken in the country in 2005 (on 14-19 March, 16-21 May and 30 June-1 July), during which meetings were organized with political authorities; universities, laboratories and companies were also visited. This report presents conclusions and recommendations based on those visits.

A decade after the signature of the Dayton Peace Agreement (signed in 1995) which put an end to the war, BiH is still facing a very difficult situation: the unemployment rate is high (40% of the active population), large sectors of the economy have collapsed, and a large part of the infrastructure has not been reconstructed. Furthermore, the division of political and administrative responsibilities between the three levels of political government inherited from the Dayton Agreement (the State of BiH, the Srpska Republic, and the Federation of BiH and its ten cantons) makes it difficult to define and implementation policies at the country level, especially a science and technology policy.

Although BiH inherited from Yugoslavia a strong scientific and technological tradition and potential (in 1991, before the war, the latter had invested 1.5% of its GDP in R&D activities) and a solid industrial base, its research system is currently not able to function in accordance with international standards. BiH has maintained a science and technology system with eight universities, several public mission-oriented research institutes (for example, in metallurgy and agriculture) with various legal (and often undefined) statutes, as well as a limited number of industrial laboratories (performing mainly development tasks). The present funding of R&D activities in the country is very low (around 0.05% of GDP according to official figures, a value which is probably underestimated by a factor 3). Most of the research infrastructure is obsolete; many laboratories, if not all, are lacking operating funds; libraries are not able to pay subscription costs to international science journals and the internet connection suffers from low bandwidth; the younger generation attending universities has no means to be trained in research activities; and the majority of industrial research has been dismantled.

This means that BiH is not able to prepare for its own future which, in modern societies, relies on the capacity of countries to mobilize scientific and technical expertise. In view of this situation, there exist neither mechanisms nor resources at the State level to define and implement a policy to begin reconstruction of the research potential of the country. Political and administrative barriers resulting from the post-war situation are a very serious obstacle to this process. Furthermore, the privatisation of the economy that has been engaged does not take

into account the need for preserving the technical capital of industrial companies which, in some sectors (energy and metallurgy, for example), remains valuable.

However, although the overall situation is serious, it is not hopeless. In many sectors, there is a consciousness that solutions to problems are urgent, and despite numerous barriers researchers have found the means to restart activities and cooperate with partners inside and outside the country.

Rebuilding the scientific and technological potential of BiH will require the adoption of a "road-map" with three general mid-term objectives (2006-2015):

- training of a new generation of scientists in BiH universities or abroad;
- development of research infrastructures (experimental equipment, computers, information networks and libraries) of international standard;
- reinvestment in industrial research in a limited number of sectors (as a priority, in those sectors that export a large fraction of their production).

Although basic research should be primarily developed in several disciplines to lay the ground for the future, and since resources are restricted and the needs of BiH for its social and economic development are greatly needed, a limited number of priorities will have to be defined, such as: health, environment, metallurgy, energy, agriculture, forestry and the food industry. Research projects in these domains, should be funded only following appropriate evaluation.

The definition of a science and technology policy at the State level of BiH is an absolute prerequisite in order to rebuild a recognized and effective competence in science and technology in the country and to develop research activities that may address the needs of BiH socio-economic development. The State policy might be complemented by actions supported at the level of other politico-administrative entities such as the Srpska Republic, the Federation of BiH and some of the latter's cantons, depending upon their respective needs and financial means. This is all the more needed having in mind that the future integration of BiH into the European Union would require negotiation at the level of the BiH State with regard to the participation of BiH in the research Framework Programme, thus entitling the country to become a member of the European Research Area.

A State science and technology policy also requires that a legal framework be put into place. This is the role of the two Laws on Higher Education and on Science which have been drafted and are presently being debated. The adoption of these laws is urgent.

It is strongly recommended that the elaboration of the Science Law involve, in a preliminary phase, all the main stakeholders of the present research system in BiH (ministries and administrations in charge of science and innovation in the politico-administrative entities of the country, the Academies, the universities and research institutes, representatives of the economic sectors).

The Science Law should define, in a limited number of articles:

- The responsibility of the BiH State in the definition of a science and technology policy and the legal framework to implement it.

- The role and means of a State institution to be created with the task to implement this policy in coordination with the other politico-administrative entities of the country.

Funding of R&D should be tripartite: the State of BiH; the politico-administrative entities such as the Republika Srpska, the BiH Federation and some cantons (in particular those who support universities); and the private sector (industry and services). For the short term (2006-2007), it is recommended that the plan for the Medium-term Development Strategy, which is being revised, take into account the necessity of integrating R&D as a transversal priority for the development of BiH, with an objective of at least doubling investments in research infrastructures during the period from its present level. For the mid-term (2010-2012) an urgent financial plan should be adopted that would aim at a global yearly expenditure by public entities (State and other entities) and private sector representing at least 0.5% of the country's GDP. This funding should be complemented by additional investments and loans (from the European Investment Bank and the World Bank, for example). During the same period industry should also increase its own R&D investment, which might represent, by 2012, one third of total R&D expenditure of the country. In the long term BiH should invest 2% of its GDP in R&D.

The creation of State institutions to define and implement such a policy is the major objective of the Law on Science being drafted. The main recommendations are as follows:

1. To establish a **State Ministry** responsible for science and research policy in BiH. It could be either an existing ministry (the present Ministry for Civil Affairs, for example) or an *ad hoc* ministry created for the purpose.

2. To create, under the responsability of the State Ministry, a **State Agency for Science and Research.** The Agency shall have the following missions**:**
   - to assess needs for research activities;
   - to define science and innovation priorities for the country;
   - to propose to the Government the means to implement these priorities;
   - to establish and coordinate at European and international levels cooperation with BiH in science and research;
   - to collect statistical R&D data.

3. To set up an inter-ministerial Committee for S&T activities entrusted with the definition of the main guidelines and priorities of the research policy at the State level. This Committee should be chaired by the Prime Minister. The Agency would act as a secretary for this Committee. An **Advisory S&T Committee** should also be established, working with the Agency and advising it on establishing priorities.

4. To create a **State Fund for R&D in BiH** (under the responsibility of the Agency), with the objective of supporting scientific projects.

Seizing the opportunity of the revision of the Plan for the Medium-term Development Strategy, the Government should create the Agency for Science and Technology at the State level with a **State Fund for Research** under the responsibility of the Prime Minister for a transitory period.

Science should be considered not only as an asset to rebuild the economy of BiH and a support to public policies, but also as an essential dimension of the culture of the country. It is thus important to enhance the public understanding of science through specific actions.

The BiH scientific community should be able to join the European Research Area and to be involved in international scientific cooperation. It is therefore recommended that: the BiH scientific community be strongly involved in regional and European cooperation in research projects funded by the European research and technological development Framework Programme; for the duration of the Seventh Framework Programme, the EU should devote funds through an *ad hoc* International Programme for Western Balkan States; and BiH should participate in the COST and Eureka Programmes.

The UNESCO Office in Venice, which commissioned this Report, has launched several initiatives over the last few years to support the reconstruction of the scientific potential of the South East European countries. We strongly recommend that this action be continued, since UNESCO can play a catalytic role in the region by contributing to initiatives aimed at the development of regional scientific cooperation (through expertise, training of experts, support to specific actions to rebuild the science potential, etc.).

Scientific and technological research in BiH is in a state of emergency. Actions are urgently needed both at national and international levels. Reconstructing the science and technology potential of the country is both a necessity for the preparation of the country's future and an important step towards the consolidation of peace in the region.

Rezime

UNESCO Biro u Veneciji je opunomoćio stručnu misiju u BiH sa dva osnovna cilja: da ispitaju naučni potencijal zemlje (naročito u istraživanju infrastrukture) te da sačini preporuke za njihov buduši razvoj i integraciju u medjunarodni i evropski istrazivački sistem. Ova inicijativa je bila potpuno podržana od bh. političara, naročito gosp. Safeta Halilovića, ministra za civilne poslove BiH, i ambasadora BiH u Francuskoj i stalnog predstavnika BiH u UNESCO, Željane Zovko. Tri misije su obavljene u 2005. godini (od 14. do 19. marta, od 16. do 21. maja i od 30. juna do 1 jula), i za to vrijeme organizovani su razgovori sa političarima, univerzitetima, laboratorijama i preduzećima koje su posjetili. Ovaj izvještaj predstavlja naše zaključke i preporuke.

Deset godina nakon potpisivanja Dejtonskog sporazuma (potpisan 1995) čime je rat završen, BiH se još uvijek nalazi u teškoj situaciji: stepen nezaposlenosti je visok (40% aktivnog stanovništva), uništen veliki broj polja aktivnosti u ekonomskom sektoru i uništen veliki dio infrastukture koja još nije rekonstruisana. I još više, podjela politickih i administrativnih odgovornosti izmedju tri nivoa političkih entiteta naslijedjena Dejtonskim sporazumom (država BiH, Federacija BiH sa deset kantona, Republika Srpska) predstavljaju ozbiljnu prepreku za definisanje i uspostavljanje mjera u zemlji, a naročito naučnih i tehnoloških.

Iako je BiH naslijedila od Jugoslavije jaku naučnu i tehnološku tradiciju (1991 prije rata investiralo se 1,5% od njihovog nacionalnog dohotka u razvoj i istraživanje) i jaku baznu industriju, njihov sadašnji istrazivački sistem ne može se uskladiti sa medjunarodnim standardima.
Tehnološki i naučni sistem u BiH se održava sa 8 univerziteta, nekoliko istraživačkih instituta (npr. u metalurgiji i poljprivredi) sa različitim zakonskim (često nedefinisanim) statusom, ograničenim brojem indutrijskih laboratorija (koje obavljaju uglavnom te razvojne poslove)

Ali, fond za istraživačke i razvojne aktivnosti u zemlji (oko 0,05% nacionalnog dohotka, prema zvaničnim podacima) je veoma nizak, većina istraživačkih infrastruktura je zastarjela, mnoge laboratorije, ako ne sve, nisu dovoljno finansirane, biblioteke se ne mogu pretplatiti na stručne revije i uključenje u medjunarodni komunikacioni sistem ne ide tako brzo, mlada generacija na univerzitetima nema sredstva da se obrazuje za istraživačke aktivnosti, i većina industrijskog istraživanja je u raspadu.

To znači da BiH nije u stanju da pripremi svoju budućnost, koja se u modernim drustvima, oslanja na mobilizaciju naucne i tehnicke ekpertize. Suprotstavljajući se takvoj situaciji, ne postoje ni mehanizmi ni resursi na državnom nivou koji bi odredili i primijenili mjere za početak rekonstrukcije istraživačkog potencijala države. Političke i administrativne barijere koje su rezultat poslijeratne situacije predstavljaju ozbiljnu prepreku za početak tog procesa. I još više, privatizacija ekonomije koja je započeta ne uzima u obzir neophodnost sačuvanja tehničkog kapitala industrijskih preduzeća koji je u nekim sektorima (energija i metalurgija npr) još uvijek koristan. Iako je situacija ozbiljna, nije tako crna. U mnogim sektorima postoji svijest da je hitno

rješavanje ovih problema i istraživači u teškim situacijama su našli načina da pokrenu aktivnosti i saradnju sa partnerima unutar zemlje, pored svih brojnih prepreka.

Rekonstrukcija naučnog i tehnološkog potencijala BiH zahtijeva usvajanje direktiva sa tri srednjoročna opšta cilja (2005-2015):

- Formiranje nove generacije naučnika na bh. univerzitetima ili u inostranstvu
- Izgradnja istraživačke infrastrukturne mreže u zemlji (eksperimentalna oprema, kompjuteri, informatička mreža, biblioteke) prema medjunarodnim standardima.
- Reinvestiranje u industrijsko istraživanje u ograničenom broju sektora (prioritet imaju oni koji izvoze veći dio svojih proizvoda).

Iako bi bazična istraživanja trebalo da budu neophodno razvijena u nekoliko disciplina da bi se položili temelji za budućnost, i imajući u vidu da su sadašnji resursi ograničeni a potrebe BiH za socijalnim i ekonomskim razvojem ogromne, mora se definisati nekoliko prioriteta: kao što je zdravlje, okolina, metalurgija energija, agronomija, šuma i prehrambena industrija. Projekti u ovim domenima kao i u ostalim trebali bi biti finansirani poslije ispitivanja.

Definisanje jedne naučne i tehnološke politike na državnom nivou je apsolutno preduslov za formiranje efikasne kompetencije u nauci i tehnologije zemlje i za razvoj istraživačkih aktivnosti koje mogu zadovoljiti potrebe BiH u njenom razvoju. Ta državna politika bi mogla biti dopunjena akcijama podrške na nivoima ostalih poltičko-administativnih entiteta kao što su Republika Srpska i Federacija BiH i kantonima, u odnosu na njihove potrebe i finansije. Buduća integracija BiH u EU trebalo bi da pretpostavi i pregovaranje državnog nivoa za učešće BiH u istraživanju okvirnog programa, koje bi joj omogućilo da postane članica Evropskog istraživačkog područja.

Jedna nauka na državnom nivou i politika tehnologije zahtijeva takodje stvaranje zakonskog okvira; To je i uloga dva zakona visokog obrazovanja i nauke koji su napisani i o kojima se trenutno raspravlja. Usvajanje tih zakona je hitno.

Preporučujemo da u izradi ovog zakona budu uključeni u prvoj fazi glavni sudionici sadašnjeg istraživačkog sistema u BiH (ministri i administracija koja se bavi naukom i inovacijama u političko-aministrativnim entitetima zemlje, Akademija, univerziteti i instituti, predstavnici ekonomskog sektora).

Zakon o nauci trebalo bi definisati, u ograničenom broju članova:

- Odgovornost države BiH u definisanju naučne i tehnološke politike sa zakonskim okvirom u njenoj primjeni
- Ulogu i sredstva jedne državne institucije koju bi trebalo formirati da primjeni te mjere kao i mjere drugih političko administrativnih entiteta u zemlji.

Finansiranje istraživanja i razvoja trebalo bi da bude tripartitno: Država BiH, političko-administrativni entiteti kao sto su Republika Srpska i Federacija BiH sa kantonima (koji podržavaju univerzitete) i privatni sektor (industrija i servisi). Za srednjoročni period (2012) mi predlažemo urgentni finansijski plan kojim bi se usmjerio na globalni trošak od strane državnih entiteta

(država i entiteti) od otprilike 25 miliona eura godišnje i koji bi bio dopunjen investiranjem EU i kreditima. (Evropske investicione banke i Svjetske banke, npr). Tokom ovog perioda industrija bi takodje trebalo da poveća svoje ulaganje u istraživanje i razvoj, koji bio mogao predstavljati do 2012 trećinu troškova zemlje u istraživanju i razvoju. U dugoročnom periodu BiH bi mogla investirati 2% od njenog nacionalnog prihoda u istraživanje i razvoj kao sto predlaže Akademija nauka i umjetnosti BiH.

Formiranje državnih institucija za definisanje i primjenu takve politike glavni je cilj već elaboriranog Zakona o nauci.

Naše osnovne preporuke su:

1. **Ministarstvo** mora imati političku odgovornost u naučnoj i tehnološkoj politici u BiH. Sadašnje ministarstvo za civilne poslove npr ili jedno ministarstvo oformljeno u te svrhe Prva solucija se čini najjednostavnija.

2. Pod njegovom odgovornošću jedna **agencija (ili savjet) za naučnu i tehnološku politiku** bila bi uspostavljena sa slijedećim zadacima: ispitivanje potreba u istraživačkim aktivnostima, definisanje prioriteta u zemlji, predlažući Vladi sredstva za primjenu ovih prioriteta, uspostavljanje saradnje sa Evropskim komitetom imajući u vidu učešće BiH u kadru Programa aktivnosti i drugih medjunarodnih programa, skupljanje statističkih podataka u istraživanju i razvoju (uz podršku specifičnog Opservatorija).

3. Utvrdjivanje glavnih direktiva i prioriteta u istraživačkoj politici na državnom nivou, premijer bi predsjedavao periodično, **medjuministarski komitet za naučne i tehnološke aktivnosti u BiH. Agencija bi djelovala u smislu sekretara tog komiteta. Savjetodavni komitet za nauku i tehnologiju** (ili kolegij) bio bi oformljen. On bi radio sa Agencijom (ili Savjetom) i savjetovao bi stvaranje prioriteta.

4. **Državni fond za istraživanje i razvoj u BiH** trebalo bi da bude oformljen (pod odgovornošću Savjeta ili Agencije) čija bi uloga bila da podržava naučne projekte.

Nauka će biti smatrana ne samo kao kapital za izgradnju ekonomije u zemljii i podrška politici nego i kao osnovna dimenzija kulture zemlje. Zato je važno povećati i javno razumijevanje za nauku putem različitih akcija.

Bh. naučna zajednica bi mogla da se pridruži Evropskom istraživačkom području te učestvovati u medjunarodnoj naučnoj saradnji. Mi zato predlažemo da bh. naučna zajednica bude snažno umiješana u regionalnu saradnju sa evropskim partnerima u istraživačkim projektima finansiranim u kadru Programa za evropski istraživački i tehnološki razvoj - za vrijeme Sedmog programa EU bi morala posvetiti fondove za medjunarodni program za zapadne zemlje Balkana – i učešće BiH u COST i Eureka programu.

UNESCO Biro u Veneciji, koji je opunomoćio ovaj izvještaj, započeo je nekoliko inicijativa posljednjih godina za podržavanje rekonstrukcije naučnog potencijala u zemljama Južnoistočne

Evrope i naročito one zapadnog Balkana. Mi preporučujemo da se ova akcija nastavi, pošto UNESCO može odigrati ulogu katalizatora u regionu pridonošenjem inicijativa usredsredjenih na razvoj naučne saradnje u regionu. (ekpertizama, formacijom eksperata, podrškom specifičnih akcija za rekonstrukciju naučnog potencijala).

