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Contents

1 Introduction

This country report is produced by the "Information Office of the Steering Platform on Research for Western Balkan Countries" and reviews the situation of Science and Technology (S&T) in the Former Yugoslav Republic of Macedonia (FYR of Macedonia).
The report summarises main papers published by the United Nations Educational, Scientific and Cultural Organization (UNESCO), the South-East European ERA-NET (SEE-ERA.NET), the Austrian "Gesellschaft zur Förderung der Forschung", and several independent scholars on the issue of S&T in FYR of Macedonia. For the complete list of references please see References in chapter 7, starting on page 29 of this report.

The objective of this study is to enhance our understanding of the national innovation system in the Former Yugoslav Republic of Macedonia (FYR of Macedonia). An overview of the situation in S&T regarding the main stakeholders, input and output indicators, the national strategies and priorities, and the main documents and laws in the field is given below.

The 'system of innovation' approach was taken into account when compiling this report, and it covers important factors influencing the development, diffusion and the use of innovations, as well as the relations between these factors. It does not place emphasis on individual firms or research organisations, but rather on innovation as an interactive and interdependent process.
Relevant organisations in this respect are firms, higher education institutions, government agencies, etc. interacting to create knowledge and innovation. The macro-level of the system is analysed using indicators such as R&D personnel ratios, R&D expenditure, patent application intensity rates, etc.

The report was compiled in autumn 2006 by the Information Office and reviewed by the following actors:
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1.1 The Former Yugoslav Republic of Macedonia – A Brief Profile

The FYR of Macedonia is one of the smallest economies in the Western Balkans with a population of 2,050,554[1]. According to the CIA World Factbook (2006), at the time it gained its independence in September 1991, FYR of Macedonia was the least developed of the Yugoslav republics, producing merely 5 % of the total federal goods and services output. The collapse of Yugoslavia saw an end to transfer payments from the central government and eliminated the advantages

[1] July 2006 est.

of being part of a de facto free trade area. Economic growth in FYR of Macedonia was further hindered until 1996 by the absence of infrastructure, the UN sanctions on the downsized Yugoslavia (one of its largest markets), and a Greek economic embargo resulting from a dispute over the country's constitutional name and flag. Since then, GDP subsequently rose each year until 2000. However, due to the ethnic conflicts of 2001, the economy shrank by 4.5 % as a result of the decreased trade, intermittent border closures, increased deficit spending on security needs, and investor uncertainty. Growth barely recovered in 2002 (0.9 %), then rose by 3.4 % in 2003, 4.1 % in 2004, and 3.7 % in 2005. The FYR of Macedonia has managed to maintain macro-economic stability with low inflation, but lags behind in attracting foreign investment and job growth has been anaemic (Central Intelligence Agency (CIA) 2006). The general macro-economic problems were reflected in the financial situation of the research institutes and the prevalent closure of business R&D divisions and departments.

1.2 Relations between the FYR of Macedonia and the EU

The report starts by discussing the position of the FYR of Macedonia and its current situation regarding the enlargement process of the European Union (EU). This process is closely intertwined with the development of the innovation system within the country under scrutiny. As official candidate countries, Croatia and the FYR of Macedonia are well on their way to joining the EU, while Serbia, Montenegro, Bosnia and Herzegovina and Albania hold only potential candidate country status and have a longer way to go in achieving EU accession.

Within the EU and among its national economies, research and development (R&D) is perceived to be the key resource for increasing competitiveness and long-term growth. As part of the transition to a knowledge-based economy, one of the actions called for by the Lisbon European Council in March 2000 is to stimulate the creation, absorption, diffusion and exploitation of knowledge through the European Research Area (ERA). The provision of education and training for the knowledge society, and the start-up and development of innovative businesses are also important. At the Barcelona Council meeting in March 2002, an agreement was reached, whereby R&D expenditure will be increased to 3 % of GDP by 2010, two-thirds of which should originate from the private sector.[2]

The FYR of Macedonia began contractual relations with the EC in 1996, when it signed an agreement granting eligibility for assistance from the EC PHARE programme. In 1997 it signed a Cooperation Agreement, which remained in force until 2004. Meanwhile, the Stabilisation and Association Agreement (SAA) was signed in Luxemburg in April 2001 and entered into force in April 2004. The FYR of Macedonia then submitted an application for EU membership on March 22, 2004. After a thorough revision of the application, the European Commission

[2] In the EU-15 in 2000, average general expenditure for R&D was 1.93 % of GDP (compared to 2.69 % in the US and 2.98 % in Japan), while in 2001 it was 1.98 % (or 1.93 % in the EU-25, according to the estimates of the European Commission); Industry-financed R&D in 2000 was 56.3 % of total R&D spending (compared to 68.2 % in the US and 72.4 % in Japan); see European Commission (2003).

adopted its opinion on November 9, 2005, taking into account the country's capacity to meet the Copenhagen criteria set out by the European Council (1993) and the conditions set out in the Stabilisation and Association Process for the Western Balkans (European Commission 2006).