Naučno i tehnološko istraživanje u BiH nalazi se u stanju hitnosti. Akcije su neophodne i na nacionalnom i medjunarodnom nivou. Rekonstrukcija naučnog i tehnološkog potencijala u zemlji je potrebna za pripremu budućnosti i to je takodje važan korak prema stabilizaciji mira u regionu.

Извршни резиме

UNESCO Office in Venice је оформио експертску мисију за Босни и Херцеговину са два основна циља: – процјена научног потенцијала земље (посебно истраживачких инфраструктура) – припремити препоруке за њен будући развој и интегрисање у међународну и европску истраживачку заједницу. Ову иницијативу су у потпуности одобриле БиХ политичке власти а посебно г. Сафет Халиловић, министар цивилних послова Босне и Херцеговине и г-ђа. Жељана Зовко, амбасадор БиХ у Француској и Амбасадор, Стални делегат при UNESCO-у. У земљи су, током 2005. године, проведене три мисије (14-19 марта, 16-21 маја, 30 јуна-1 јула). За чланове мисије су током тих посјета били организовани састанци са политичким властима, а посјећени су и неки универзитети, лабораторије и компаније. Овај извјештај презентује наше закључке и препоруке.

Десет година након Дејтонског мировног споразума (потписаног 1995.) којим је окончан рат, Босна и Херцеговина се још увијек суочава са веома тешком ситуацијом: – стопа незапослености је веома висока (40% активне популације) – велики привредни сектори су у колапсу а огроман дио инфраструктуре још увијек није обновљен. Осим тога, подјела политичке и административне одговорности између три нивоа политичких цјелина наслијеђених из Дејтонског мировног споразума (држава БиХ, Република Српска, Федерација БиХ и њених десет кантона,) представља озбиљну препреку дефинисању и имплементацији политика дјеловања на државном нивоу а посебно политике дјеловања у области науке и технологије.

Иако је БиХ од бивше Југославије наслиједила јаку научну и технолошку традицију (прије рата, она је у 1991. инвестирала је 1.5% свог БДП-а у истраживачко развојне активности) и снажну индустријску базу, у овом тренутку њен истраживачки систем није у могућности да ради у скалду са међународним стандардима. БиХ одржава научни и технолошки систем са осам универзитета, неколико намјенских истраживачких института (на примјер, у металургији и пољопривреди) уз разне правне (и често недефинисане) статуте, ограничен број индустријских лабораторија (који углавном обављају развојне задатке). Међутим: - финансирање истраживачко-развојних активности у земљи (око 0.05 процената БДП-а према званичним подацима) је веома ниско – већи дио истраживачке инфраструктуре је застарио – многим лабораторијама, ако не и свим, недостају оперативни фондови – библиотеке нису у могућности да плаћају претплату на научне часописе а прикључак са међународним системом комуникација не иде убрзано – млада генерација на универзитетима нема средстава за обуку у области научних истраживања – већина индустријског истраживања је онеспособљена.

То значи да БиХ није у могућности да припреми властиту будућност која се, у модерним друштвима, ослања на способност држава да мобилишу научно и техничко знање. У овој ситуацији, на државном нивоу не постоје ни механизми ни ресурси за дефинисање и

имплементацију политике за започињање обнове истраживачког потенцијала земље. Политичке и административне баријере које су резултат послијератног стања представљају веома озбиљну препреку овоме процесу. Осим тога, приватизација економије не води рачуна о потреби очувања техничког капитала индустријских компанија који, у неким секторима, (на примјер, енергетском и металуршком) остаје драгоцјен. Иако је ситуација прилично озбиљна, она није баш у потпуности црна. У многим секторима постоји свијсет да су рјешења ових проблема ургентна а истраживачи у тешким условима проналазе начина да, упркос бројним препрекама и потешкоћама, покрену активности и сарадњу са партнерима унутар земље.

Поновна изградња научног и технолошког потенцијала Босне и Херцеговине захтијева усвајање "мапе пута" са три општа средњорочна циља (2005-2015):

- Обука нове генерације научника на БиХ универзитетима и у иностранству.
- Развој мреже истраживачких инфраструктура у земљи (експериментална опрема, компјутери, информатичке мреже, библиотеке) у складу са међународним стандардима.
- Поновно инвестирање у индустријско истраживање у ограниченом броју сектора (приоритетно оних који извозе велики дио своје производње).

Иако би се нужно требало развити основно истраживање у неколико дисциплина како би се поставиле основе за будућност, уз ресурсе који су ограничени и потребе БиХ за социјалним и економским развојем које су огромне, мораће се дефинисати један ограничен број приоритета као што су: – здравство – околиш – металургија – енергија – пољопривредна, шумска и прехрамбена индустрија. Након евалуације треба финансирати пројекте из ових и других области.

Дефинисање научне и технолошке политике на државном нивоу БиХ је апсолутан предуслов за поновну изградњу признате и ефективне компетенције у науци и технологији у држави и за развој истраживачких активности које могу одговорити на потребе БиХ за властитим развојем. Државна политика дјеловања може бити допуњена активностима које су подржане на нивоу других политичко-административних цјелина као што су Република Српска, Федерација БИХ и неки од њених канотна, као функција њихових властитих потреба и финансијских средстава. Будућа интеграција БиХ у Европску Унију ће претпостављати преговоре на нивоу државе БиХ о учешћу БиХ у истраживачком Оквирном програму, који ће тако дати земљи право да постане чланица Европског истраживачког подручја (European Research Area).

Државна политика дјеловања у науци и технологији такође захтијева постојање правног оквира. То је улога Закона о високом образовању и науци који су сачињени и о којима се тренутно воде дебате. Усвајање ових закона је ургентно.

Ми снажно препоручујемо да израда овог закона о науци у својој прелиминарној фази укључује главне заинтересоване стране у постојећем истраживачком систему у БиХ (министарства и администрације задужене за науку и иновације у политичко-административним ентитетима државе, Академију, универзитете и институте, представнике привредних сектора).

Закон о науци треба да дефинише, у једном ограниченом броју чланова:

- Одговорност БиХ државе у дефинисању политике дјеловања о области науке и технологије уз правни оквир за њену имплементацију.
- Улогу и средства државне институције која би била оформљена у сврху имплементације ове политике дјеловања као и политика осталих политичко-административних ентитета државе.

Финансирање истраживачко-развојних активности треба бити трипартитно: Држава БиХ; политичко-административне цјелине као што су Република Српска, Федерација БиХ и неки кантони (који подржавају универзитете) и приватни сектор (индустрија и услуге). За средњорочни период (2012) ми предлажемо ургентан финансијски план који би имао за циљ укупну потрошњу од стране државних ентитета (држава и други ентитети) од приближно 25 милиона евра годишње што би требало бити допуњено ЕУ инвестирањем и кредитима (од Европске банке за инвестирање и Свјетске банке, на примјер). Током истог тог периода индустрија би такође требало да повећа своје властито инвестирање у истраживачко-развојне активности, што би могло, до 2012, представљати једну трећину укупних истраживачко-развојних трошкова земље. Дугорочно, БиХ би требало да инвестира 2% свог БДП-а у истраживање и развој као што је то препоручила Академија наука и умјетности БиХ.

Стварање државних институција за дефинисање и имплементацију такве политике дјеловања јесте основни задатак Закона о науци који је у изради. Наше главне препоруке су сљедеће:

1. Једно **министарство** би требало да има политичку одговорност за БиХ политику дјеловања у области науке и технологије. То би могло бити или постојеће министарство (садашње министарство цивилних послова, на примјер) или неко *ad hoc* министарство оформљено у ту сврху. Прво рјешење је најједноставније.

2. Под његовом одговорношћу **би се требала оформити Агенција (или Савјет) за политику дјеловања у науци и технологији** са сљедећим задацима:
   - процјена потреба за истраживачким активностима,
   - дефинисање приоритета за државу,
   - предлагање влади средстава за имплементацију ових приоритета,
   - успостављање сарадње са Европском заједницом с циљем учешћа БиХ у активностима Оквирног програма и другим међународним програмима,
   - прикупљање статистичких података из области истраживања и развоја (уз подршку посебног тијела за праћење).

3. У сврху дефинисања основних смјерница и приоритета истраживачке политике на државном нивоу, премијер би, периодично, предсједавао **Међу-министарским комитетом за научне и технолошке активности у БиХ. Агенција би дјеловала као секретаријат овог комитета.** Требало би оформити **Савјетодавни комитет (или одбор) за науку и техологију** који би радио са агенцијом (или савјетом) и пружао савјете о успостављању приоритета.

4. Требало би оформити **Државни фонд за истраживање и развој у БиХ** (под надлежношћу савјета или агенције) с циљем пружања подршке научним пројектима.

Науку не би требало посматрати само као средство поновне изградње економије Босне и Херцеговине и као подршку државним политикама дјеловања већ и као суштинску димензију културе ове државе. Стога је изузетно важно, кроз специфичне активности, унаприједити и појачати разумијевање шире јавности о науци.

БиХ научна заједница би требало да буде у могућности да се придружи Европском истраживачком подручју и да буде укључена у међународну научну сарадњу. Стога ми препоручујемо да: - БиХ научна заједница буде снажно укључена у регионалну сарадњу и сарадњу са европским партнерима у истраживачким пројектима које финансира европски Оквирни програм за истраживање и технолошки развој, - током трајања Седмог оквирног програма, Европска Унија треба посветити средства путем *ad hoc* Међународног програма за државе Западног Балкана, - учешће БиХ у програмима COST и Eureka.

UNESCO Регионална канцеларија за науку и технологију у Европи (Office in Venice) са сједиштем у Венецији, која је и сачинила овај извјештај, покренула је током неколико посљедњих година један број иницијатива за подршку у обнови научног потенцијала у земљама Југоисточне Европе а посебно земљама Западног Балкана. Ми снажно препоручујемо да се ова активност настави пошто UNESCO у овом региону може имати улогу катализатора путем доприноса иницијативама које имају за циљ развијање регионалне научне сарадње (кроз експертизу, обуку стручњака, подршку специфичним активностима на поновној изградњи научног потенцијала, итд.).

Научно и технолошко истраживање у БиХ је у критичној стању. Потребна је хитна акција и на државном и на међународном нивоу. Обнављање научног и технолошког потенцијала државе потребно је за припрему земље за будућност и уједно представља важан корак према стабилизацији мира у региону.

Rezime

UNESCO Biro u Veneciji je opunomoćio stručnu misiju u BiH sa dva osnovna cilja: da procijeni naučni potencijal zemlje (naročito u istraživanju infrastrukture) te da sačini preporuke za njihov budući razvoj i integraciju u internacionalni i evropski istraživacki sustav. Ova inicijativa je bila potpuno podržana od bh. političara, naročito gosp. Safeta Halilovića, ministra za civilne poslove BiH, i veleposlanice BiH u Francuskoj i stalnog predstavnika BiH u UNESCO, Željane Zovko. Tri misije su obavljene u 2005. godini (od 14. do 19. ožujka, 16-21. svibnja i 30. lipnja do 1 srpnja). Tijekom tih posjeta organizirani su razgovori sa političarima, univerzitetima, laboratorijama i poduzećima koje su posjetili. Ovo izvješće predstavlja naše zaključke i preporuke.

Deset godina nakon potpisivanja Dejtonskog sporazuma (potpisan 1995) čime je rat završen, BiH se još uvijek nalazi u teškoj situaciji: stepen nezaposlenosti je visok (40% aktivnog stanovništva), uništen veliki broj polja aktivnosti u ekonomskom sektoru i uništen veliki dio infrastukture koja još nije rekonstruirana. I još više, podjela političkih i administrativnih odgovornosti izmedju tri nivoa političkih entiteta naslijeđena Dejtonskim sporazumom (država BiH, Federacija BiH sa deset kantona, Republika Srpska) predstavljaju ozbiljnu prepreku u definiranju i uspostavljanju mjera u zemlji, a naročito naučnih i tehnoloških.

Iako je BiH naslijedila od Jugoslavije jaku naučnu i tehnološku tradiciju (1991 prije rata investiralo se 1,5% od njihovog nacionalnog dohotka u razvoj i istraživanje) i jaku baznu industriju, njihov sadašnji istrazivački sustav ne moze se uskladiti sa međunarodnim standardima.

Tehnološki i naučni sustav u BiH se održava sa 8 univerziteta, nekoliko istraživačkih instituta (npr. u metalurgiji i poljoprivredi) sa različitim zakonskim (često nedefiniranim) statusom, ograničenim brojem indutrijskih laboratorija (koje obavljaju uglavnom te razvojne poslove)

Ali, fond za istrazivačke i razvojne aktivnosti u zemlji (oko 0, 05% nacionalnog dohotka, prema zvaničnim podacima) je veoma nizak, većina istraživackih infrastruktura su zastarjele, mnoge laboratorije, ako ne sve, nisu dovoljno finansirane, biblioteke se ne mogu pretplatiti na stručne revije i uključenje u međunarodni komunikacijski sustav ne ide tako brzo, mlada generacija na univerzitetima nema sredstva da se da se obrazuje za istraživacke aktivnosti, i većina industrijskog istraživanja je u raspadu.

To znači da BiH nije u stanju da pripremi svoju budućnost, koja se u modernim društvima oslanja na mobilazaciji naučne i tehničke ekpertize. Suprotstavljajući se takvoj situaciji, ne postoje ni mehanizmi ni resursi na državnom nivou koji bi odredili i primijenili mjere za početak rekonstrukcije istražnog potencijala države.Političke i administrativne barijere koje su rezultat poslijeratne situacije ozbiljnu prepreku za početak tog procesa. I još više, privatizacija ekonomije, koja je započeta, ne uzima u obzir neophodnost sačuvanja tehničkog kapitala industrijskih poduzeća koji je u nekim sektorima (energija i metalurgija npr) još uvijek koristan. Iako je

situacija ozbiljna, nije tako crna. U mnogim sektorima postoji svijest da je hitno rješavanje ovih problema i istrazivači u teškim situacijama su našli načina da pokrenu aktivnosti i saradnju sa partnerima unutar zemlje, pored svih brojnih prepreka.

Rekonstrukcija naučnog i tehnološkog potencijala BiH zahtijeva usvajanje direktiva sa tri srednjoročna opća cilja (2005-2015):

- Formiranje nove generacije naučnika na bh. univerzitetima ili u inozemstvu
- Izgradnja istraživacke infrastrukturne mreže u zemlji (eksperimentalna oprema, kompjutori, informatička mreza, biblioteke) prema medjunarodnim standardima.
- Reinvestiranje u industrijsko istraživanje u ograničenom broju sektora (prioritet imaju oni koji izvoze veći dio svojih proizvoda).

Iako bi bazična istraživanja trebalo da budu neophodno razvijena u nekoliko disciplina da bi se polozili temelji za budućnost, i imajući u vidu da su sadašnji resursi ograničeni a potrebe BiH za socijalnim i ekonomskim razvojem ogromne, mora se definirati nekoliko prioriteta: kao što je zdravlje, okolina, metalurgija, energija, agronomija, šuma i prehrambena industrija. Projekti u ovim domenima kao i u ostalim trebali bi biti financirani poslije ispitivanja.

Definiranje jedne znanstvene i tehnološke politike na državnom nivou je apsolutno preduvjet za formiranje efikasne kompetencije u nauci i tehnologije zemlje i za razvoj istrazivačkih aktivnosti koje mogu zadovoljiti potrebe BiH u njenom razvoju. Ta državna politika bi mogla biti dopunjena akcijama podrške na nivoima ostalih poltičko-administativnih entiteta kao što su Republika Srpska i Federacija BiH i kantonima, u odnosu na njihove potrebe i financije. Buduća integracija BiH u EU trebalo bi da pretpostavi i pregovaranje državnog nivoa za učešće BiH u istraživanju okvirnog programa, koje bi joj omogućilo da postane članica Europskog istraživačkog područja.

Jedna znanost na državnom nivou i politika tehnologije zahtijevaju takodje stvaranje zakonskog okvira. To je i uloga dva zakona visokog obrazovanja i znanosti koji su napisani i o kojima se trenutno raspravlja. Usvajanje tih zakona je hitno.

Preporučujemo da u izradi ovog zakona budu uključeni u prvoj fazi glavni sudionici sadašnjeg istrazivačkog sistema u BiH (ministri i administracija koja se bavi znanosti i inovacijama u političko-administrativnim entitetima zemlje, Akademija, univerziteti i instituti, predstavnici ekonomskog sektora).

Zakon o znanosti trebalo bi definirati, u ograničenom broju članova:

- Odgovornost države BiH u definiranju znanstvene i tehnološke politike sa zakonskim okvirom u njenoj primjeni
- Ulogu i sredstva jedne državne institucije koju bi trebalo formirati da primijeni te mjere kao i mjere drugih političko administrativnih entiteta u zemlji.

Financiranje istraživanja i razvoja trebalo bi da bude tripartitno: Država BiH, političko-administrativni entiteti kao sto su Republika Srpska i Federacija BiH sa kantonima (koji podržavaju univerzitete) i privatni sektor (industrija i servisi). Za srednjoročni period (2012) predlazemo urgentni financijski plan koji bi se usmjerio na globalni trošak od strane državnih entiteta

(država i entiteti) od otprilike 25 miliona eura godišnje i koji bi bio dopunjen investiranjem EU i kreditima. (Europske investicione banke i Svjetske banke, npr). Tokom ovog perioda industrija bi takodje trebalo da poveća svoje ulaganje u istraživanje i razvoj, koji bio mogao predstavljati do 2012 trećinu troškova zemlje u istraživanju i razvoju. U dugoročnom periodu BiH bi mogla investirati 2% od njenog nacionalnog prihoda u istraživanje i razvoj kao sto predlaže Akademija znanosti i umjetnosti BiH.

Formiranje državnih institucija za definiranje i primjenu takve politike glavni je cilj već elaboriranog Zakona o znanosti.

Naše osnovne preporuke su:

1. **Ministarstvo** mora imati političku odgovornost u naučnoj i tehnološkoj politici u BiH. Sadašnje ministarstvo za civilne poslove npr ili jedno ministarstvo oformljeno u te svrhe Prva solucija se čini najjednostavnija.

2. Pod njegovom odgovornošću jedna **agencija (ili savjet) za znanstvenu i tehnološku politiku** bila bi uspostavljena sa slijedećim zadacima: ispitivanje potreba u istrazivačkim aktivnostima, definiranje prioriteta u zemlji, predlašući Vladi sredstva za primjenu ovih prioriteta, uspostavljanje suradnje sa Europskim komitetom imajući u vidu učešće BiH u kadru Programa aktivnosti i drugih medjunarodnih programa, skupljanje statističkih podataka u istraživanju i razvoju (uz podršku specifičnog Opservatorija)

3. Utvrdjivanje glavnih direktiva i prioriteta u istrazivačkoj politici na državnom nivou, premijer bi predsjedavao periodično, **medjuministarski komitet za naučne i tehnološke aktivnosti u BiH. Agencija bi djelovala u smislu sekretara tog komiteta. Savjetodavni komitet za znqnost i tehnologiju** (ili kolegij) bio bi oformljen. On bi radio sa Agencijom (ili Savjetom) i savjetovao bi stvaranje prioriteta.

4. **Državni fond za istraživanje i razvoj u BiH** trebalo bi da bude oformljen (pod odgovornošću Savjeta ili Agencije), čija bi uloga bila da podržava naučne projekte.

Znanost će biti smatrana ne samo kao kapital za izgradnju ekonomije u zemljii i podrška politici nego i kao osnovna dimenzija kulture zemlje. Zato je važno povećati i javno razumijevanje za znanost putem različitih akcija.

Bh. znanstvena zajednica bi mogla da se pridruži Europskom istraživačkom području te učestvovati u medjunarodnoj naučnoj saradnji. Mi zato predlažemo da bh. znanstvena zajednica bude snazno umiješana u regionalnu suradnju sa europskim partnerima u istraživačkom projektima financiranim u kadru Programa za evropski istrazivački i tehnoloski razvoj - za vrijeme Sedmog programa EU bi morala posvetiti fondove za medjunarodni program za zapadne zemlje Balkana – i učešće BiH u COST i Eureka programu.

UNESCO Biro u Veneciji, koji je opunomoćio ovo izviješće, započeo je nekoliko inicijativa posljednjih godina za podržavanje rekonstrukcije znanstvenog potencijala u zemljama Južnoistočne

Europe i naročito one zapadnog Balkana. Preporučujemo da se ova akcija nastavi, pošto UNESCO može odigrati ulogu katalizatora u regionu pridonošenjem inicijativa usredsredjenih na razvoj znanstvene suradnje u regionu. (ekpertizama, formacijom eksperata, podrškom specifičnih akcija za rekonstrukciju naučnog potencijala).

Znanstveno i tehnološko istraživanje u BiH nalazi se u stanju hitnosti. Akcije su neophodne i na nacionalnom i medjunarodnom nivou. Rekonstrukcija znanstvenog i tehnološkog potencijala u zemlji je potrebna za pripremu budućnosti i to je takodje važan korak prema stabilizaciji mira u regionu.

1. Introduction

Bosnia & Herzegovina, which had been, since 1945, one of the six Republics of the Federal State of Yugoslavia, became an independent state in 1992 and was recognized by the international community (the European Union states and the USA recognized its sovereignty in April 1992). The independence of BiH was bought about as part of a series of events taking place when Yugoslavia collapsed as a federal State and in the midst of great turmoil. The new BiH State paid a high price for its independence, since the country was the victim of a war that lasted more than three years, between 1992 and 1995. This war not only caused very severe destruction throughout the country but also was marked by massive killings of the civilian population (the total number of victims is estimated to have been about 250,000 people). The siege of Sarajevo and the resistance of its population were symbolic of the will of the city to withstand adversity and to maintain the historical heritage of the country. As it has been highlighted in several books and articles, BiH's historical experience is indeed deeply rooted in the political and cultural past of the Balkans countries, with a multinational and multiethnic dimension that characterizes the country. This is certainly an asset for Bosnia & Herzegovina as it has been a bridge between different worlds in Europe.

The war was ended when a "General Framework Agreement for Peace in Bosnia & Herzegovina" was initiated in Dayton (USA) on 21 November 1995 and signed as a Treaty in Paris on 14 December 1995. This Agreement (of 11 articles with 11 annexes) provided for a territorial settlement, a new constitution, various mechanisms for the protection of human rights, the return of refugees and the reconstruction of the economy. An international force, under NATO leadership, was deployed within the country to supervise the application of the Agreement on the ground and the end to hostilities. A civilian "High Representative" was nominated by the UN to monitor and coordinate the whole process of implementing the Dayton Accord.

According to the Dayton Agreement, BiH is a sovereign State which "shall consist of the two entities, the Federation of BiH and the Republika Srpska" (Article 1). The Federation itself is divided into ten cantons which have a rather high degree of autonomy (universities, for example are under their tutorship). The Dayton Agreement also defines the responsibilities of the institutions of the Bosnian State and of the entities (Article 4). 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. According to the constitutional arrangements of the Dayton Agreement, a central Government with a Parliament, a Council of Ministers and a three-person Presidency was established; and elections were organized in the country. Many areas of policy and law were left to the "entities" and one must stress, for example, that neither education nor scientific research are considered as responsibilities of the BiH State.

Returning to the pre-war situation, we must observe that BiH, although not among the wealthiest Republics of Yugoslavia, had been able to establish a network of public infrastructures and a significant industrial base. BiH had, and still has, relatively important natural resources: coal and iron ore deposits, a forest that has long been exploited, and water resources capable of providing hydroelectricity. Heavy industries (steel and aluminium) were developed after World War II and half of the Yugoslav defence industry were settled in BiH.

The University of Sarajevo had been officially established in 1947 (although some faculties had existed before) and scientific research was developed in academic laboratories, in local sites of the University, as well as in autonomous institutes dedicated to applied research (for example, in Zenica and Mostar for metallurgy, and Tuzla for mining, for example). Industry had developed its own research quite intensively during this period, often in cooperation with academic research. The company Energoinvest, which produced machines (in particular for the energy sector), various electronic equipment and components, was the largest enterprise in pre-war Yugoslavia and exported most of its production. Energoinvest was thus heavily involved in research, with PhDs, MScs and several hundred engineers and technicians working in its own laboratories; food and pharmaceutical industries were also able to develop their own R&D activities. Intellectual life thus flourished in the country, with a lively artistic and literary community and very active scientific research that had earned BiH an internationally recognized reputation.

Most of these assets (in higher education, research and industry) collapsed during the 1992-1995 war and its aftermath. Major damage was inflicted on industrial and research facilities during the hostilities. Scientific research almost came to a standstill due to destruction of buildings and for lack of funding. Furthermore, a large fraction of the elites in universities and industrial laboratories emigrated to foreign countries (Energoinvest lost most of it researchers), a situation that contributed to the weakening of the intellectual base needed for the reconstruction of the country.

Ten years after the signing of the Dayton Peace Agreement, many observers of the Bosnia & Herzegovina situation (both inside and outside the country) have stressed three issues.

First, although the Agreement had the great merit of putting an end to the war and of laying the foundations for establishing the conditions for the democratic life of the country, they do not consider that BiH is yet a united country, since the central and common organs for the Government of the country remain weak. The weakness of the BiH State and the partition of the country into two entities (the Srpska Republic being largely centralized while the Federation is decentralized with ten autonomous cantons) is certainly a very serious obstacle to the reconstruction of the country and its intellectual and economic development (for example, three independent companies have responsibility for electricity production) which should be based, as in all modern countries, on its ability to mobilize scientific and technological expertise.

Second, they observed that the social and economic situation in BiH remains precarious. Although basic infrastructures (roads, bridges, schools, etc.) have been reconstructed, many of them remain in poor condition. In 2004, the BiH national product (8 billion KM) represented

56% of its pre-war level, while, according to official figures: the unemployment rate remained very high (40% of the active population), and 20% of the population was below the poverty line. BiH suffers also from a large trade deficit, with exports covering only 30% of imports, and a low rate of savings. The picture is not, however, completely dire: inflation has been mastered and is standing at a low level, which contributes to monetary stability; a tax reform has been adopted which will be applied in principle in 2006 (a value added tax is to be introduced); a large number of economic reforms have been introduced; and industrial production is increasing. Nevertheless, BiH development remains difficult in these conditions and we should not be surprised to learn that, according to an opinion poll, 60% of young people expect their future to lie abroad and not in their country.

Lastly, but by no means least, the sad events and considerable suffering that people have experienced throughout the country remain deeply etched on their memories. Although many believe in the future of Bosnia & Herzegovina, which has already been through very difficult periods in its history, the country is not totally reunified in peoples' mind.

Education and scientific research are, without doubt, effective tools for preparing the future of a country and this was the main motivation behind the decision taken by UNESCO to commission this study to assess the situation of research in BiH and to propose recommendations for the rebuilding of the scientific and technological potential of the country.

2. Assessment of the research potential

2.1. Research activities

Although the missions included, for obvious practical reasons, only a finite number of universities, laboratories, and private companies, a first clear observation is that only a few institutions have been able to maintain research activities corresponding to international standards. There are several reasons for this:

1. The war caused severe physical damage to buildings and thus to equipment in universities, institutes and industrial laboratories.

2. A sizeable fraction of the scientific manpower has emigrated to other countries (this is probably the case for the big majority of researchers of industrial laboratories, such as those of Energoinvest, which lost three-quarters of its R&D manpower, representing 1600 persons in 1992).

3. Severe budgetary constraints occurred after the war have prevented laboratories from buying new equipment, and thus the majority of BiH research infrastructure is either out-dated or in need of repair.

Reconstruction of the science and technology potential was not considered a priority by political authorities and by the international community (primary and secondary education were priorities). Only a limited number of laboratories have been able to maintain research activity of an international standard; in the face of so many difficulties their merit is thus very great (this is the case, for example, of the Institute of Agriculture in Banja Luka, of the Institute of Genetic Engineering and Biotechnology in Sarajevo, and of the two Agro-Mediterranean Institutes in Mostar).

In general, the eight existing **universities** (Sarajevo, Bihac, Tuzla, Zenica, and the two universities of Mostar for the BiH Federation; East Sarajevo and Banja Luka for the Srpska Republic) 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 PhD programmes with a sizeable number of students, mostly in the social sciences and humanities).

Meanwhile, some **research institutes** have succeeded in keeping a critical mass through continuous efforts of cooperation with the industrial sector (mostly on very short-term objectives) which have enabled them to gain contacts and thus to renew their scientific equipment.

One must also underline that access to important **research infrastructures** such as libraries (and in particular the National Library of BiH and the National and University Library of the Srpska Republic) which contain rare books and manuscripts is very difficult. Collections of rare manuscripts of the National Library in Sarajevo have been stored in wholly unsuitable conditions since the destruction of the library building during the Sarajevo siege. Access to the internet is also difficult due to bad telecommunication connection, and the academic network is not working properly despite the recent efforts of ministerial authorities, particularly those of the Sarajevo Canton. One may also observe that, according to figures from the Academy of Sciences and Arts of BiH (see Annex III), the number of internet hosts is rather small in BiH (950 per million people with 30 PCs per 1000 people, figures for 2000).

As far as **industrial research** is concerned, although BiH had established an excellent reputation in several technical sectors (mechanical and electrical engineering, metallurgy, the food industry and pharmaceuticals) before the break-up of Yugoslavia, this technological asset has almost completely vanished. Large companies have disappeared and few of those still remaining have been able to maintain a minimum of technical expertise in development laboratories. There exist, meanwhile, a few exceptions: the Aluminij Company in Mostar, and the Bosnalijek pharmaceutical company in Sarajevo being examples of companies that have invested to maintain their technical competence. Furthermore, the difficult situation of most academic laboratories (particularly in faculties of engineering) is a serious obstacle to cooperation with industry.

The Observatoire des Sciences et des Techniques (OST) in Paris has recently produced science indicators for BiH (see Annex III). They reveal that, although the evolution of scientific output during the period 1993-2001 has been positive, the absolute number of scientific papers published in international journal nevertheless remains weak (a total of 30 papers in 2001). It also appears that BiH has its strengths in medicine (accounting for 40% of the papers published in international journals), engineering sciences (20%) and physics (18%).

2.2. Funding of the research effort

In the absence of overall statistics for research and development (R&D) activities in BiH, it is difficult to come up with an exact evaluation of public investment in such activities. As far as manpower is concerned (teachers and advisers), official statistics for the Federation of BiH (*Statistical data on economic and other trends,* January 2005), show that there were 2.125 teachers and advisers in the six universities of the Federation (among them 1.044 professors and 903 doctors) and 58.000 students. According to the 2003 statistics prepared for the SEE-ERA.NET network by the BiH coordinator, there were 1226 permanent professors and assistants in the eight BiH universities, figures that are coherent with those for the Federation.

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 Srpska Republic, have recently established research funds for supporting projects. There does not yet exist any funding at the level of the BiH State. By and large, public funding of research activities (exclud-

ing salaries of university staff) amounts to approximately 8 million KM (4 million euros) at most. 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).

As far as industry is concerned, no figures exist on research budgets and manpower; one may estimate that research staff in those industrial laboratories that remain in the country (and which are mainly carrying out development work or testing) number 100 persons at most.

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), the ratio of national expenditure in BiH to the Gross Domestic Product (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 probably underestimated. The GDP of BiH amounting approximately to 8 billion euros in 2003, a ratio of 0.05 per cent would represent 4 million euros, i.e. 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, and must thus be corrected probably by a factor of 3. Even with this correction, it appears that the ratio of BiH R&D expenditure to GDP (0.15 per cent maximum) is far below international standards (in excess of 1 per cent in most EU countries) and corresponds to the situation of a country which is not able to reach the critical mass to maintain or initiate research activities on a competitive basis.

2.3. Research and socio-economic development

BiH had, prior to 1990, an economy in which industry was significant, with important industrial companies that had established their international competitiveness on a technological basis (EnergoInvest was the most prestigious and important). These companies had created and developed large research laboratories with several hundred researchers each. Almost all this technical expertise disappeared during and after the war, and only a few companies have been able to maintain a minimum of research activity in metallurgy (steel and aluminium), electricity production, pharmaceuticals and food production. It has retained a mining industry (iron ore and coal) and agricultural resources and forests represent an important asset (BiH exports wood).

The economic development of BiH, where unemployment is at a very high level (the unemployment rate is around 40% of the active population), requires a minimum base of technological research, which the country is presently unable to perform either in public or in private laboratories for lack of resources and manpower. This is without doubt a most severe handicap for the future.

The BiH State Unit for Economic Policy Planning has published a “Medium-term Development Strategy” (2004-2007), which devotes several chapters to the industrial development of the country, although it must be noted that scientific and technological research is almost com-

pletely absent from the document (references to the importance of research are made for some industrial sectors such as metallurgy and electricity production, but without details or objectives). No expert group (or round table) was specifically dedicated to these issues during the preparation of the Plan; and research equipment is not considered to be a basic infrastructure of the country. This is an indication that governmental authorities are not yet aware of the importance of these activities for the future of the country's socio-economic development. Furthermore, one must stress that the privatization process, which has been recently launched, does not take into proper consideration the need for preserving the technical capital of BiH industrial companies that remain and which still represent, in a few sectors, an asset for the country. The privatization process is therefore likely to bring about the dismantling of the technical research of the country.

One must also emphasize that, while foreign assistance has been significant since 1996 (through grants and loans), most of it was focused on public infrastructures, education, demining operations, administration and economy; research activities as such were almost absent. Thus, according to a report prepared with the support of UNDP, *International assistance to BiH, 1996-2002*, the combined sector of culture and science received just US$13 million of assistance (of a total of US$2.5 billion), and it appears that, probably, most of these funds were devoted to the reconstruction of the historical monuments that are attracting growing international interest.

Lastly, one must stress the fact that BiH has not been able to organize a patent system which would allow the protection of the intellectual property rights of researchers and companies. This is certainly a handicap for the future.

2.4. The institutions for science and technology policy

The dissolution of Yugoslavia and the application of the Dayton Peace Agreement (1995) have had a serious impact on BiH research institutions. Let us recall that there presently exist three levels of political and administrative competences in BiH: the State, the BiH Federation and the Srpska Republic, and the ten cantons of the BiH Federation. For the time being, the State of BiH has limited competence in science and technology through the Ministry of Civil Affairs which has no financial resources to allocate to science and research activities. This is not the case for the Federation and for the Srpska Republic, both entities have a ministry in charge of science (Ministry of Education and Science in the Federation, and the Ministry of Science and Research in the Srpska Republic) and posses financial resources.

Furthermore, the **universities** are under the tutorship of the cantons in the Federation and of the Ministry of Culture and Education for the Srpska Republic. The universities are funded by the cantons of the Federation. For various reasons (some of them political) the university system of BiH is organized into eight universities (Universities of Sarajevo, East Sarajevo, Banja Luka, Zenica, Bihac, Tuzla, Dzemal Bijedic-Mostar, Mostar) over the country without any real coordination of investment for the development of their research activities. It does not appear that the Rectors' Conference of these universities has taken any initiative regarding research

activities. One must also note that, at least to our knowledge, only the Sarajevo Canton and the Srpska Republic have passed legislation on the organization of scientific research, the latter having also published an official document defining a R&D strategy.