The opinion contained a detailed analysis on the country's ability to fulfil the obligations of the membership, based on 33 chapters of the *acquis*. It was concluded that the FYR of Macedonia should be in a position to take up most of the membership obligations in the medium term (5 years), but major efforts to ensure the effective implementation and enforcement of legislation will be necessary. In particular, the question of technical norms and standards, the protection of intellectual property rights, competition policy, environment, and financial control were identified as critical issues (European Commission 2006).

Following the Commission's recommendation, the European Council decided to grant candidate status to Macedonia on December 17, 2005. Before further steps are taken, the European Council concluded that the FYR of Macedonia will first have to demonstrate further progress and achievements in meeting the Copenhagen political criteria, the requirements of the Stabilisation and Association Process and the effective implementation of the Stabilisation and Association Agreement (SAA). On January 30, 2006, the Council adopted a decision on the principles, priorities and conditions contained in the European Partnership with the former Yugoslav Republic of Macedonia (European Commission 2006). On November 8, 2006, after acquiring candidate country status, the Progress Report for the FYR Macedonia was released by the European Commission. In this report, general remarks on the achievements and difficulties were given (Stefov 2007).

According to the Science and Research Progress Report from the European Commission, there is a wide disparity between the needs and the available budget in the R&D sector, although provision has been made for co-operation with the private sector. As regards the 6th and 7th Framework Programmes for Research and Technological Development (FP6/FP7), there has been reasonable progress in preparing for participation (Stefov 2007). The European commissioner for science and research, Janez Potočnik, visited the FYR Macedonia in November 2006 and met officials from the government, the Ministry of Education and Science, as well as members of the Macedonian Academy of Sciences and Arts. In the academy, he gave a presentation on the prospects of enhanced integration of Macedonian science into the ERA. The Macedonian Prime Minister officially stated the willingness and readiness for improvement of science and research in the country and a full participation in the 7th Framework Programme (Stefov 2007).

More information on the stakeholders in international and regional R&D cooperation is given in chapter 2.2 on International Cooperation below.

2 Contemporary Institutional Landscape

The FYR of Macedonia is amongst other countries in the region in undergoing radical changes and transitions since 1991[3]. The science and technology (S&T) system of the former Socialist Federation Republic of Yugoslavia (SFRY), which the successor states inherited, was of comparatively good quality despite its uneven distribution. However, it was severely damaged by the wars of the 1990s, which had a significant impact on the innovation system. However, as the European Commission has recently acknowledged in its report on relations with the FYR of Macedonia, today the country is perceived to be a functioning democracy with stable institutions which are able to guarantee the rule of law and fundamental rights of its citizens (European Commission 2006).

2.1 Main Stakeholders Involved in Policy Making in the FYR of Macedonia

In the decade following independence, the FYR of Macedonia was confronted with severe economic problems, resulting in the virtual disappearance of business sector R&D during the restructuring and privatisation period. State financing for science and research is very low and international donor participation in the S&T sector is also rather limited.

The governmental body responsible for S&T policy is the Ministry of Education and Science. Its competencies and responsibilities comprise the organisation, financing, development and promotion of science and technology, Information and Communication Technologies, and technical culture, as well as promoting international cooperation, supervising and monitoring the system, and drafting laws and bylaws (Government of the Republic of Macedonia 2005b, p. 63f). In cooperation with the Ministry of Economy, a new fund has been created and efforts have been made to secure a loan from the World Bank in order to set up a new centre of excellence[4]. Other ministries with activities in the field of S&T include the Ministry of Agriculture, Forestry and Water Management, the Ministry of Health, the Ministry of Environmental Protection and the Department for European Integration (Barbutov 2004; Government of the Republic of Macedonia 2005b; Popovski 2005; UNESCO Office Venice 2004).

The vast majority of R&D is carried out through the 'Ss. Cyril and Methodius University' in Skopje, established in 1949 and comprising of 23 faculties and 10 public scientific institutes and other institutions. The network of scientific institutions also includes universities in Bitola and Tetovo, the European University in Skopje, the Macedonian Academy of Sciences and Arts, other public

[3] The FYR of Macedonia declared its independence from SFRY on September 17, 1991.

[4] The Government of the FYR of Macedonia signed the Agreement on the First Programmatic development Policy Loan PDPL 1 in 2005. PDPL 1 is part of the World Bank's three-year strategy supporting the FYR of Macedonia between 2004 and 2006. The scenario anticipates that the FYR of Macedonia will receive financial support as a loan totalling USD 165 million in the three-year period (2004-2006). The loan from the International Bank for Reconstruction and Development - World Bank will be allocated to the FYR of Macedonia as an amount of EUR 24.4 million (USD 30 million).

scientific institutes (e.g. the Institute for Seismologic Engineering, the Economic Institute, the Veterinary Medicine Institute, the Agriculture Institute etc.), a few R&D institutions within industry and independent researchers (Dall 2006; Stefov 2007).
The University of Bitola 'St. Clement Ohridski' was established in 1979 and currently offers 5 faculties and 3 scientific institutes.
The University of Tetovo was (illegally) established in December 1994 with the objective of providing the country's Albanian minority with university instruction in their own language. Despite ongoing harassment, the authorities did not shut down the university, which continued to function, albeit underground. In the year 2004, the Macedonian government legalised the University of Tetovo, which comprises of four faculties and a polytechnic centre, with approximately 5,000 students currently enrolled in its programmes.
There is also a competing institution that offers education in the Albanian language – the 'Southeast European University' (SEE University) at Tetovo – a private university established in 2001, sponsored by the OSCE, the European Commission and others.

Further information on the financial input for the national innovation system of the FYR of Macedonia is given in chapter 3, The Input Side of the National Innovation Systems, below.

The Ministry for Education and Science also supports technological development and technical culture and provides some support to enterprises. It provides programmes to encourage innovation, but the impact on the business community is rather limited as only a small percentage of the projects funded under these programmes are implemented in private sector enterprises (Small and Medium Size Enterprise Development 2005). On the other hand, the Ministry of Economy is responsible for entrepreneurship policy and tries to improve competitiveness with support from regional and local centres for economic development. There is also a National Council for Entrepreneurship and Competitiveness.

The Council for Science and Research has been the strategic body for the promotion and development of science and research since July 2005. It delivers recommendations, opinions and proposals regarding the annual programmes for the implementation of the Scientific Research Programme, and participates in the drafting of procedures and rules for the allocation of resources. Finally, the Commission for Education, Science and Sports, which was appointed by the Assembly of the FYR of Macedonia, delivers opinions to the parliament on draft laws and the funding of scientific and technological development (Dall 2006).

Table 2.1: Main S&T Stakeholders in the FYR of Macedonia

Main ministry in the FYR of Macedonia competent for S&T:	- Ministry of Education and Science
Other ministries with importance to the S&T sector:	- Ministry of Economy (and Department for European Integration) - Ministry of Health - Ministry of Agriculture, Forestry and Water Supply - Ministry of Foreign Affairs

	- Ministry of Environment and Physical Planning - Ministry of Transport and Communications
Other important stakeholders:	- Macedonian Academy of Sciences and Arts (MASA) - Council for Science and Research - Council for Entrepreneurship and Competitiveness Further information on relevant stakeholders is provided in Annex I – List of Further Institutes
Main research institutions / universities	- University Ss. Cyril and Methodius, Skopje - University St. Clement of Ohrid, Bitola - University of Tetovo - European University, Skopje - South-East European University, Tetovo

2.2 International Cooperation

The Macedonian scientific community became quite isolated from Western and Central Europe as a result of the war in the region. Today, the country is ready to reintegrate into the scientific community of the so-called European Research Area. An excellent way to achieve this is to exchange researchers, familiarise Western Balkans researchers with EU opportunities etc. Due to their apolitical nature, scientific relationships may support peace and stability in the region as well as having an impact on future economic development.

Countries of the Western Balkans have experienced a constant renewal of international cooperation and support, especially in the last five years. Cooperation has been substantially supported by many international organisations, as well as through the assistance of other countries in bilateral programmes (also providing significant benefits to the R&D sector). The vast majority of financial support in this respect came from the funds of the Stabilisation and Association Process, the CARDS programme, the Stability Pact for South-East Europe, the European Investment Bank, and the European Bank for Reconstruction and Development, while the Tempus programme has been important in the area of higher education. Inclusion of the Western Balkan countries (WBC) into the 5th and 6th European Framework Programmes for R&D, and their gradual integration into the European Research Area (ERA), has also been of particular importance[5]. The recent inclusion of these countries into the European Investment Bank's Innovation 2000 Initiative ought to prove useful as well. Concerning multilateral cooperation in the area of science and research, the Western Balkan countries have closely cooperated with many United Nations'

[5] Framework Programmes (FPs) have been implemented since 1984 and cover a period of five years, with a short overlap between the last year of one FP and the first year of the following FP. FP6 ran up until the end of 2006. FP7 will run for a seven year period from January 1, 2007, and expiring in 2013. It is designed to build on the achievements of its predecessor, working for the creation of a European Research Area, but will hopefully carry the work further, developing the knowledge economy and society in Europe (CORDIS Community Research and Development Information Service (2006): Towards FP7. Available from: www.cordis.europa.eu/fp7/faq.htm, accessed 03.08.06.
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(UN) specialised agencies, such as UNESCO, UNIDO, UNDP and UNECE[6]. Some other international organisations, such as the World Bank, have also been important donors and have helped in the area of R&D (Uvalic 2006).