Under such conditions, one must not be too surprised to learn that there is no research policy at the level of BiH, since there exists no tool to assess the situation and the needs (manpower and infrastructure), define priorities, organize the coordination of activities within the country, mobilize funding for research activities, and stimulate international cooperation. There is as yet no "voice" for BiH science and technology. The present situation, with the handicaps it represents, has meanwhile been recognized in several documents (in particular a report by the Academy of Sciences and Arts of BiH and a report prepared for the SEE–ERA.NET network) that address these issues.

Within this dim picture, one must, however, acknowledge the existence of a few **research institutes** that operate at the level of the country, in cooperation with partners in several regions and even abroad (this is the case, for example, of the Agriculture Institute in Banja Luka). This clearly shows that the possibility of undertaking joint tasks at the level of the country does remain, despite the difficulties of the time. One must also emphasize the fact that most of remaining research institutes created outside university campuses at the time of Yugoslavia, have an "undefined" legal statute which is proving a supplementary handicap for their activities.

The BiH has thus created a research system *à la Suisse*, but, above all, without a State to set up common objectives and mobilize the financial means to operate it, as is the case in a federal country such as Switzerland. The absence of State institutions to define and implement a research and technology policy is a major obstacle to reconstruct a research activity with a critical mass in BiH.

In this context, governmental authorities rightly decided, in 2004, to draft two laws: the first one for higher education, the second for science. The Law on Higher Education gives guidelines for the operation of universities in accordance with the Bologna Principles and sets standards and criteria for the accreditation of diplomas. The Law was drafted in 2004 but the BiH Parliament has so far failed to adopt it, mainly for political reasons. The Law on Science is in a less advanced stage (the first draft was circulated at the beginning of 2005) and its drafting is under the responsibility of the BiH Ministry of Civil Affairs.

The Science Law will, in principle, define the general objectives of a BiH science policy and will provide the legal framework in which the research system will operate, with guidelines and institutional means for defining priorities and funding research activities at the State level. We consider that the adoption of such a Law is a first step in the reconstruction of the BiH research system. One must note that, although the Higher Education Law has been widely discussed within universities, it appears that the great majority of actors of the research system seem to be unaware of the Law's existence or its objectives. This means that the drafting of this law has not yet been used as a means of mobilizing the scientific community and its economic partners into rebuilding the BiH research system.

Lastly, one must stress that neither the Office of the High Representative (OHR) nor the OSCE have used their influence and also potential expertise to advise the BiH political authorities on these matters, although the training of a workforce in universities and the development of research activities must be considered as a critical issue for the future of the country. The World Bank itself has meanwhile agreed to grant funds to universities to contribute to the modernization of their operation, which is a positive step.

2.5. Cooperation between the R&D actors

In a country where war has had a deep and lasting impact on people's minds and in which short-term considerations tend to dominate (the day-to-day operation of laboratories, for example), one cannot be surprised that cooperation between the public research actors (academics and researchers of various institutions) and between researchers and industry is not considered a priority. The almost non-existence of competitive academic infrastructures is also a factor which inhibits cooperation on projects between public laboratories, and between industry and research institutes. However, the picture is not completely grim. Cooperation between universities, research laboratories and occasionally between local firms and research institutes, even at the national level, does exist, which means that there is awareness of the importance of cooperation. Most of the actors in the economic sectors (and particularly the BiH Chamber of Commerce) are also pleading for the development of cooperation between the academic community and its industrial partners.

At the international level, the BiH scientific community has maintained links with partners abroad (in some cases through former colleagues who have emigrated), and this has prevented them from being totally isolated. Programmes of the EU, such as Tempus, have also contributed to cooperation with European universities. A few laboratories have sought to participate in either the integrated programmes or excellence networks of the Sixth Framework Programme of the European Union, but to our knowledge none has yet succeeded. One must also emphasize that, probably due to the lack of a national authority for research policy, BiH institutions have not benefited from the support of the "Western Balkans" Programme of the EU Sixth Framework Programme.

2.6. Summary

BiH scientific and technological potential is in a critical state: the training of the young generation of researchers is not being undertaken, most of the research infrastructures are obsolete or in need of repair, industrial research is almost non-existent, and there exists neither expertise nor tools at the State level to define and implement a research policy. This situation, if not rapidly corrected, may condemn any effort to reconstruct the scientific and technological basis of the country's development.

3. Recommendations

3.1. Why is research so important for BiH?

Since the Second World War almost all developed countries have considered that research activities have become an important dimension of public policies in modern States and a basis for their industrial development. After the War, the former Republic of Yugoslavia had thus supported R&D at the federal level and, in this context, BiH succeeded in gaining and developing a well recognized competence in science and technology in its universities, national institutes and large industrial companies that successfully exported technology.

More recently, Member States of the European Union adopted the so-called Lisbon Strategy (in March 2000) which stressed the importance of scientific research to build a "knowledge-based economy". Building a European Research Area is considered by the EU an important objective to be achieved during the coming years.

One should thus consider that BiH will not have a future if it is not capable of rebuilding a scientific and technical expertise through research activities at various levels.

Scientific and technological research is important, as it would:

- offer a perspective for the creation of new knowledge in academic science and thus help eradicate the massive brain drain of scientific manpower and elites from which the country is suffering (both in universities and industry); and also, at least in the long term, giving possibilities of even a partial return of the BiH scientific diaspora with its acquired know-how (China, for example, has been putting a major effort in this direction for two decades).
- increase the level of scientific and technological expertise that is necessary for the economic development of the country and the well-being of its population; this expertise based on research is necessary, for example, for health and environment public policies, the definition and enforcement of sanitary norms and standards, and the exploitation of natural resources.

Furthermore, academic research in the social sciences and humanities is certainly a most important tool to investigate and understand better the wealth of the culture of BiH in all its diversity. Every country needs to understand its origins with the various dimensions of its culture (languages, literature, philosophy, etc.) and research is a key activity to achieve this objective.

For all these reasons rebuilding and developing scientific research is an urgent matter for BiH.

3.2. Priorities for action

Research facilities in BiH were severely damaged or destroyed during the war, and one observes a general lack of investment in new equipment and a widespread brain drain of the scientific workforce from universities and industry. Rebuilding the scientific and technological capacity and workforce of the country requires the adoption of a "road-map", with objectives to be reached step-by-step and with clear priorities.

Three general objectives have to be achieved in the mid-term (2006-2015):

- **Ensure the training of a new generation of scientists** in BiH universities or abroad and retraining of existing scientists in new experimental techniques.
- **Build-up the country's research infrastructures** (technical equipment, computers, information networks, libraries) which should provide the scientific community with the capacity to undertake competitive research activities.
- **Reinvesting in industrial research in a limited number of sectors** (in prioritize those which export a large percentage of their production).
- Create a general framework for the **development of industry-university** partnership.

A minimum of basic research should be developed in disciplines such as physical sciences, mathematics, biological sciences and medicine, social sciences and humanities, as this would lay the ground for future technical development (in SMEs, for example) and constitute a means of interacting with the international scientific community. Meanwhile, resources being limited and needs of BiH for its social and economic development being very great, a limited number of priorities will have to be defined.

These priorities should take into account a number of factors:

- the basic social needs of the population: health, education and employment being probably the most important;
- the availability of resources in the country: mining, agriculture and forestry, for exemple;
- the technical needs of industry in several important sectors: metallurgy (steel and aluminium in particular), energy, pharmaceuticals and food.

Within this framework, a limited number of research priorities might be defined (this would be the task of the State research institution to be created). We propose:

- *health* (which would include activities in biology and genetics, clinics, well chosen topics in pharmacology, management of the public health system, and the relationship between environment and health conditions);
- *metallurgy* (steel, aluminium, alloys, mechanical properties, basic processes and surface treatment, and the reduction of pollution);
- *energy* (hydropower, coal, renewable energy and transmission);
- *agriculture, forestry, and food industry* (in particular Mediterranean agriculture, medicinal plants, processing of wood, and soil protection).

In all these sectors the contribution of the social sciences will be important (sociology and economics, for example). Research activities in those sectors should help understand the condi-

tions for economic development and the international context, as well as the evolution of living and working conditions in the country. Particular attention shall be given to the development of the industry-university partnerships. The priorities should be clearly defined and integrated into all future strategic development plans for BiH, which is not yet the case. These plans should forecast adequate means (including finances) to implement them and define the role of the various actors.

3.3. The need for a State science and technology policy

In a majority of the countries of the world, science and technology policy is a "State mission". This means that, taking into account its importance and the level of resources that this policy should mobilize, it must be supported at the State level. We have described in the introductory part of the report the complex politico-administrative situation of BiH, as a result of the Dayton Peace Agreement signed in 1995. For the time being, in 2005, there is no political entity (i.e. a ministry) at the State level that has responsibility for higher education, research and even industry. The Ministry of Civil Affairs of the BiH State has, in principle, a general responsibility in these domains but is without any legal framework to undertake action and has no funding to support research activities.

The definition of a science and technology policy at the State level of BiH is an absolute prerequisite in the view of the rebuilding of a recognized and effective national competence in science and technology, and to develop research activities that may address the needs of BiH on its road to development. The State policy might be complemented by actions supported at the level of other politico-administrative entities, such as the Srpska Republic, the Federation of BiH and some of the latter's cantons, in function of their respective needs and financial means. The State science and technology policy would define the framework for mobilizing the scientific and technical competences of the main common actors throughout the country (universities, institutes, public and private companies, etc.).

The situation of Switzerland has often been put forward in the recent past as a political "model" for BiH. For several reasons this comparison can be misleading. Let us simply recall that in Switzerland (7 million inhabitants and a wealthy country) responsibilities for research and higher education are shared between the central State (the Confederation) and the regional authorities (the cantons). The State is responsible for the two federal institutes of technology, in Zurich and Lausanne, while 10 cantons (out of 26) support universities. The State has an overall responsibility for the coordination of science policy in the country and it finances research activities through the Swiss National Science Foundation which supports mainly academic research, and also several important federal research institutes.

The future integration of BiH into the EU would suppose negotiations on the participation of BiH in the research Framework Programme, which would thus entitle the country to be a member of the European Research Area. These negotiations will necessarily take place at the level of the BiH State.

The definition of a State science and research policy with indication of clear objectives and mens of implementation is thus an urgent requirement, and the means of implementing it in terms of funding needs to be addressed. This supposes that the fiscal and financial power of the BiH State should be clearly and rapidly defined, in particular in the perspective of the creation of a national Value Added Tax.

A State science and technology policy also requires that a legal framework be put in place. This is the role of the Laws on Higher Education and on Science, which have been drafted and are presently being debated. The adoption of these laws is urgent, but it must be stressed that, even though higher education and research, the two main missions of universities, have a clear connection, *the two laws could be treated and adopted separately.* We must also stress that the Law on Science should encompass research activities that go beyond the academic institutions and concern the economy and public policies in sectors such as health and environment. We thus support the idea that the two laws be drafted and adopted separately by the BiH parliament.

It is **strongly recommended** that the drafting of the Law on Science involve, in a preliminary phase, the main stakeholders of the present research system in BiH (ministries and administrations in charge of science and innovation in the politico-administrative entities of the country, the academies, the universities and research institutes, representatives of the economic sectors). These actors should agree on an assessment of the present situation of the BiH research potential, and the complementary roles of the various institutions in charge of science and technology policy in the country.

The **Law on Science** should define, in a limited number of articles:

- the responsibility of the BiH State in the definition of a science and technology policy;
- the role and means of a State institution to be created for the implementation of this policy;
- the legal framework to implement this policy: statutes of State institutes to be created whenever necessary, statutes of researchers not employed by universities, specific regulations regarding cooperation between research institutions (for example, public and private);
- the means to evaluate projects, programmes and institutes;
- rules for intellectual property protection.

The definition of research priorities should be left to the future State institution in charge of the implementation of the science and technology policy.

3.4. Funding a national BiH research programme

One of the greatest weaknesses of scientific research in BiH is the lack of funding. According to available official BiH figures, R&D expenditure represented, in 2003, just 0.05% of the country's GDP (8 billion euros). We have the feeling that this figure probably underestimates by a factor of 3 the actual level of national expenditure, since it appears that estimated spending does not take into account the salaries of scientific manpower in universities, institutes and industry (the actual value being probably closer to 0.15-0.2%).

However, corrected figures 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%; within the larger Member States R&D expenditures are equal to or above 2% of GDP (Italy being an exception with a ratio of only 1%); differences between the ten new Member States (R&D expenditure/GDP ratios) are rather significant: Slovenia (1.57%), Czech Republic (1.30%), Hungary (1.0%), Poland and Slovakia (0.6%), Cyprus and Latvia (< 0.5%).[1]

Last, let us also record that the EU has recently set itself (in Barcelona, 2002) an ambitious objective for 2010: investment of 3% of GDP of Member States towards R&D activities. Despite the fact that some countries (Finland and Sweden) have already achieved this objective, few experts believe that the Barcelona objective will be reached.

As far as BiH is concerned, there is an absolute urgency to re-invest in scientific and technological research. Launching an ambitious programme to train Ph.D. students, and thus to educate the young generation of scientists, and building-up the country's research infrastructures are the two most urgent tasks for which State funding (complemented by international funds) is necessary. In parallel, salaries of research scientists (in universities and institutes) have to be increased step by step, so that they would be able to invest at least half of their time in research activities; new research positions should also be created in universities, national institutes and industry.

Funding of R&D should be tripartite: the State of BiH; the politico-administrative entities such as the Srpska Republic, the BiH Federation and some cantons (that support universities); and the private sector (industry and services). As far as public funding is concerned it should be shared between the State and the other politico-administrative entities in proportion to their future relative fiscal and financial powers.

We propose that State funding should be concentrated on: research infrastructures of national interest, a PhD training programme, and support to "national institutes". Most of this funding (with the exception probably of that going to the PhD programme) should be granted on the basis of evaluated project proposals.

The Academy of Sciences and Arts of BiH has proposed that BiH invest 2% of its GDP in R&D activities. This would represent, with the present level of the country's GDP (8 billion euros in 2003), a global expenditure of 160 million euros, compared with the likely present level of 0.15% of GDP (corresponding to a national expenditure of 12 million euros at most, according to our own estimation). It is clear that this objective could only be (and should be) achieved step-by-step over the long term (2020).

For the short term (2006-2007) the Medium-term Development Strategy (presently under revision) should take into account the necessity of integrating R&D as a transversal priority for

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

the development of BiH, with an objective of at least doubling investments for research infrastructures during the period from its present level.

For the mid-term (2006-2012) an urgent financial plan should be elaborated that would aim at a global yearly expenditure by public entities (State and other entities) and private sector representing at least 0.5% of the country's GDP. This funding should be complemented by EU investments and loans (from the European Investment Bank and the World Bank, for example). During the same period industry should also increase its own R&D investment, which might represent by 2012, one third of total R&D expenditure of the country. For the long term BiH should invest 2% of its GDP in R&D.

3.5. Tools for a science and technology policy

For the time being no mechanism exists at the State level to define and implement a science and technology policy for BiH. The creation of State institutions to define and implement such a policy is the major objective of the Law on Science being drafted. Our main recommendations are the following:

A **Ministry** should have the political responsibility of the science and technology policy of BiH. It could be either an existing ministry (the present Ministry for Civil Affairs, for example) or an ad hoc ministry created for the purpose.

It is equally important that, under the responsibility of the Ministry, a State institution called, for example, **State Agency for Science and Technology** and entrusted with national research policy, be established by law. The Agency should have the following tasks:

- to assess needs (human resources, research infrastructures, etc.) for research activities;
- to define science and innovation priorities for the country;
- to propose to the Government the means to implement these priorities;
- to establish, on behalf of the State, cooperation with the European Commission with a view to ensure the participation of BiH in Framework Programme activities and other international programmes. A specific unit might be established within the Agency to address this issue (probably in partnership with the Ministry of Foreign Affairs);
- to collect statistical data regarding R&D activities in the country, and prepare reports for the Council of Ministers.

A **State Fund for R&D in BiH** should be created (under the responsibility of the Agency) with the objective of supporting scientific projects, following their evaluation, and contributing to the provision of equipment in laboratories. Special attention would be paid to rebuilding basic infrastructures (premises, scientific equipment, libraries, etc.) that have been seriously damaged or are obsolete. Universities, institutes and industrial laboratories would be eligible for support from the Fund.

An **Advisory S&T Committee** should be established, to work with the Agency and advise it on establishing priorities. It would assess the main scientific projects of major importance and

supported by the State Fund for R&D. The BiH Academy of Sciences and Arts could carry out the functions of this committee, or at least provide its secretariat. Care should be taken over the nomination of several young scientists to this Committee and to a fair representation of disciplines (natural sciences, medicine, engineering, social sciences, humanities, etc.).

A **Unit (or Observatory) for Science and Technology Indicators** should be established, whose main mission would consist of producing:

- basic indicators (statistics) on human resources and the funding of R&D activities;
- indicators on publications in various disciplines (from international data banks);
- indicators for patents in the main industrial sectors;

as well as registering:

- basic figures for research institutions in BiH;
- basic data concerning researchers in BiH (publications, books, name of their laboratory).

This Unit should work closely with the BiH State Agency for Statistics. It would assist the Agency for Science and Technology Policy in its work.

An **Inter-ministerial Committee for S&T activities in BiH** might be established at the State level. Chaired by the Prime Minister, its membership would consist of all Ministers whose portfolios need to be supported by scientific expertise (health, transport and industry, for example). The Inter-ministerial Committee would adopt guidelines and priorities for the research activities of the country. The Agency for Science and Technology Policy would act as the Secretariat to this Committee.

The Agency for Science and Technology Policy should provide advice to the Government during the process of privatization of companies (in particular, large companies) or State services in order to preserve the technological interests of BiH (for large companies, new shareholder investment should provide the means by which in-house research activities can be developed in cooperation with public laboratories).