During recent years, the Ministry has promoted and stimulated international cooperation in all fields of scientific research and technological development. This strategy produced a substantial increase in the international scientific cooperation with many countries, especially the EU countries. Scientific cooperation is realised through the Framework Programmes, COST, NATO, UNESCO, IAEA and JICA. The increased participation of Macedonian scientists in the 6th Framework Programme should also be particularly highlighted. According to data available to the Ministry, more than 50 projects run by Macedonian scientists have been approved, which is 4-5 times more than in the 5th Framework Programme. The Department of Science at the Ministry of Education and Science is an active participant in two large and important multilateral projects in the 6th Framework Programme (SEE-ERA.NET and ERA-WEST-BALKAN), which will enable wider incorporation of Macedonia into European scientific research and development activities (Stefov 2007).

SEE-ERA.NET is a networking project, which aims to integrate EU Member States and South-East European countries into the European Research Area by linking research activities within existing national, bilateral and regional RTD programmes, was launched in September 2004 for a duration of five years. SEE-ERA.NET is financed by the European Commission and represents a consortium of 17 institutions from 14 European countries, including ministries in charge of international RTD cooperation from Austria, Bosnia and Herzegovina, Bulgaria, Croatia, France, the FYR of Macedonia, Germany, Greece, Hungary, Montenegro, Romania and Slovenia. In 2006, the network extended to include two more countries; Albania and Serbia. The Austrian Centre for Social Innovation (ZSI) co-ordinates the project. The idea behind SEE-ERA.NET is to coordinate existing bilateral S&T agreements and unilateral activities, incorporating isolated activities into a flexible system of multilateral initiatives which support regional R&D cooperation (Schuch 2006).

The FYR of Macedonia participated in 15 FP5 projects – with Greece, Croatia and Bulgaria being the main cooperation partners. In the 6th Framework Programme for R&D, 44 projects were recorded according to the evidence available from the Ministry of Education and Science of Republic of Macedonia, with awarded grants amounting to 4.5 million euros. Several National Contact Points have been set up and trained within the ERA WESTBALKAN Project (FP6-SSA), including those for IST and for Food Quality and Safety. Seventeen promotions and 'Information Days' were organised with the expert assistance of the EU and the NCPs (Paier, Roediger-Schluga 2006; Stefov 2007; Uvalic 2006).
IST2WEB, a project assisting the integration of scientists into the IST Programme of the 6th Framework Programme and SEE-INNOVATION (focussing on the integration of SMEs in the same field) also operates in the FYR of Macedonia, collaborating with the Faculty of Economics at the University of St. Cyril and Methodius and the Macedonian Association for Information Technology respectively.

[6] See Chapter 8 List of Acronyms.

The participation of Macedonian scientists in the COST Programme during the last three years has also significantly increased from five actions in 2003 to 25 actions in 2006 (Stefov 2007).

In the last few years, the Department of Science has promoted a European oriented science policy and stimulates and assists in the establishment of international cooperation in every way. In 2003, bilateral project cooperation only existed with Slovenia and Germany, but since then, cooperation has been established with Bulgaria, Serbia, Croatia, France, Albania, the Russian Federation, Japan and China, totally over a hundred bilateral projects. In the near future, cooperation with the USA, Israel, Austria and Spain is envisaged and there is also an open call for joint project proposals with institutions from countries with which Macedonia has not yet signed scientific cooperation agreements (Stefov 2007).

The FYR of Macedonia has allocated a relatively high level of resources to international cooperation in the last years (namely 15.9 % of the Ministry of Education and Science's budget for science). The largest number of bilateral projects were with Slovenia (12 projects in 2001, 12 in 2002, 12 in 2003, 16 in 2004, and 18 in 2005), Bulgaria (9 in 2005, and 9 in 2006), Serbia (7 in 2005), Croatia (8 in 2005), Albania (6 in 2006), Turkey (4 in 2005), France (3 in 2004) and Germany (2 in 2004) (Stefov 2007).
The main areas of international cooperation are: Agriculture, Biotechnology, Food processing, Chemistry, Pharmaceutical research, and Environmental protection. More information on the thematic priorities is provided in chapter 5.3, the Main Fields of Intervention and Research Priorities.

All these activities are intended to facilitate the incorporation of Macedonia into the European scientific research area, which, according to the European Commission is necessary for the status of this sector; '*in the fields of Science and Research, the Republic of Macedonia should not have major difficulties in applying the acquis in the medium term*' (Government of the Republic of Macedonia 2005b).

Many regional projects have been launched with the objective of promoting regional cooperation in South Eastern Europe. Regional scientific cooperation of the Western Balkan countries is currently being promoted within several regional organisations: the Central European Initiative (CEI), the Alps-Adriatic Task Force, the Adriatic-Ionian Initiative, and the Stability Pact for South-East Europe. Regional networks also include initiatives for the participation of Western Balkan countries in the EU Framework Programmes for R&D, as defined by the EU-Balkan countries Action Plan on Science & Technology adopted at the Ministerial Conference in Thessaloniki on June 26-27, 2003. In most countries, current bilateral S&T cooperation within the region has been used as a starting point for identifying partners for FP6, COST and EUREKA. Positive examples of regional networks include the Inter-Balkan Forum on IST and the Balkan Physical Union (Uvalic 2006).

At the time of writing this report in 2006, 130 Macedonian researchers were involved in international cooperation projects. As for the researchers' mobility, in 2004, 230 Macedonian researchers were awarded study grants for individual

research, participation at conferences and other scientific events, in the fields of Biology, Chemistry, Agriculture and Technology. Furthermore, 68 foreign researchers were enrolled, mostly in the same fields, in institutions in the FYR of Macedonia in 2004. The countries most frequently participating in the exchange of R&D personnel are: Slovenia, Turkey, Germany and Bulgaria. Macedonian institutions also participate in the Regional Centre for Technology Transfer (for the countries of Central and Eastern Europe) in the domain of Biotechnology and Applied sciences at the University in Zagreb, Croatia. In 1992, a regional innovation centre was established in Štip. Furthermore, the FYR of Macedonia participates in 25 actions of the COST programme (Stefov 2007; Uvalic 2006).

2.2.1 Further International Cooperation Programmes for Science

The FYR of Macedonia has also cooperated with the International Atomic Energy Agency (IAEA). Based on the Agreement on Technical Co-operation with the IAEA and the Country Programme Framework, several national projects for the direct application of nuclear techniques in human and veterinary medicine, agriculture, ecology and industry, have been carried out. Furthermore, regional projects related to the strengthening of radiation protective infrastructure are being carried out through collaborative projects with the North Atlantic Treaty Organisation (NATO), especially within the Science for Peace Programme.
UNESCO is also funding projects in the fields of education and science. The FYR of Macedonia has also been included in UNESCO's Programme for Basic Sciences.

The Norwegian Centre for International Cooperation in Higher Education (SIU) and the Research Council of Norway have established the Norwegian Cooperation Program on Research and Higher Education with the Western Balkan countries. The programme is due to span the time period between 2006 and 2009. The objective of the agreement is to initiate, develop and fund collaboration within higher education and research institutes between universities, university colleges and research institutions in the Western Balkans and Norway (SIU - Norwegian Centre for International Cooperation in Higher Education 2006).
The FYR of Macedonia participates in two SIU projects involving higher education (Development towards the Inclusive School: Practices-Research-Capacity Building; Education, Research and Training for Global Environment Change and Sustainable Management of Natural Resources in Western Balkans) and two research cooperation projects in the fields of water resource management and democracy building (SIU - Norwegian Centre for International Cooperation in Higher Education 2006).

The FYR of Macedonia is also a recipient of numerous financial contributions from the US, e.g. the Paul Getty Institute, which funds international research, and the South-East Europe Project organised by the Woodrow Wilson International Center for Scholars, which provides grant opportunities.

The Macedonian Ministry of Foreign Affairs lists 37 international organisations of which the country is member (Ministry of Foreign Affairs of the FYR of Macedonia 2006); some of which are relevant to the field of S&T, such as:

- WIPO (World Intellectual Property Organisation)

- UNIDO (United Nations Industrial Development Organisation)
- WHO (World Health Organization)
- UNESCO (United Nations Educational, Scientific and Cultural Organisation)
- ILO (International Labour Organisation)
- IMO (International Maritime Organisation)
- WMO (World Meteorological Organisation)
- INTELSAT (International Telecommunications Satellite Organisation)
- GEF (Global Environmental Facility)
- IAEA (International Atomic Energy Agency)
- WB (The World Bank Group)
- FAO (Food and Agriculture Organisation)
- ICCROM (International Centre for the Study of the Preservation and Restoration of Cultural Property)
- OIML (International Organisation for Legal Metrology)
- ITU (International Organisation for Telecommunications)
- IFAD (International Fund for Agricultural Development)
- ICGEG (International Centre for Genetic Engineering and Genetics)

etc.

2.2.2 Participation of the FYR Macedonia in Programmes for Education

The Tempus programme is especially important for the higher education sector, which carries out most of the R&D activities in the FYR of Macedonia. Within Tempus, during 1996-2006, there were 80 joint European projects, 17 structural and complementary measures, 10 compact measures, 333 individual mobility grants and three projects for the establishment of transfer technology structures, implemented in cooperation with Macedonian organisations (e.g. Electro-Technical Faculty, Faculty of Technology and Metallurgy, and Faculty of Agriculture; Faculty of Mechanical Engineering; Faculty of Geology and Mining; Law Faculty) (Stefov 2007; Uvalic 2006). As higher education and training have been regarded as key areas in the process of economic and social reform, the European Community actively works to develop the content and modalities for the fourth phase of the trans-European cooperation scheme for higher education for the period 2007 - 2013. The Republic of Macedonia participated in the phase Tempus II bis and Tempus III, which ended in 2006. The specific aim of Tempus III was to promote the development of higher education systems in eligible countries by encouraging understanding between, and rapprochement of, cultures, by addressing the reform of structures and management in higher education, and by improving links with business actors, etc. (European Commission 2000; Stefov 2007).