We also propose that, seizing the opportunity of the revision of the Medium-term Development Strategy, the Government creates the Agency for Science and Technology Policy at the State level with a **State Fund under the responsibility of the Prime Minister during a transitory period**. Partial tax exemption (or other incentives such as loans) for companies investing in research activities (whether in-house or in cooperation with universities) should be adopted (one-half of investment in research activities being tax deductible, for example). This exemption should apply at each level of taxation.

The creation of a national system for patenting should be established in accordance with European Union law. It could be managed by a national agency for norms, trade marks and patents.

In many countries various mechanisms have been created over time to encourage and facilitate cooperation between public institutes or laboratories, and between public and private laboratories. Legislation has often been drafted to allow the creation of entities promoting this cooperation. The Law on Science should thus give a simple legal basis to create (either on a

permanent or on a temporary basis) the equivalent of "joint ventures" between various types of scientific and technical institutions within the country. This would, for example, entitle several institutes, academic laboratories or private laboratories to undertake joint research programmes over a long period of time and to eventually share important research infrastructures.

3.6. Specific mechanisms

Access to competitive research infrastructures (experimental equipment such as electron microscopes, various types of spectrometers, lasers, etc.) is for BiH researchers a *sine qua non* condition to take an active part in today's science and research. Funds should thus be available to purchase such equipment and also to cover its maintenance and operational costs. A first list of priority research infrastructure was established in 2003 by the UNESCO Office in Venice by an Expert Group on Research Infrastructures, but this list must certainly be up-dated.

The necessity of allowing *access to basic research infrastructures* to various scientific communities in BiH leads us to suggest that, at least on a temporary basis, a network of the major facilities (for example, electron microscopes, NMR and mass spectrometers) should be created so as to "pool" resources and grant access to laboratories all over the country to this equipment (for example, electron microscopes might be used by biologists, material scientists, metallurgists, etc., working in various universities and even companies in different towns). This "Research Infrastructure Network for BiH" could thus cover step-by-step most of the needs of the scientific community.

A similar scheme could be envisaged for the main university libraries, which could be operated as an academic network. In particular, the situation of the National Library of BiH should be addressed, so that access to the important and rare collections of manuscripts that it has preserved, despite severe difficulties, could be provided to researchers within the country and abroad.

The possibility of **accessing scientific information** (scientific journals, data banks, etc.) through internet and various electronic systems is also a necessity for researchers in BiH. For the time being this access is not granted widely and with sufficient speed. A scientific information network for BiH should be considered as an important research infrastructure.

A BiH *Law on Science* would establish the basic principles and legal framework for a national science and technology policy. State institutes should be established in the four priority sectors identified. These institutes, supported by State funding (totally or partly), would work in close cooperation with academic laboratories and industry. Each institute would be affiliated with a university with which it would possibly share equipment; they might also constitute a research network with several academic laboratories and, whenever possible, with industrial laboratories. Similar schemes might be adopted, but on a more flexible basis, in the area of social sciences and humanities.

Lastly, we must stress the fact that, since rebuilding the scientific and technological potential of BiH would require a significant effort from the country, it should be accompanied by **initiatives explaining the role of science and technology in modern societies** and bringing to the public important scientific and technological issues to be addressed. The role of the media (press, radio and television) would be very important in this perspective. Universities should also be mobilized to provide a better public understanding of science and of its challenges for BiH through debates and exhibitions. We suggest that the Academy of Sciences and Arts of BiH take initiatives in this direction, in close cooperation with universities. The future of scientific research in BiH lies in the hands and brains of a young generation of scientists which must be attracted by the challenges of a research career either in public laboratories or in industry. A major effort towards informing the public at large, and the younger generation in particular, is thus of uppermost importance.

3.7. Regional and International Cooperation

The BiH scientific community should be able to join the European Research Area and to be involved in international scientific cooperation. A "first circle" of scientific cooperation should be established or re-established on a regional basis (with neighbouring countries from former Yugoslavia, as well as with Albania, Bulgaria and Romania, etc.). A "second circle" could consist of scientific institutions of several EU Member States which, for various reasons, wish to develop their cooperation with institutions in BiH. The possibility of accessing research infrastructures in neighbouring countries might be granted to researchers in BiH through this cooperation.

Neighbouring institutes from the "first circle" might eventually share important research infrastructures through cooperation. The cooperation in the field of astronomy in the South-East European countries through a network launched and supported by the UNESCO Office in Venice is a successful example to which one might refer.

We also recommend that the BiH scientific community be involved with European partners in research projects funded by the European Framework Programme. However, a realistic appraisal of the present situation of research laboratories in the country leads us to conclude that the great majority of them would not be able to compete in getting their projects approved and funded, since their equipment is often obsolete. This leads us to recommend that, at least for the duration of the Seventh Framework Programme, the EU should devote funds through an *ad hoc* International Programme for Western Balkan States. These funds should be granted to BiH, for example, on a project basis to finance research infrastructures and partly a PhD training programme (priority sectors could be, for example, chosen).

Lastly, we recommend, in the same spirit, the participation of BiH in the COST and Eureka Programmes, which would entitle both SME and academic laboratories of the country to be involved in research and technological development activities over a wider range than the EU. The BiH Ministry of Foreign Affairs (and in the long term the State Agency for Science and Technology) should fund the participation of BiH in these two programmes.

3.8. The role of UNESCO

The UNESCO Office in Venice, which has commissioned this Report, has launched several initiatives over the last few years to support the reconstruction of the scientific potential of the South East European countries. We strongly recommend that this action be continued, since UNESCO can play a catalytic role in the region by encouraging, through its advice, Governments to build frameworks for science and technology policies and, when possible, contribute to initiatives aiming at the development of regional scientific cooperation.

As far as BiH is concerned we wish to put forward the following suggestions:

- UNESCO Office in Venice might constitute a "platform of expertise" to support, through providing advice, the political authorities of the BiH State in their efforts to define and implement a S&T policy whenever they wish it.

- UNESCO Office in Venice could organize regular sessions to train experts from BiH on science management in its various dimensions (management of programmes, finance planning, evaluation, production of indicators, protection of intellectual property, etc.). Participation in such sessions should not be restricted to experts from BiH, but might be extended to other countries of the region.

- Several libraries of BiH, and in particular the National Library of BiH in Sarajevo, have saved rare manuscripts and books from destruction during the war. These documents are part of the cultural heritage of BiH and are of great interest to scholars not only in this country but also in Europe. UNESCO-BRESCE should envisage the launching of an initiative in cooperation with BiH to provide access to those rare documents to a large community of scientists in Europe.

- Science should be considered not only as an asset to rebuild the economy of BiH and a support to public policies but also as an essential dimension of the culture of the country. UNESCO Office in Venice could thus support initiatives in BiH in cooperation with other countries to enhance the public understanding of science (organization of debates and exhibitions, cooperation with the media, etc.) and bridge existing gaps between science and other dimensions of culture.

4. Conclusions

Due to obvious practical reasons, it was not possible to visit all academic institutions and industrial centres in Bosnia & Herzegovina, a valid diagnosis of the situation of scientific and technological research in the country can be presented. It is in a critical situation: most of research infrastructures are obsolete, many laboratories, if not all, are lacking operating funds, libraries are not able to pay subscription costs to scientific journals and connection to the international communication system is slow, the younger generation in universities has no means to be trained in research activities, and the majority of industrial research has been dismantled due to war destruction and the collapse of many economic sectors.

Despite the fact that BiH inherited from Yugoslavia a strong scientific and technological tradition, its research system is presently unable to work properly according to international standards. Thus, the funding of R&D activities in the country (at around 0.1% of the GDP) is far below the levels attained in industrialized countries. This means that BiH is not able to prepare its own future which, in modern societies, relies on the capacity of countries to mobilize scientific and technical expertise. Faced with this situation, there exist neither mechanisms nor resources at the State level to define and implement a policy to start the reconstruction of the research potential of the country. The division of political and administrative responsibilities between the various political entities inherited from the Dayton Peace Agreement is a serious obstacle to define and implement a science and technology policy. In a world where scientific and technological competition is severe, such a policy needs to be defined at the State level, in close cooperation with all the actors in the science systems (politico-administrative entities, universities, research institutes, industry). Although the situation is serious, it is not completely without hope. We can witness that in many sectors there is an awareness that solutions to problems are urgent (our diagnosis is widely shared) and researchers in difficult situation have found a means of restarting activities and even developing cooperation with partners inside the country despite numerous barriers.

To address all these issues, institutional tools need to be established; this would be the mission of a State institution, the Agency for Science and Technology (for example) which we have proposed to be created to define and implement a science and technology policy. A major financial effort is, of course, necessary at all levels (including industry) to build new infrastructures, to suitably fund the operational costs of laboratories, and create fellowships to train the young generation of scientists. The voting of the Laws on Higher Education and Science to set guidelines for future policy is also urgent. Although a dialogue between all partners in these domains is important and necessary, it is urgent to make political decisions so as to start the process to rebuild the BiH research system.

Faced with this important task, and taking into account the severe economic and financial constraints which the country is facing, it is clear that BiH needs significant international financial

support. For the time being this support is almost inexistent in science and technology. Financial support from the EU (for example through the next research Framework Programme) is thus necessary. Such European support would contribute to catalysing the integration of the BiH scientific community into the European Research Area. UNESCO Office in Venice should also be able to bring its contribution to this effort. We must also emphasize that such integration supposes that there exists a common voice for BiH science, and thus the existence of an institution able to plead for BiH scientific and technological research.

Rebuilding the science and research system in BiH is a means to ensuring the cultural and economic future of the country. It will be also a means to stabilizing the peace in a country that has been physically and morally damaged by war. Quoting the famous Yugoslav writer Ivo Andric (Nobel Prize for Literature in 1961), Nikola Kovac, Vice-Rector of Sarajevo University and former Ambassador of BiH to France and to UNESCO, wrote in 1995: "Today's Bosnia and Herzegovina defends values which rejoin those of modern civilization. To admit and live difference in unity, these are the historical challenges and the manner of being for Bosnia and Herzegovina, the only State in the Balkans whose founding idea is not conceived on only one nationality or a single religion". [2] This was written during dark times for BiH but, ten years later, there is no doubt that this idea is even more valid today and that scientific research should also contribute to highlighting what constitutes a common wealth of a country which is at a "cultural crossroad half-way between East and West".[3] We strongly feel that the international community, and Europe in particular, should take this important message into account.

[2] *Nikola Kovac,* Bosnie, le prix de la paix*, p. 57, Editions Michalon, Paris 1995.*

[3] *Ibid. p. 45.*

ANNEX I

Institutional contacts and Brief summary of discussions

Missions I, II and III

(14-19 February, 16-21 May and 30 June-1 July 2005)

SARAJEVO

Ministry of Civil Affairs of Bosnia & Herzegovina

Trg BiH 1 tel. 387 33 223 889

Dr Safet Halilović, Minister, Ms Esma Hadzagić, Assistant to the Minister

• Minister Halilović fully approved UNESCO's expert mission to provide an assessment of the situation of BiH research potential and benefit from outside expertise to better define a State policy. The Ministry of Civil Affairs has competence at the level of the State (in particular, it has responsibility for de-mining, which is still an important task in BiH), but it has only general competence for education, science, culture and sports, activities that remains funded at the BiH Federation and its cantons levels, and at the RS level. The Ministry has no funds to support R&D activities. A research policy at the national level is necessary to reconstruct the infrastructures and develop important projects corresponding to established priorities. The Ministry of Civil Affairs has taken the initiative of drafting a Law on Science. A group of experts chaired by the Minister Emir Turkusić (Canton of Sarajevo) are undertaking this responsibility, and the expertise of UNESCO Office in Venice in the process was appreciated. The Ministry considers that the reconstruction of the science and technology potential of BiH is vital for the country's future.

Minister Halilović at the UNESCO Meeting in Sarajevo, 18 October 2005

Ministry of Education and Science, Federation of BiH Government

Obal Maka Dizdara 2, 71000 Sarajevo, tel. 387 33 25 41 01, www.from.gov.ba

Prof. Zijad Pasić, Minister

• The Ministry is responsible for education and research at the level of the Federation. BiH had a very important tradition before the war but presently most of its R&D potential was destroyed or out-dated. After the war, priority was given to education (primary and secondary). Presently, an effort is being made towards improving conditions in higher education by the adoption of a national law (that has yet to be voted), as well as the elaboration of a State law for

science and technology activities. The pre-war level for R&D investment should be recovered (1.5% of GDP); this would require an effort from the BiH State, Federation and its cantons and the RS. The Ministry has established a fund (1.9 million KM) to support research projects; a call for tenders has been launched and the evaluation of proposals are under the responsibility of the Academy of Sciences and Arts of BiH. The Ministry is in need of statistics and data on R&D activities (scientific manpower, finances, infrastructures, scientific publications, patents) in the Federation (the problem is the same at the State level).

Ministry of Education and Science, Sarajevo Canton

Reisa Dzemaludina Causevica 1, 71000 Sarajevo, tel. 38733 562-218, www.ks.gov.ba
Dr. Emir Turkusić, Minister, Ms. Amra Avdagić, Assistant for Science

• The Sarajevo Canton is the only canton within the BiH Federation which has voted a science law for the organization of research activities within its territory (the Sarajevo region mainly). It has established a research fund (1.5 million KM) to support research projects on the basis of an evaluation of experts under the responsibility of the Academy of Sciences and Arts of BiH. Most of the research infrastructures within the country and the cantons are obsolete and a policy at the level of the country is necessary to rebuild its potential. Minister E. Turkusić has been commissioned by the BiH Ministry for Civil Affairs to draft the Law on Science. The urgent need for the adoption of the law is well recognized and a first draft has been available since the beginning of the year and is under discussion. A new policy will require statistics and indicators (publications, manpower, etc.), which are lacking. The Ministry has recently created a new department of informatics which gives access to an ensemble of 46 scientific journals through *Science Direct*. This is a great progress enabling access to the international scientific literature.

From left to right: S. Pejovnik, A. Avdagić and Minister E. Turkusić

The Ministry awaits a vote on the Higher Education Law by the Parliament of BiH. The urgent need for the adoption of the Law is well recognized.

State Commission for Cooperation with UNESCO

Trg Bosne I Herzegovine
Mr Sead Avdić, President; Professor Numankadić; Professor Metka Kraigher-Hozo, Academy of Fine Arts, Sarajevo

• The Commission was created two years ago, and academic communities from all over the country are represented on it. The Commission is pleading for the reconstruction of the scientific potential of the country. A large fraction of the scientific manpower has emigrated. The level of research infrastructures in universities is very poor so that only a limited number of research projects can be launched in experimental sciences (research has been maintained

at a fair level in social sciences, humanities and arts). The Commission stresses the asset that the multi-cultural dimension of the BiH heritage represents. This heritage is of great value for the future of the country and UNESCO has a role to keep it alive; it is also an important task for Europe.

Unit for Economic Planning and Implementation of the Medium-term Development Strategy of BiH

Mustajbega Fadilpasica 1, 71000 Sarajevo, tel. 387 33 218 552, www.eppu.ba
Mrs Azemina Vuković, Head of the Unit; Mr Fahrudin Memić, Consultant for Statistics and Indicators

• The Office, which is under the responsibility of the Council of Ministers of BiH, has the mission of preparing a Plan for the development strategy of the country. The Plan has been adopted for the period 2004-2007. Twenty-one working groups (including experts such as academics, representative of administrative and of economic sectors) have prepared the strategy. There was no specific group or panel for R&D activities (the importance of research for economic sectors as energy and metallurgy is, however, underlined in the Plan). The fact that research is almost totally absent from the Plan is the result of dispersion of competence in this domain between the Federation, the Cantons and the RS (statistics in this domain are rather rare and are badly needed). A Science Law is being drafted, and its adoption is necessary to launch the reconstruction of the S&T potential of the country. There does not yet exist a clear awareness of the importance of R&D for the future development of the country.

Academy of Sciences and Arts of BiH

Bistrik 7, Sarajevo, tel. 387 33 206 032, akademija@anubih.ba
Prof. Bozidar Matić, President

• The President recalled the main lines of the analysis of the situation of science and technology in BiH that were highlighted in a document prepared by the Academy (also presented them also to a conference dedicated to Science and Research Potential in BiH, organized on the occasion of the International Metal Fair in Zenica, in May 2005).

One of the major points is the scarcity of funding devoted to R&D in BiH (1.5% of the GDP before the war versus around 0.05% presently). As a former director of R&D within Energoinvest, which was one of the major industrial companies in former Yugoslavia, he pointed out that industrial research is almost inexistent at the moment in the country, although it had a strong basis before 1990 (Energoinvest had a workforce of 1600 people before the war in 11 centres but 75% of them have emigrated). Acad. Matić has stressed the necessity of adopting the two Laws on Higher Education and Science at the State level;

From left to right: B. Matić, P. Papon, S. Pejovnik

which should give guidelines for the future science policy and legal rules to implement it. He recommended: a large increase of funding, and the creation of a Fund to support research activities at the State level; that public funding should be allowed according to the fiscal power of the politico-administrative entities (State, Federation and RS, cantons); that industry would finance at least one third of the country's R&D effort; and that the country devote in the future 2% of its national product to R&D. Participation to European programmes (Framework Programme COST, Eureka) is necessary.

National and University Library of Bosnia and Herzegovina

Madja od Bosne 8B, 71000 Sarajevo, tel. 387 33 275 312, www.nub.ba
Dr. Enes Kujundzić, Director

• The library was created in 1945. Until 1992, the library possessed 3 million books, journals and rare manuscripts, some of them several centuries old and which are considered as an important asset for scholars. The library was completely destroyed during the night of 24/25 August 1992 at the beginning of the Sarajevo siege. Most of the documentary records (including rare manuscripts) were burnt. The library has been moved to former barracks in the city and has presently 2000 m^2 (instead of 6000 m^2 formerly). The library has several important functions: to serve as a legal deposit; to provide access to documents (350 000 volumes including old and rare manuscripts and books that have been saved); to create and publish the current bibliography of BiH, research on retrospective bibliography; to provide inter-library services; and to provide specific training. It has 69 employees. Although it remains the national library for the BiH State, its legal statute has to be clarified. Funding has been reduced (until 2004 mostly from the BiH Federation, presently partly from the Ministry of Civil Affairs). Funds are needed to support the network of libraries in the country, facilitate access to the documents, and begin the digitalization of rare documents. The library wishes to have the support of UNESCO and NGOs for establishing normal conditions of work. An important part of its documentary collection represents national BiH heritage and is of great value for scholars in Europe.