In 2006, the Tempus priorities for curriculum development in the FYR of Macedonia were to reform the content and teaching methodologies used in applied sciences and technologies, management and business, vocational life-long learning training courses, social sciences, natural sciences and mathematics. Reforms of university administration aimed to promote an integrated university, of which faculties are a constituent part, and improve university governance. Institution building activities would target officials and staff from public and private institutions in the fields of public administrative reform and civic society

development, public procurement, intellectual property, data protection and agricultural and veterinary policy. Further major tasks in the FYR of Macedonia are to secure equal opportunities for access to higher education, to follow the Bologna process and to integrate into the European Higher Education Area.
Decentralisation is a key policy challenge in the FYR of Macedonia and forms part of the country's broader political agenda connected with the Stabilisation and Association Process (SAP) and the 'Ohrid Framework Agreement' of 2001. In education, the decentralisation process started in July 2005 and the Ministry of Education and Science needs to ensure the smooth and gradual transfer of responsibilities to local authorities over the next few years. The 'National Strategy for the Development of Education 2005–2015' was approved by parliament and action programmes are under development (ETF 2006). In addition, four successive PHARE and CARDS programmes have been supporting the reform of Vocational Education and Training (VET) in selected pilot schools since 1998.
The Macedonian government has developed a macroeconomic policy that gives high priority to employment issues and employment policy. In December 2003, it endorsed the National Action Plan for Employment (2004–2005) developed under the CARDS 2002 Programme. However, implementation proved to be difficult due to the lack of resources (ETF 2006).

Further important actors involved in this field are for example, the German Gesellschaft für Technische Zusammenarbeit (GTZ), Kulturkontakt Austria, USAID, the World Bank, the Soros Foundation, the UK Department for International Development and the UNDP.

3 The Input Side of the National Innovation Systems

Regarding the input indicators for the S&T system, some questions (e.g. the share spent in terms of the gross domestic product (GDP), volumes, growth rates etc.) need to be addressed. Here a distinction is made between private and public investment. R&D investment is used as an indirect measure of a country's innovation capacity (Fischer 2006).

The current economic situation in the Western Balkan countries still poses significant constraints on national policies in R&D. Most countries of the region are still at less than 30 % of the EU-25 GDP per capita average, hardly reaching 60-80 % of their 1989 GDP. Restrictive fiscal and monetary policies, necessary for attaining macroeconomic stabilisation, allow for limited public expenditure and generally contributed to the low investment rates, also in the R&D sector. Although financial assistance received from abroad is significant, it is not usually provided on a continuous basis (Uvalic 2006).

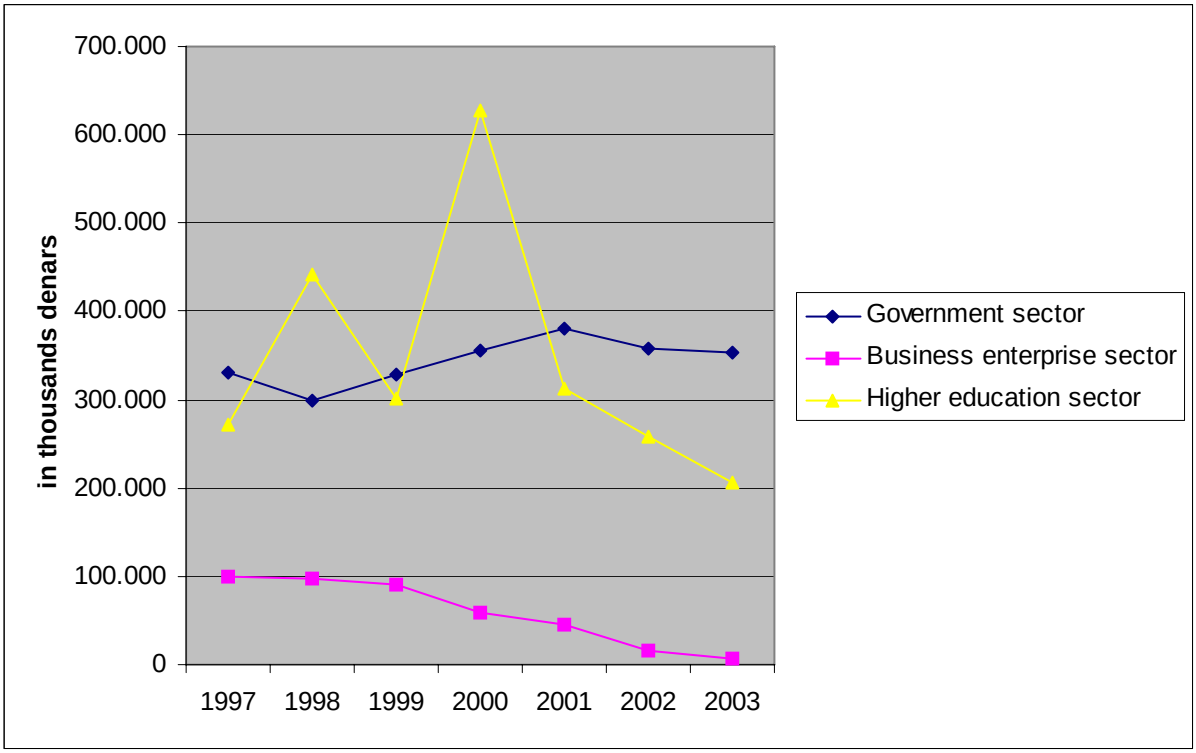
3.1 Development of Financial Resources Allocated to R&D

General expenditure on R&D in the FYR of Macedonia between 1997 and 2003 shows the volume of gross domestic expenditure on R&D (GERD). Figures show that R&D expenditure was on an upward trend between 1997-2000[7], while it decreased dramatically following the 2001 political crisis and was down to 50 % of the 2000 level, at a low of 0.22 % of GDP by 2003 (Fischer 2006; Uvalic 2006).
R&D intensity (R&D expenditure or investment as a proportion of GDP), provides a useful measure of how countries invest in R&D in relation to the value of their total production. It is important to stress that the question of the absolute volume of R&D investment and the level of R&D intensity is not only one of money. Both investment and intensity indirectly reflect – and are also dependent upon – the availability of a sufficient stock of human resources (discussed in chapter 3.5), a regulatory environment for R&D (discussed in chapter 5.1) and a general capacity to exploit these resources effectively. R&D intensity for the FYR of Macedonia in 2003 was measured at 0.18 %. Like many other countries in the region, the FYR of Macedonia had a lower level of R&D intensity in 2003 than in 1999. The negative growth rate was –9.2 %, mainly due to the growth of the economy, which outpaced the development of R&D expenditure (Fischer 2006).

Financial sources for R&D are provided by the government budget, as business enterprise funds were rather negligible and also decreased after 1997[8]. There was also a threefold reduction in higher education spending on R&D, from 0.27 % of GDP in 2000 to only 0.08 % of GDP in 2003 and an almost threefold reduction in the government budget for science from 1997-2003. In 2003, the budget for science was mainly used to finance Science and Research (around 85 %), around 10 % was allocated for technical culture (promotion of science, conferences, seminars, etc.), and the remaining part went to so-called technological development (see below Table 3.2). Regarding the financing of projects according to scientific discipline, the situation has been rather variable during the last ten years; in 2003, the major part (almost 40 %) was allocated to Technical sciences, another 20 % to Bio-technical sciences, 14 % to Natural sciences and Mathematics, 13 % to Medical sciences, while Humanistic sciences and Social sciences attracted a much lower percentage of resources (Uvalic 2006).

[7] EUR 13 million in 1997, EUR 17 million in 2000 and EUR 9 million in 2003.
[8] In Chapters 3.3, 3.2 and 3.4, the general structure of R&D expenditure, divided between the business sector, the government sector and the higher education sector is discussed.

Figure 3.1: Dynamics of Expenditure for R&D per Sector



3.2 Government Sector Expenditures on R&D

Research institutions outside the business and higher education sector provide important links with the national innovation systems, as fundamental research often calls for high R&D investment and a specific research environment in which researchers can collaborate and exchange ideas.

The government's research priorities in the wider region have reshaped the system already. The current tendency is to make it necessary for institutions to generate more commercial income and emulate business practices. In some cases, research institutions have been privatised, but more commonly, institutions have been further supported by the government on a contractual basis (Fischer 2006).

The volume of government expenditure on R&D (GOVERD) between 1997 and 2003 was largely stable and remained at a low level, fluctuating at around EUR 5.9 million in 1997, 2000 and 2003. However, GOVERD as a percentage of GDP declined over the observation period (from 0.18 % in 1997 to 0.14 % in 2003). Government R&D expenditure per capita in the FYR of Macedonia increased insignificantly over the observation period (EUR 2.7 per capita in 1997 and EUR 2.8 in 2003) (Fischer 2006; Stefov 2007)[9].

[9] Percentages differ between the sources. This report has used the data provided by Stefov (2007)

Government research institutions generally play a significant role in national innovation systems. In the FYR of Macedonia, the government's share of public R&D is higher than that of the higher education sector. Although the government's contributions to public sector research institutions across the wider region seem to be diminishing, the same cannot be said for the FYR of Macedonia (Fischer 2006).

The figures described by Fischer show that the government sector's share of total R&D expenditure in the FYR of Macedonia in 2003 was 62.3 %. The average annual growth rate of GOVERD in FYR of Macedonia between 1997and 2003 is negative, –0.5 %. The EU-15 were characterised by a 0.2 % average growth in the period between 1995-2000 (Fischer 2006).