University of Sarajevo, Rectorate

Rectorate: Kulina Bana 7/II, www.unsa.ba, info.rektorat@unsa.ba
Professor Mensur Hajro, Vice-Rector in charge of Science and Research; Professor Nikola Kovać, Vice-Rector in charge of International Cooperation; Ms Ljiljana Sulentić, Coordinator for International Cooperation

• Established in 1949, the university is organized into 23 faculties with several associated institutes (47 000 students in total). Severely damaged during the war, the university is in the process of reorganization with the objective of taking into account the Bologna rules for higher education. Priority has been given since 1995 to the rebuilding of the teaching capacity. In general, research has greatly suffered from the war and most of faculties are not able to maintain research activity at the international level (programmes do still exist in social sciences and humanities and in some engineering departments). There does not exist funds within the university budget to support R&D (the creation of such a fund is in preparation).

Faculty of Economics, University of Sarajevo
Trg oslobodejna 1, 71000 Sarajevo, tel. 387 33 275 916, www.efsa.unsa.ba
Professor Nenad Brkić, Vice-Dean

• The faculty has 10 departments (macro-economy and business administration, for example) with 70 professors and assistant professors and 7000 students (a large fraction of them paying tuition fees). No specific fund for research activities presently exists, although the faculty intends to create one; meanwhile there are some on-going research projects in cooperation with external partners. Although a State agency for statistics has been created, economic statistics are judged insufficient

Faculty of Philosophy, University of Sarajevo
Franje Rackog 1 71000 Sarajevo, tel. 387 33 253 204
Professor Josip Baotić, Vice-Dean

• The faculty encompasses 12 departments (philosophy, history, literature, etc.) with 1300 students and an academic staff of approximately 200 persons. An Oriental Studies Institute is affiliated to the faculty (it had a national status), and it is engaged in important international cooperation. Most of the funding is devoted to staff salaries and there is no specific funding for research. The faculty has maintained an important library (300 000 books) but has no funding to maintain subscriptions to journals and it does not receive support from the National Library of BiH.

Faculty of Electrical Engineering, University of Sarajevo
Zmada od Bosne Bb71000 Sarajevo tel. 387 33 250 759
Prof. Kemo Sokolija, Dean, Prof. Adnan Salihbegović, Vice-Dean, Assoc. Prof. Semsudin Masić

• The Faculty moved into new premises after the war (former military barracks) which had to be re-equipped. Its main activities are in the area of information technology, automation and electricity production process and transmission (which was an important sector before the war with the major company Energoinvest).
It has little equipment (other than computers) and it is facing severe difficulties to buy new research equipment (most equipment is devoted to teaching). The university does not provide specific funding for research; it has received funds from the science ministry of the Sarajevo Canton to support 3-4 projects. Possibilities of cooperation with industry are presently rather difficult, due firstly, to a lack of competitive infrastructures in the laboratories, and secondly to the almost disappearance of the industrial sector in its area of activity. The faculty is engaged in a cooperative project on Artificial Intelligence with the University of Erlangen (Germany). Presently, five students are preparing their PhD in its laboratories. No specific means for the production of its intellectual property through patents are envisaged for the time being. Energy should certainly constitute a national priority for research. A science law is certainly necessary to provide a framework for the R&D policy of the country.

Faculty of Science, University of Sarajevo

Zmadja od Bosne 33 i 35 Srajevo, tel. 387 279 871, www.pmf.unsa.ba
Professor Sulejman Redzić, Dean; Prof. Muharen Avdispahić, Vice-dean

• The faculty was created in 1950 and has departments of physical sciences, mathematics and biology with around 2000 students and 85 teaching staff (127 teaching staff before the war). It does not receive any funds from the university for research equipment, and most of its infrastructure is outdated, although there are some ongoing research projects. Priorities need to be defined nationally at the State level.

Institute for Genetic Engineering and Biotechnology

Kemalbegova 10, 71000 Sarajevo, tel. 387 33 220 926, www.ingeb.ba
Prof. Kasim Bajrovic

• The Institute was created in 1987. It suffered significant material damages during the war. Moreover, a large fraction of its staff left the laboratory and emigrated. It is presently under the tutorship of the Sarajevo Canton and affiliated to the Sarajevo University. Its core activity is genetic engineering and techniques based on it, both basic (3-4 international publications per year) and applied. It is organized around several main areas: forensic genetics (use of DNA expertise for identification purposes); human genetics (molecular expertise, collaboration with hospitals); molecular biology and genetics applied to biodiversity (fish and plants); and plant genetics and food quality control. The Institute has well recognized expertise in BiH and abroad. It has established a regional database for plants and animals. It currently has a staff of 15 scientists (3 PhD holders, plus 4 PhD and 8 Master's students) with a budget amounting to approximately 350 000 KM per year (budget partly provided by the canton, partly by the BiH Federation), which does not permit investment in new equipment (it has almost no access to international journals). It has established cooperation with the Bosnalijek company, the Agro-Mediterranean Institutes in Mostar, the Agricultural Institute of Banja Luka, and the University of Banja Luka. The Institute has not yet succeeded to obtain funds through the EU Framework Programme; meanwhile, it has established a network of international cooperation (Slovenia, France, Austria Italy and Turkey) and is working for the UN International Commission on Missing Persons. It wishes to be supported at the State level as a national BiH institute and to be considered as a national expert centre for genetics in relationship with hospitals and agro-industry. It already serves as a national focal point of BiH with the International Centre for Genetic Engineering and Biotechnology (ICGEB).

Researcher of the Institute

University of East Sarajevo

• The University is composed of 16 faculties in several campuses dispersed within the territory of RS (8 locations, 4 faculties or departments being in Pale). The University is not yet a completely integrated University but changes are now being prepared. The campus in East Sarajevo (4 faculties including electrical and mechanical engineering) is situated in former buildings of the Energoinvest company.
Some 12 000 students are presently enrolled at the University, which is mainly funded by the Ministry of Education of SR (with a small financial contribution from the municipalities). There is no specific funding for research activities in the university's budget. Some equipment mainly devoted to student laboratories can be used for research activities.

Students at Faculty of Electrical Engineering

Faculty of Electrical Engineering, University of East Sarajevo

1 Vuka Karadzica 71123 East Sarajevo, tel. 387 57 342 788,
Professor Slobodan Milojkovitch; Professor Zoran Zljuboje, Vice-Dean; Prof. Vojislav Suka, Secretary-General of the University.

• The University of East Sarajevo has 16 faculties in several campuses dispersed on the territory of SR (8 locations, 4 faculties or departments being in Pale). The University is not yet a completely integrated one, but changes are now being prepared. The campus in East Sarajevo city (4 faculties including electrical and mechanical engineering) is located in former buildings of the Energoinvest company. Some 12 000 students are presently enrolled at the university, which is funded by the Ministry of Education of SR. Some research projects are ongoing (mostly short-term); 30 students are engaged in post- graduate studies, in particular in cooperation with SMEs (in the telecommunication sector, for example). The University and the faculty have recently devoted efforts towards distance learning and the use of virtual laboratories (with the support of UNESCO Office in Venice). A sizeable fraction of the University staff and former students have emigrated. An effort should certainly be undertaken at the national level to rebuild the research infrastructure.

Innovative experimental techniques, Faculty of Electrical Engineering, University of East Sarajevo

SEE-ERA.NET
National Information Point for Sixth Framework Programme in BiH
Zmaja od 71000 Sarajevo, tel. 38 Bosne 8, tel. 387 33 559 520 www.nip-fp6.ba
Mr Ammar Mirasija, Director; Mr Lamija Tanović, Professor at the University of Sarajevo

• This focal point conveys information to laboratories in the country about the present EU Framework Programme (FP). BiH is a member of the SEE-ERA.NET (network for South-European countries) supported by the European Commission.
The network was created by EU with funding from FP 6; it aims at gathering information on basic science indicators on research activities in the region (output and input) and on scientific cooperation between partners. It has also the objective of catalysing possibilities of cooperation. BiH is not yet involved in COST and Eurêka and it is desirable that it be involved in these programmes. Several institutes of BiH appear to be involved in FP 6 projects but it is presently difficult to have a clear picture of those that have succeeded in gaining approval of their funding. The situation of academic research is poor, since funding is scarce research and not yet considered as a priority of universities. International cooperation is necessary to rebuild the potential, in particular through the EU. A Science Law is necessary at the country level.

Foreign Trade Chamber of Bosnia & Herzegovina
71000 Sarajevo Branislava Durdeva 10 www.komarabih.com, tel. 387 33 66 36 31
Mr Milan Lovrić, President

• The Trade Chamber operates for the whole country (local chambers exist, as well as industrial federations, membership being compulsory). The present economic situation of the country is difficult, with a high unemployment rate (around 40%) and a large trade deficit. Direct foreign investment is rather rare (with the exception of the steel industry (Mittal company) in Zenica, and aluminium in Mostar). Some sectors are exporting (steel, aluminium, timber, textiles, leather and electricity), and they need to invest in R&D to prepare for the future. The reconstruction of the research potential should be a national priority. The privatization process has not taken into account the necessity of preserving the technical capital of companies. A policy is needed at the BiH level (the use for R&D purposes of income from value added taxes should be envisaged). The patent system is non-existent and this is another handicap for BiH industry.

Bulldozer Commission (Buldozer Komisija)
Ilica Zmaja od Bosne 4/IX 71000 Srajevo, tel. 387 33 552 460, www.bulldozer.com
Mr Alija-Remso Baksić, Secretary-General (and Secretary-General of the Association of Wood and Furniture Processors)

• The association is working at the national level with the objective of identifying and eliminating obstacles to economic reforms in the country (50 proposals have thus been made to the authorities. It operates with a central committee on which entrepreneurs are represented (the national commission of BiH entrepreneurs), and with five regional committees which involve

companies and in particular SMEs. A privatization process has been launched but conditions are not adequate (capital of companies is often underestimated, technical assets not protected). No comparison has been made with similar on-going privatization processes in foreign and neighbouring countries. The role of IMF and WTO has been negative with regard to this process. Investment in BiH is insufficient, and although domestic capital exists, it is probably frozen. BiH imports a great deal of foreign technology, and national effort is insufficient to support national industry (industrial R&D, although strong before the war, has almost vanished). A national research strategy should contribute to the strengthening of the technical basis of industry and it should be included in the BiH plan for development. Some sectors such as the timber industry are exporting (wood is an important resource for BiH) but they need domestic technical expertise. In general, information on EU programmes, which could be useful for researchers and industry, is not circulating.

'Circle 99', Association of BiH intellectuals

Vrazova 1, Pen Club offices, Sarajevo 71000, tel. 387 33 20 01 55, www.penbih.ba
Professor Dolocek, President

• This Association was created in 1993 to facilitate dialogue between intellectuals from various communities within the country by launching debates on various aspects of the reconstruction of the country. It has a large audience in many parts of BiH and its positions are well covered by the media. It is considered as a space for debating democratic issues. It organizes conferences and it publishes a regular review. One of its main objectives is to contribute to "Think Bosnia" of the future by highlighting, in particular, the asset that the diversity of its cultural heritage represents. It is necessary to go beyond the Dayton Peace Agreement so as to be able to construct policies in various sectors at the level of the whole country.

'Energoinvest' Company

71000 Srajevo Tvornicka 3, tel. 387 33 62 89 29
Mr Kolakovic Nedzad, Director of R&D, Mr Zdenko Vavra, Director of the Institute of Materials and Quality

• Energoinvest was the most powerful industrial company at the time of Yugoslavia, with sister companies in several countries around the world (one of them still exists in Mexico). It had established several important research laboratories within the country that were very active and had good connections with academic laboratories. The company, although still existing, has almost completely collapsed and has lost all its assets.
Three research institutes were situated in Sarajevo (on material sciences and energy in particular) with 628 employees in 1992 (16 PhD and 55 Masters), by 2005 just 27 employees remain (1 PhD only). The facilities were completely destroyed during the Sarajevo siege, but part of the laboratories (in material sciences) has been rebuilt; meanwhile, scientific and technical equipment is still lacking or outdated. The institute is still the property of Energoinvest (share capital: 36% private and 64% the BiH Federation). Privatization will be engaged but a strategic partner is necessary. The institute undertakes mainly contracted work (with IAEA in

Vienna, and the Ministry of Culture of the Federation). It has developed good expertise in software and systems used for land survey and geographic information systems (dedicated, for example, to the construction of images and data banks of historical monuments). The situation of Energoinvest's remaining research laboratories is close to catastrophic, and if nothing is done soon the whole technical competence of the company will disappear.

'Grizelj' company

71210 Sarajevo Ilidza, Nikole Sopa 46, tel. 387 33 542 992, www.grizelj.com
Mr Tomislav Grizelj, President, Chairman of Employers' Association of BiH

• The company was established in 1978 and it is private, with three sister companies in Austria, Germany and Croatia. Its business is mainly in engineering (thermal energy, heating and cooling, air conditioning, control and monitoring systems). Most of its production is exported; it has obtained the ISO 9001 certification and several awards. The company has a laboratory in Sarajevo which is mainly devoted to control and calibration and technical expertise to examine new working means. It is not currently performing R&D projects but it has some needs. On some occasions it contracts technical research projects with an academic laboratory in the Faculty of Engineering. It holds only one patent and it does not purchase foreign licences (the cost being too high). A unique economic space is necessary for BiH with a State which would be able to support research activities at the country level. For the time being, the fragmentation of politico-administrative entities is too strong and this constitutes a handicap for the economy and the technical development of the country. The Association of BiH employers is conscious of the importance of technology for BiH and of the need for reforms; the Bulldozer Commission performs important work in this domain.

'Bosnalijek' company

71000 Sarajevo, Jukiceva 53, tel. 387 33 25 44, www.bosnalijek.com
Mrs Seherzada Hadzidecić, Director of Development Department; Mrs Ljiljana Kamberović, Executive Director for Business Development; Mr Nedim Vilogorać, Strategic Marketing Unit

• The company was established in 1951 and today its main domain of activities consists of the production of generic pharmaceuticals (40% cardiovascular). Its facilities were severely damaged during the war and have now been completely reconstructed and modernized. In 2004 its sales amounted to 70 million KM (with a 10% yearly increase). It has 515 employees (40% with a university degree). Some 30% of its capital is public (mainly from the BiH Federation), and 52% is owned by individuals. The production processes are highly automated and competitive. The company does carry out research activities but it performs mainly development projects (drug conditioning, for example). It has established good cooperation with faculties of medicine and pharmacy in several universities (students are often working on the company's premises on projects) and abroad (Basle, for example). The company would need research support from academic laboratories, but their infrastructures are often outdated; a reconstruction of this potential is necessary and important for the future of the industrial development of the country.

Office of the High Representative (OHR)
Emerika Bluma 1, 71000 Sarajevo, tel 387 33 283 506
Ambassador Werner Wnendt, Senior Deputy High Representative; Ms Daria Duilović, Programme Officer for Education

• The Office is the agency in charge the implementation of the Dayton Peace Agreement (civilian aspects) on behalf of the international community. The High Representative and his deputies have the mandate to oversee all such civilian aspects. Ambassador Wnendt stresses the necessity of preparing the future of the country beyond the application of the Dayton Agreement. Scientific research should be considered as both a means to stabilize peace in the country and a factor for its development. This requires the definition of a policy at the level of the country, as science necessitates national priorities and investments. The laws which are being prepared (on higher education and science) are important steps in this direction. For the time being, the OHR has not been involved in the preparation of these laws. It is also necessary to define a clear European perspective for the whole country so that its research activities could be integrated in the European Research Area as soon as possible.

World Bank Country Office in BiH
Fra Andela Zvizdovica 1, 71000 Sarajevo, tel. 387 33 251 500
Ms Zorica Lesić

• The World Bank has been deeply involved in the reconstruction of the country by support through loans (soft credits without interest) and sometimes grants for the rebuilding of public infrastructures (bridges, roads, etc.). Education is one of the priorities; support to the economy is another (a privatization process has been engaged since the signature of the Dayton Agreement). The Bank has not been involved in the funding of research operations; however, it is engaged in supporting the university reform in relation to the Bologna process) at the level of US$ 10 million. Its usual partner is the BiH State (with the Conference of Rectors in the case of higher education).

OSCE Mission in BiH
Fra Andela Zvizdovica 1, 71000 Sarajevo, tel. 387 33 752-333, www.oscebih.org
Mr Claude Kieffer, Deputy Director, Education Department (legislative reform)

• The OSCE is not directly involved in the legislative process concerning the Higher Education and Science Laws, although it considers that legislation is necessary at the State level in these two domains. The Higher Education Law should provide guidelines for the application of the Bologna process, accreditation and evaluation. It considers that the legislative process in this domain has been much delayed. Taking into account the urgency of building-up BiH research capacities, Mr Kieffer has suggested a gradual strategy which would consist of attracting foreign donors to constitute a R&D fund to finance research projects. Neither OSCE nor the OHR have been involved in debates about the reconstruction of the BiH research and science potential.

Delegation of the European Commission to Bosnia and Herzegovina
Union Bank building, Dubrovacka 6, 71000 Sarajevo, tel. 387 33 254 700, www.delbih.cec.eu.int
Ambassador Michael Humphreys, Head of Delegation; Mr André Lys, First Counsellor, Head of Operations; Mr Gianmatteo Arena, Attaché

• The EU Delegation represents the Union and supervises civil aid granted by the Union to BiH. It has a close relationship with the OHR. European support to the reconstruction of the country has been and is still important. For the time being, EU does not support research activities and higher education in BiH directly, although BiH laboratories can participate in the Sixth Framework Programme (in particular through the INCO programme). The scientific and technological potential of BiH must be reconstructed (an effort is being made in the domain of information technology); this requires a policy at the country level which is presently non-existent, hence the importance of the Higher Education and Science Laws that are presently being discussed. The future integration of BiH into the EU presupposes a more unified country with policies at the national level (in research, for example). A partnership between BiH scientific institutions and the EU also presupposes unification of views between the various entities and speaking with a common voice. In this respect participation in the Seventh Framework Programme will be very important.

Embassy of France to Bosnia and Herzegovina
18 Ulica Mehmed Bega Kapetanovica Ljubusaka, 71000 Sarajevo, tel 387 33 65 81 49, www.ambafrance.ba
Mr Henry Zipper de Fabiani, Ambassadeur Extraordinaire et Plénipotentiaire; Mr Jean-Jacques Beucler, Conseiller de coopération et d'action culturelle; Mr Erik Ponsard, Scientific attaché; Ms Julia Nietsch, Attachée de coopération scientifique et technique

• Ten years after the entry into force of the Dayton Peace Agreement, the BiH situation is still difficult in many domains, although basic infrastructures have been largely reconstructed: unemployment rate remains high and economic investments are insufficient. The reconstruction of the scientific and technological potential that was greatly damaged during the war has not been considered until now as a priority. European cooperation is certainly a means to catalyse this reconstruction. France has several on-going projects of cooperation with BiH partners, in particular in the social sciences and humanities. Other priorities for cooperation include: environment, energy, industrial technologies, agriculture, and public heath. It is now necessary to go beyond the Dayton Peace Agreement in many areas and to build a more unified country with national policies, which is a condition for the future integration of BiH into the EU. The tax reforms that have been adopted should help the funding of such policies at the State level.

'Oslobodjenje' Newspaper
Ms Angelina Simić, journalist

• *Osbobodjenje* is the main newspaper of BiH, with a large audience throughout the country. It played an important role during the Sarajevo siege as a symbol of the resistance of the city.

Besides daily information, it publishes articles on various political, economic and cultural issues but rarely on scientific issues. In general, there are few debates in the country on science issues or events; the public is not aware of the situation of scientific research of the country and why science is relevant for its future. Debates on these questions would be necessary and welcome.

BANJA LUKA

Ministry of Science and Technology, Srpska Republic (SR)

St Vuka Karadzica 4, 78 000 Banja Luka, tel. 387 51 331 542, www.vladars.net
Mr Fuad Turalić, Minister

• The Ministry deals with issues of science and technology within SR. It has a limited staff. Its budget amounts to 3 million KM in 2005, with 80% dedicated to R&D activities through support to projects. The RS has voted a law for research activities which defines the main guidelines for these activities.
The Ministry has also adopted a basic document for the research strategy of SR that defines the main areas to be supported and developed within the universities, institutes and industry. In 2005, a call for tenders has been launched by the Ministry for the support of projects in all disciplines (130 proposals have been submitted). A committee will rank the proposals according to criteria decided upon by the Ministry. Any BiH State Law on Science should be harmonized with existing laws in other political entities as SR, the Federation of BiH and its cantons, and should take into account the present situation of the research potential of BiH on which information is incomplete; a broad debate on these issues is necessary before voting the Law. The definition of priorities will be certainly necessary.

Minister Turalić at the UNESCO Meeting in Sarajevo, 18 October 2005

University of Banja Luka

Trg srpskih vladara 2/II 78 000 Banja Luka, www.unibl.org, tel. 387 51 312 112
Professor Dragoljub Mirjanić, Rector; Prof. Djordje Marajanović, Responsible for International Cooperation

• The university is financed by the Government of SR (the Ministries of Culture and Education, and of Science and Technology). Founded in 1975, the university has presently 15,000 students and a budget amounting to 10 million KM; it consists of thirteen faculties located on several campuses in the city (a new campus is being built). It is strongly involved in the application of the Bologna scheme for the reorganisation of higher education. The University receives modest funding for its research activities from the Ministry of Science and Technology

of SR; it has kept research activity in the social sciences and humanities, as well as in food technology (cooperation is ongoing with the Institute of Agriculture of the Srpska Republic).The industry is no longer strongly developed in SR; however, priorities such as food, water, forestry and public health are certainly important and have to be integrated into a research policy at various levels.

Faculty of Electrical Engineering, University of Banja Luka
Patre 3, 78000 Banja Luka, tel. 387 51 221 221 824
Professor Slavko Marić, Vice-Dean

• The main activities of the Faculty are in the areas of electricity power, electronics, computers, communication and information technology (700 students in total). The faculty has few financial means and has lost its critical mass for research (it is lacking equipment). Meanwhile, it has developed good contacts with the telecommunication industry with which it is undertaking technical projects (it has thus established an expertise in multimedia activities and it is equipped for video conferences).

Agriculture Institute of Srpska Republc, Banja Luka
Knjaza Milosa17, 78000 Banja Luka
Dr Vojiilav Trkula, Deputy Director

• Founded in 1947, the Institute has presently a staff of 73 persons (including 9 PhDs) and consists of 6 departments (mostly in plant research and certification); its budget amounts to 3 million KM (from three sources: Ministry of Science and Technology, Ministry of Agriculture of SR, contracts). It has also field stations which produce plants and seeds; this production is a source of revenue.
It has maintained a high level of research activities in several areas (including genetically modified organisms) with equipment which is of an international standard. It maintains a gene bank and it has developed activities on plant nutrition and environment protection, and on the appearance of pest diseases and their control; it has a recognized expertise at the level of BiH, in particular within a network for the health of plants. The Institute has developed an important effort for the training of national experts and is involved in several international cooperative projects.

Banja Luka College of Modern Management, Private Faculty of Economics
78250 Karadovreda 44, 78000 Banja Luka, tel. 051 322 850
Professor Zejko Baros, Dean

• The college was created in 2003 and has been accredited as a private faculty of management and economics by the Ministry of Culture and Education of SR. For the time being, it has no research activity, although the creation of a postgraduate programme is planned.

National and University Library of Srpska Republic
51 000 Banja Luka Jevreska 30, R.S, BiH, tel. 387 51 215-894, www.nubdrs.rs.ba
Mr Ranko Risojević, Director

• The library is altogether the library of SR, of the Municipality of Banja Luka and of the University of Banja Luka. With a staff of 50 persons, it does not have its own budget, but receives operating funds from the Ministry of Culture and Education (40,000 KM) and from the Municipality (20,000 KM). It cannot support subscriptions to international journals for the University (with a few exceptions in medicine). It receives some support from the German and French embassies for dedicated book collections. Connection with the COBISS platform (virtual library of BiH) is possible and useful, but at low Internet bandwidth.
The library has preserved some rare manuscripts of Turkish origin. It has maintained a link with the National Library of BiH in Sarajevo. The library organizes occasionally scientific conferences for the public, in close cooperation with the University. Urgent matters to be addressed are the following: the necessity of defining a clear statute of the library with a budget for investing and covering operational costs; and the possibility of connection to Internet through a high-speed academic network for BiH.

Mr Ranko Risojević, Director of National and University Library of the Srpska Republic

MOSTAR

Ministry of Education, Science, Culture and Sport, Herzegovina-Neretva Canton
Stepana Radica 3, 88000 Mostar, tel. 387 36 186, prosvjetahnz@net.hr
Prof. Jago Musa, Minister

• The two Mostar Universities are funded by the Herzegovina-Neretva Canton (with additional financial support from three other Cantons), but there is no specific financial contribution for research activities. The infrastructures of the universities have been seriously damaged during the war and many professors have left the city. Defence and metallurgy were two important industrial activities in the region whose activities greatly suffered during the hostilities, although there is some recovery with regard to the aluminium industry. Employment perspectives are a major preoccupation for the students. The aluminium, food (linked to Mediterranean agriculture), and tourism industries are certainly major economic priorities of the Canton, to which training and research activities should be devoted.

'Sveučilištu' University
Trg hrvatskih velikana 1, 88000 Mostar
Prof. Zeljko Suman, Vice-Rector; Prof. Vojo Visekruma, Vice-Rector

• The University (900 professors and associated professors, 11,000 students, 10% of them coming from other Cantons and from Croatia) is under the tutorship of the canton from which it receives its budget. It is composed of 9 faculties or departments and it is strongly involved in the Bologna process (this issue had been highlighted in a European University Association evaluation report in 2004) although it is still waiting for a Law on Higher Education at the level of BiH State. The University has created 6 research institutes (agronomy, economics, law, Croatian language and literature, civil engineering, mechanical engineering). Because of the lack of investment for the renewal of infrastructures, research activities are not well developed (industrial contacts being rare after the war since a large part of the industrial potential of the region has been destroyed); a PhD programme exists in law and economics. The University is conscious of the need to develop its research activities and is in favour of a science law which would entrust the BiH State with prerogatives in research policy.

'Dzemal Bijedic' University of Mostar
Marsal Tita bb, 88104 Mostar, tel. 387 (0) 36 571 197, 570 727, www.unmo.ba
Prof. Fuad Catović, Rector

• The University (5,000 students and 300 persons as permanent staff) was created in 1997. Most of its premises and equipment were lost or destroyed during the war. Its present premises are former military barracks. It is composed of 8 faculties and 4 institutes (mechanical engineering, civil engineering, economic development, international centre for philosophy and creation) devoted to research activities.
Its total budget amounted to 7 million KM in 2004 (salaries, equipment, operation costs; 35% was granted by the canton, 60% came from tuition).The Agro-Mediterranean Faculty, created in 2003, is also developing its own research. Poor material conditions, obsolescence of infrastructure, and economic difficulties in the region are presently major obstacles for the development of research activities (this was stressed in an internal evaluation report), although some potential is still existing (for example, in engineering, agriculture and social sciences). Thus, the Agro-Mediterranean Faculty is creating a basis for serious research activities in agriculture, horticulture and food industry, in cooperation with partners from the region and abroad, research contracts being used to finance a new building and to renew the research equipment.

'Aluminij' Company
88 000 Mostar, tel. 387 36 385 555, aluminij@aluminij.com
Mijo Brajković, Director-General

• The Company was created in 1945 to exploit bauxite ores. After a merger with Energoinvest, and through cooperation with 'Pechiney' (France), it became an aluminium producer in

1981.The plant was seriously damaged during the war, the electric substation was destroyed causing the cut of the electrical power supply, but electrolysis cells were saved. After the war, the plant was completely rebuilt and new processes were introduced (new technology with a very high yield, close to 94%) with the technical support of foreign companies such as 'Glencore'. Presently, 'Aluminij' in Mostar is the major exporter of BiH with a staff of 950 persons, and a production of 130,000 tonnes exported. It produces pure aluminium or mixed products (the plant has its own automated anode production). As the electrical power represents 35% of the company's production costs, the high cost of electricity in BiH is a disadvantage for the company. The majority of the shares are in the hands of the Federation of BiH (Croatia being a shareholder at 12%). The privatisation process is presently open and the company is seeking a strategic partner to take the majority of its capital. The company has been engaged in an active social policy (developing agriculture activities on its own premises to employ disabled workers of the plant), and has invested heavily and successfully in environmental protection. The company performs in-house R&D projects directly related to its production processes and products. It cooperates with academic laboratories on a project basis; furthermore, it has difficulties to find adequate training in universities for its employees and therefore has engaged an 'in-house' training programme.

ZENICA

Institute of Metallurgy 'Kemal Kapetanovic'

72 000 Zenica, Travnicka 7, tel. 387 32 417 336/117
Dr Mirsada Oruć, Director; Ms Neira Delić, in charge of finance and external relations

• The Institute (staff of 400 persons before the war, 120 presently) had a well established scientific reputation in metallurgy before the war (it brought fruitful support to the steel and aluminium industries in BiH) but lost most of its equipment, which has not been renewed because of the lack of budget. The Institute has maintained, despite severe difficulties, scientific activity and recognized technical expertise in several areas of metallurgy (4 or 5 papers published per year), as well as cooperation with industry, on a short-term basis. Two priorities have been defined: structural studies, and metallurgy processes and the environment. Renewal of the equipment is urgent (in particular for electron microscopy). Its role as a national institute has to be defined in relationship with industrial activities and the university.

University of Zenica

Fakulteska 3, 72 000 Zenica, tel. 387 32 444 430, http:// www.unze.ba
Prof. Sabaduhin Ekinović, Rector, rektorat@unze.ba; Ass. Prof. Darko Petković, Vice-Rector for Science, Development and Int. Cooperation; Prof. Damir Kuuić, Dean of the Faculty of Pedagogy; Prof. Memunna Kasacina, Vice-Rector

• The University was created five years ago (it was formerly a branch of the Sarajevo University) with seven faculties (including two more recent faculties for health management and pedagogy). The University has applied Bologna rules for university management.

Metal science and mechanical engineering are among the priorities of the University which is very much willing to establish a strong cooperation with industry and plans to create a technological park to facilitate this cooperation and the creation of start-ups. The University is under the tutorship of the Zenica Canton from which it receives the majority of its budget (60% from the Canton, 40% through contracts, 1 million KM from the Canton specifically for R&D, no funding from the BiH Federation). Most of the research infrastructures of the laboratories are obsolete because of lack of funding. The University expects to develop its links with the steel industry and particularly with the 'Mittal' company with which it has close contacts.
The Faculty of Pedagogy which provides mainly training for professors has a budget of 0.5 million KM from the Canton (with an extra budget from the admission fees). It envisages a post-graduate programme. The modernization of the research infrastructures is a priority for the University.

'Metalno' Company

72000 Zenica Ul Srajevska, tel. 387 32 421 797, metal.ts@bih.net.ba
Mr Mujezinovic Nesib, Technical Director

• This company was created in 1947, producing mainly metallic structures (for bridges, industrial plants, etc.). Although few investments have been realized since the war, it has maintained its production with 70% of exports (present staff of 400 persons of whom 5-8% are engineers). The company does not perform 'in-house' R&D; whenever technological development is necessary, it proposes a project to external partners such as academic laboratories.
It has maintained cooperation with the 'Kapetanovic' Institute in Zenica and with the University of Zenica. Welding techniques is one of the company's technical priorities. The privatisation of the company is being planned according to local law, but a strategic partner has still to be found.

Mr S. Pejovnik and Mr Mujezinovic Nesib, Technical Director

'Mittal Steel' Company

Mr Seid Kapetanović, Chief Executive Officer

• After the war, the iron and steel works in Zenica had to be restructured and new techniques introduced (electrical furnaces, for example). 'Mittal', which is a multinational company and the largest world steel producer, has become a strategic partner for BiH 'Steel' in which it has invested to modernize the production; in May 2005, this company became 'Mittal Steel' Zenica, employing presently 3000 workers. It intends to bring steel production up to 2.2 million tonnes per year (representing a total investment of about 200 million dollars). 'Mittal' has also acquired an iron ore mine in Ljubija (SR) with a capacity for production of 1 million tonnes of ore per year. 'Mittal' performs 'in-house' R&D activities in several laboratories abroad (Chicago, USA, and Grandrange, France). Technical needs in Zenica steel factories are important and research cooperation with academic laboratories and the 'Kapetanovic' Institute is certainly highly desirable.

ANNEX II

Bibliography

• Kovac, N., *Bosnie: le prix de la paix,* Paris, Michalon, 1995.

• Malcolm, M., *Bosnia: a short history*, New York, NYU Press, 1996.

• Garde, P., *Vie et mort de la Yougoslavie,* Paris, Fayard, 2000.

• Observatoire des Sciences et des Techniques, *Indicateurs de la science et de la technologie*, Paris, Economica, 2005.

• Pen Center, *Literature and culture for peace,* Sarajevo, 2000.

• Kujundzic, E., *Memoria Bosniaca,* Medunarodni centar za mir, Sarajevo, 2001.

• Bosnia and Herzegovina Council of Ministers, Office of the BiH coordinator for PRSP, *BiH Medium Term Development Strategy-PRSP (2004-2007),* Sarajevo, 2004.

• South East Europe ERA.NET Network, *Data on RTD situation*, Sarajevo, 2005.

• UNDP, *International assistance to BiH, 1996-2002, A tentative analysis of who is doing what, where,* Sarajevo, 2005.

• University of Sarajevo, the Senate, *Institutional development plan of the University of Sarajevo,* Sarajevo, January 2003.

• Austrian Development Agency, *Austrian cooperation with Eastern Europe, Country Programme for Bosnia and Herzegovina 2005 to 2007,* Vienna, 2004.

• Centre for Social Innovation, *Position paper of the SEE-ERA.NET as regards the participation of the Western Balkans countries in the 7th European Framework Programme for RTD,* Vienna 2005.

• International Network for the Availability of Scientific Publications (INASP), *Accessing and disseminating scientific information in South Eastern Europe,* Draft Report to UNESCO-ROSTE, April 2005.

• International Commission on the Balkans, *The Balkans in Europe's future,* Sofia, 2005.

• World Bank, *Bosnia and Herzegovina, Post-Conflict Reconstruction and the Transition to a Market Economy,* Washington, 2004.

• Uvalic, Milic, *Science, Technology and Economic Development in South Eastern Europe,* UNESCO-ROSTE Science Policy Series, N° 1, Venice, October 2005.

• Federal Office of Statistics of Bosnia and Herzegovina, *Statistical Data on Economic and other Trends,* Sarajevo, 2005.

• Lasserre, P., Anguelov, S., Santesso, R., Nechifor, I., (editors), *Reconstruction of Scientific Cooperation in South East Europe, International Conference of Experts, 24-27 March 2001, Proceedings,* UNESCO-ROSTE, Venice, October 2001.

• OST, Yann Cadiou and Laurence Esterle, *Scientific profiles in CEEC,* a Report for UNESCO-ROSTE, Venice, March 2002.

• Anguelov, S. and Papon, P. (rapporteurs) *Research infrastructures in South-East European Countries*, a report to UNESCO-ROSTE, Venice, 2002.

• Council of Europe, European Commission, European University Association, *Institutional Evaluation of "Dzemal Bijedic" University of Mostar,* Mostar, 2005.

• University of Mostar, *EUA Evaluation Report,* Mostar, 2004.

ANNEX III

Conclusions of the meeting organised by UNESCO Office in Venice

for presentation and discussions on the draft Report 'Guidelines for Science and Research Policy in Bosnia & Herzegovina'

Sarajevo, 18 October 2005

Thirty personalities representing the institutions (public and private sectors) that had been visited by the two UNESCO experts during their missions in BiH participated in a meeting whose purpose was to discuss the first draft of this report.

The morning session was introduced by Mr Safet Halilović, Minister of Civil Affairs of BiH and was chaired by Mr Howard Moore, Director of UNESCO Office in Venice. The Minister for Science and Technology of the Srpska Republic, Mr Fuad Turalić, and the Minister for Science and Education of the Sarajevo Canton, Mr Emir Turkusic, attended the meeting; the Minister of Education and Science of the Federation of BiH was represented at the meeting by Ms Amra Avdagić, Assistant for Science. The BiH Academy of Sciences and Arts was represented by its President, Prof. Bosidar Matić.

Minister Halilović stressed the importance of science and technology for the future development of BiH. He considered the UNESCO report to be an important contribution for the elaboration of a State policy in this domain.

After a presentation of the main analysis and recommendations of the UNESCO report by the two experts, Profs. Stane Pejovnik and Pierre Papon, many interventions were made addressing aspects of the analysis and recommendations of the report. Several suggestions were put forward, most of them aimed at reinforcing the basic recommendation that institutional reforms are necessary in the country in order to initiate and launch a science and technology policy. Remarks and comments were mainly focused on three categories of issues.

Questions related to **institutional capacities** were the main issue being addressed. The necessity of elaborating a science and technology policy (or a R&D policy, an alternative suggested by several participants) at the level of the country was unanimously recognized. The institutional dimension was also debated as it was stressed that the present BiH constitution inherited from the Dayton Peace Agreement did not leave any room for the definition of a R&D policy at the State level (there is no reference either to science or to research in the Dayton Agreement). It was also regretted that international authorities, such as the OHR, had not taken specific initiatives in this domain so as to pinpoint the importance of these issues for BiH.

Participants who took part to the discussion on these topics considered this to be a severe handicap that has to be surmounted as soon as possible. They agreed on the following:

- a State policy is necessary to support activities of national interest;
- a "joint strategy" of actors should be implemented on a tripartite basis (State, Entities, Cantons of the Federation, in accordance with their financial resources);
- industry should play a key role in supporting research activities in its laboratories and in cooperation with the academic sector.

The importance of the role of universities and of research institutes as well as that of industrial companies on questions such as technical quality standards and norms was also stressed. In order to launch and implement a R&D policy at the country level, the creation of a State Agency for Science and Technology with full political responsibility for the elaboration of such a policy was unanimously recognized.

Participants stressed the necessity of adopting as soon as possible the two Laws on Higher Education and Science that are under preparation. These laws shall provide the general institutional framework for policies in these domains. Some of the participants emphasized that the Science Law could launch a dynamic for research in the country, as long as the main actors of the system will be given the chance to be involved in its elaboration process.

Several participants pointed out that the **Medium-term Development Strategy** (2004-2007) does not take into account the importance of R&D activities and deeply regretted this situation. However, during the revision of the Strategy presently taking place (and covering the 2006-2007 period) R&D could be introduced as an important element for the development of the country. The revised Strategy which is to be approved by the Parliament will commit the government and could constitute the framework for the launching of a S&R policy and its funding. It has been suggested that the revision of the Medium-term Strategy might offer the opportunity for the creation of a Science and Technology Agency.

Issues related to **national priorities and funding of research** were also addressed. Most of the speakers agreed that in the short term there exist three main priorities:

- the training of scientists (in all disciplines) at the PhD level in universities,
- the building up of new infrastructures (several to be considered as national facilities supported by a State fund);
- reinvesting in industrial research to ensure the international competitiveness of BiH industry.

As far as funding is concerned, several participants stressed the urgent need of increasing in the very short term funding for fellowships and equipment (a doubling of funds for equipment of laboratories in 2006, from its present low level was considered to be a short-term necessity). In the long term, the objective of devoting 2% of the country's GDP to R&D was considered a necessity in order to rech international standards (EU and OECD).

Several participants underlined the importance of the **European and international cooperation** for the BiH scientific community through various schemes (Framework Programmes of the EU,

COST and Eurêka programmes). R&D should be included as an important issue in the negotiation process with the EU and be considered as a transversal priority in this perspective.

Lastly, many speakers emphasised the urgent need to bring solutions to the present problems of research activities in the country that have been identified in the UNESCO report. The revision of the plan for the Medium-term Development Strategy should be seized upon to launch a process by creating an Agency as a first step towards a policy. They also suggested that UNESCO Office in Venice send its final report to political authorities in BiH as well as to international ones such as the EU and the OHR in Sarajevo.

Participants agreed, at the conclusion of the meeting, on the importance and usefulness of such a meeting. Mrs Azemina Vuković (Unit for Economic Planning and Implementation of the Medium-term Development Strategy of BiH) and Mrs Lamija Tanović (South East Europe ERA.NET) jointly agreed to organize follow-up meetings to envisage practical implementations of the recommendations of the UNESCO Report.

Mr Howard Moore concluded the meeting by thanking all participants. He circulated a document which summarized the main conclusions of the presentations of the two UNESCO experts and which proposed the creation of a joint task force of experts designated by BiH political authorities and UNESCO so as to contribute to the process of identifying priorities for an R&D policy. He suggested that participants present any remarks they might have on this document by mail as soon as possible. He announced that the final report will be sent to the BiH political authorities, the OHR and EU and then subsequently published as an UNESCO Office in Venice Science Policy Series Report.

ANNEX IV

List of Participants

in the meeting for discussions on the draft Report
'Guidelines for Science and Research Policy in Bosnia & Herzegovina'

Sarajevo, 18 October 2005

Mr Safet Halilović
Minister of Civil Affairs of Bosnia and Herzegovina

Mr Fuad Turalić
Minister of Science and Technology
Srpska Republic

Mr Emir Turkusić
Minister of Education and Science
Sarajevo Canton

Ms. Amra Avdagić
Assistant for Science
Ministry of Education and Science, Federation of Bosnia and Herzegovina

Mr Vinko Bogdan
Ministry for Science and Technology,
Srpska Republic

Mr Popovic Rajko
Ministry of Science and Technology,
Srpska Republic

Ms Aida Durić
Professional Associate,
Ministry of Civil Affairs

Mr Sead Avdić
President,
National Commission of Bosnia and Herzegovina for Cooperation with UNESCO

Mr Numankandić
National Commission of Bosnia and Herzegovina for Cooperation with UNESCO

Prof. Bozidar Matić
President, Academy of Sciences and Arts of BiH

Mrs Azemina Vuković
Head of Economic Policy Planning and Monitoring Unit (EPPU), Medium-term Development Strategy of BiH

Dr. Enes Kujundzić
Director, National and University Library of Bosnia and Herzegovina

Prof. Fuad Catović
Rector, 'Dzemal Bijedic' University of Mostar

Mr Zoran Ljuboje
Vice Rector, University of East Sarajevo

Professor Mensur Hajro
Vice Rector in charge of Science and Research, University of Sarajevo

Ms Lamija Tanović
Professor at the Faculty of Science,
University of Sarajevo
SEE-Eranet BiH Focal point

Mr Damir Kukić
Vice Dean, Faculty of Education, Zenica

Mr Selam Spuzić
Responsible for International Relations,
University of Zenica

Ms Lajla Kapur
Research Associate, Institute for Genetic
Engineering and Biotechnology (INGEB)

Mr Fahrudin Duran
Chief Environmental Department,
Metallurgical Institute "Kemal Kapetanovic",
Zenica

Mr Omer Beganovic
Chief of Mechanical Laboratory, Metallurgical
Institute "Kemal Kapetanovic", Zenica

Mr Nedzad Kolaković
Director, Research and Development, Institute
of materials and quality 'Energoinvest'

Mr Zdenko Vavra
Director, Institute of materials and quality
'Energoinvest'

Mr Tomislav Grizelj
'Grizelj' company and Chairman of Employers
Association of BiH

Mrs Seherzada Hadzidecić
Director of Research Development
Department 'Bosnalijek' company

Mr Milan Lovrić
Vice-President, Foreign Trade Chamber of
Bosnia and Herzegovina

Mr Ammar Mirascija
Director, National Information Point for
the Framework Programme 6 in Bosnia
and Herzegovina

Dr Vojiilav Trkulja
Deputy Director
Agriculture Institute of Republic Srpska,
Banja Luka

UNESCO Office in Venice

Mr Howard Moore
Director

Ms Iulia Nechifor
Programme Specialist, Science Policy
and Capacity Building

Mr Pierre Papon
Consultant

Mr Stane Pejovnik
Consultant

ANNEX V

Science and Technology Statistics and Indicators in Bosnia and Herzegovina

S&T indicators produced by the Academy of Sciences and Arts of Bosnia and Herzegovina

The ANUBiH (Academy of Sciences and Arts of BiH) published in *'Politika Nauke u Federaciji Bosne I Herzegovine'* ('Science Policy in the Federation of Bosnia and Herzegovina') significant data allowing comparison between the number of scientific publications in various parts of former Yugoslavia before and after the war; these data clearly show the fall in scientific activity in BiH between 1990 and 2000.

Number of scientific publications per 100,000 persons:

Former republic	1990	2000
Montenegro	1.79	3.41
BiH	**1.95**	**0.61**
Macedonia	2.36	5.24
Serbia	11.92	11.34
Croatia	18.40	26.00
Slovenia	29.63	76.84

Similar existing data regarding all other R&D activities are summarized in the following table:

Data	Federation BiH	Position of BiH in the world
% of GDP for R&D	0.05	Between 55. Indonesia, 0.07, and 56. Ecuador 0.02
Number of internet hosts per million people	950	Between 36. Russia, 1,037, and 37. Costa Rica, 855
Number of PC's per 1.000 people	30	Between 39. Bulgaria, 30.08, and 40. Colombia, 28.70

Science and technology indicators produced by the Observatoire des sciences et des techniques (OST, Paris, France)

Number of publications in Bosnia – all fields:

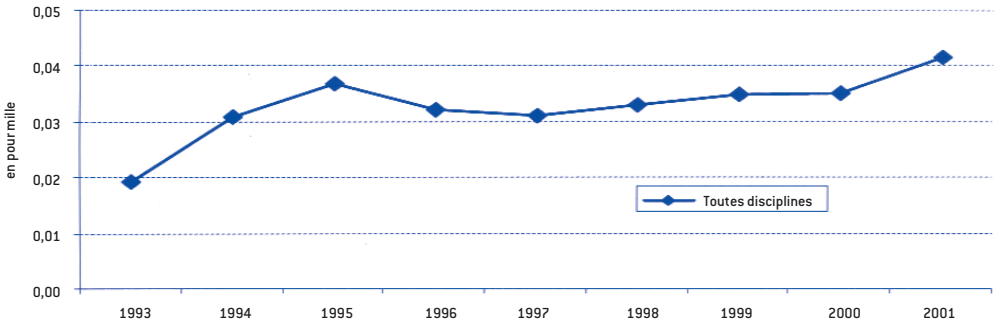
1993: 12	2001: 30

Bosnia: World share (%) evolution of the scientific literature between 1993 and 2001

	Bosnie: part/Monde (‰)				
	1933	1977	2001	Evolution 2001/1993 (%)	Evolution 2001/1997 (%)
Toutes disciplines	0,02	0,03	0,04	117	34

données ISI, traitments OST

Bosnia: World share all fields



Bosnia: scientific literature 2001

Scientific fields	Number of publications	Repartition by fields (%)	World share (%)
Fundamental biology	4	14.6	0.03
Medical research	12	39.3	0.05
Applied biology and Ecology	2	5.6	0.03
Chemistry	3	10.1	0.02
Physics	5	18.0	0.05
Earth and Space Science	1	2.2	0.01
Engineering and Technology	6	20.2	0.06
Mathematics	2	7.9	0.09
Total	30	100.0	0.04

Among the 8 scientific fields analysed by OST, BiH is active, in particular, in medical research with around 40% of its scientific literature in this field in 2001. At international level, in 2001, BiH is mainly productive in mathematics, but these indicators are based on very weak imformation sources.

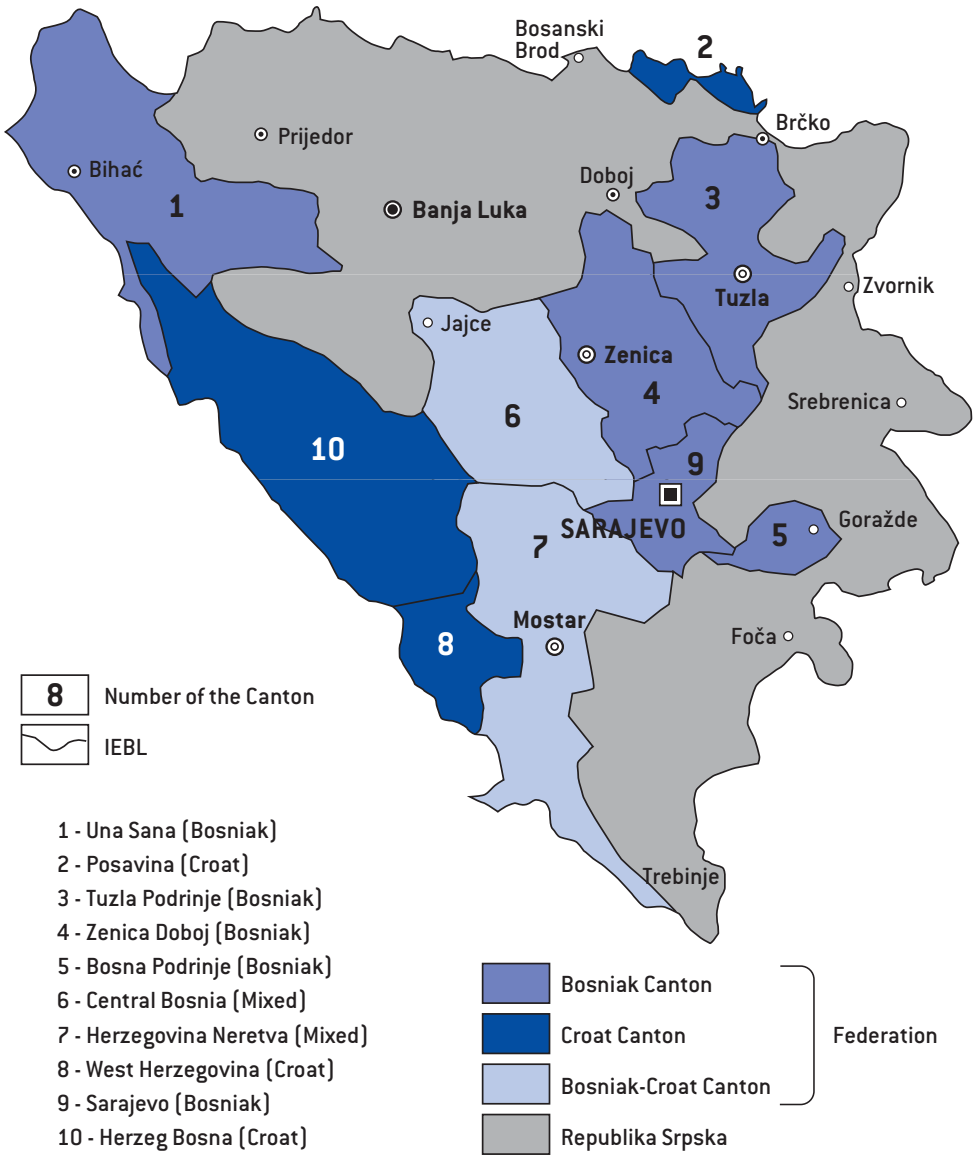
ANNEX VI

List of Acronyms

BiH	Bosnia and Herzegovina
EU	European Union
GDP	Gross Domestic Product
IAEA	International Atomic Energy Agency
IMF	International Monetary Fund
OCDE	Organisation for Economic Co-operation and Development
OHR	Office of the High Representative
OSCE	Organisation for Security and Co-operation in Europe
R&D	Research and Development
SME	Small and Medium-Sized Enterprises
S&T	Science and Technology
SR	Srpska Republic
UNDP	United Nations Development Programme
WTO	World Trade Organisation

ANNEX VII

Map of Bosnia and Herzegovina



Source: http://www.ohr.int/ohr-info/maps/images/federation-of-bih.gif

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Guidelines for a Science and Research Policy in Bosnia & Herzegovina

It is within UNESCO's mandate to provide advice to Member States on the development and reform of national science, technology and innovation systems.

This Report was carried out in close co-operation with the political authorities of Bosnia and Herzegovina who have entrusted the UNESCO Office in Venice with the task of assessing the scientific potential of the country and making recommendations for its future development and integration into the European research community. It underlines the need for adoption of a national Law on Science and Technology in Bosnia and Herzegovina and recommends a series of measures to be urgently taken in order to re-launch competitive science, technology and innovation activities in the country.

The Report is part of UNESCO's Strategy for Strengthening Cooperation with South Eastern European Member States.

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