Table 3.1: Government Sector R&D Expenditure (GOVERD)[10]

	1997	2000	2003	2004
Government Sector Expenditure (in thousands of denars)	331,524	355,567	352,518	314,762

The Ministry of Education and Science in the FYR of Macedonia has used various financial instruments to support scientific research, for example: financing national R&D projects, granting scholarships for post-graduate studies at national and foreign universities, supporting researchers in their participation in international events, supporting institutions in organising scientific events, as well as contributing to the publishing of scientific papers and developing the R&D structure. Moreover, the Ministry of Education and Science has also financially supported the establishment of technological nuclei at several faculties (Uvalic 2006).

Table 3.2: Ministry Budget for Science 1996-2003 (in Euro) [11], see (Uvalic 2006)

	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Science and Research	3,327,869	3,393,443	2,754,098	1,754,098	2,786,885	2,573,770	2,393,443	1,147,541
Technological development	65,574	81,967	81,967	81,967	163,934	8,197	196,721	83,672
Technical culture	231,148	196,721	196,721	196,721	196,721	131,148	163,934	114,754
Total	3,624,590	3,672,131	3,032,787	2,032,787	3,147,541	2,713,115	2,754,098	1,345,967

[10] Source: State Statistical Office, data for 2004 provided by Stefov (2007)
[11] Source: Ministry for Education and Science

Table 3.3: Ministry Budget for Science 2004-2006 (in Euro) [12], provided by (Stefov 2007)

	2004	2005	2006
Science and Research	1,442,623	1,941,170	1,883,980
Technological development	81,967	147,050	196,080
Technical culture	100,000	106,210	106,210
Total	1,624,590	2,194,430	2,186,270

3.3 Business Sector Expenditure on R&D

The input of the business enterprise sector is evaluated by looking at the level and dynamics of business sector R&D expenditure at the aggregate country level. The R&D activities in the business enterprise sector are particularly essential for the innovative output and competitive dynamics of a country.

The relative importance of the business sector R&D efforts is indicated by the level of business expenditure on R&D (BERD) as a share of GDP. The relative importance of BERD in total economic activity in the region of South-East Europe (0.24 % in 2003 as calculated by Fischer (2006), including Bulgaria and Romania but not BiH and Albania due to the lack of data) lags considerably behind that of the EU-15 (1.26 % in the year 2000). In the FYR of Macedonia, the level of BERD expenditure as a percentage of GDP was extremely modest – nearly negligible at 0.002 % in 2003 (Fischer 2006).

The input of the business sector in R&D activities in comparison to overall R&D activities reveals the relative importance of profit-oriented knowledge creation and absorption. Nevertheless, thorough examination of the business sector's share of total R&D expenditure shows considerable variation between the Western Balkan countries. In the FYR of Macedonia, a very low proportion of total R&D (below 15 %) was spent on business research, thus reflecting a relatively low level of business sector knowledge investment in comparison with knowledge invested by the government and higher education sectors (Fischer 2006).

Furthermore, the dynamics of BERD can be added as an important indicator of knowledge creation and absorption. Compared to the EU-15 (4.3 %, 1995-2000), the business sector R&D expenditure increased relatively slowly in South-East Europe[13] (growth rate 2.3 %, 1997-2003). Figures for the FYR of Macedonia demonstrate negative dynamics and the low level of business R&D activity results in sub-optimal absorptive capacities that could otherwise enable firms to take advantage of R&D activities undertaken elsewhere (Fischer 2006).

[12] Source: Ministry for Education and Science
[13] Fischer has included Bulgaria and Romania in this calculation but not Albania and BiH – due to the lack of data.

Table 3.4: Business Sector R&D Expenditure (BERD)[14]

	1997	2000	2003	2004
Business Sector Expenditure (in thousands of denars)	99,464	59,445	7,294	38,954

3.4 Higher Education Sector Expenditure on R&D

University research represents one key activity within the higher education sector regarding the national innovation systems, providing scientific and technological knowledge to be disseminated and utilised in the economy. However, as primary suppliers of fundamental research, universities do not only contribute to the economy through the direct provision of applicable results, but also through the diffusion and adoption of skills and techniques and through professional networks and other forms of communication channels created by academic research (Fischer 2006).

In 1997, the FYR of Macedonia spent around 5 million EUR on R&D. In 2003, it was amongst those countries of the Western Balkans, which recorded the lowest levels of HERD (Higher Education Expenditure on R&D), allocating only between 0.03 % and 0.07 % of their GDP to R&D activities in the higher education sector (Fischer 2006).

Further examination of HERD as a share of total R&D expenditure reveals that HERD was at an exceptionally high level in the FYR of Macedonia in 2003; in the range of between 35 % and 40 % of the total, a figure comparable to Portugal for example (1999) (Fischer 2006).

Taking into account the population, the amount spent on the higher education sector (*per capita*) in the FYR of Macedonia was EUR 2.44 in 1997 and EUR 1.66 in 2003. The higher education sector share mirrors the structure of government spending on public research. With 36.9 %, the FYR of Macedonia is well below the EU-15 average of 59 % (Fischer 2006).

Table 3.5: Higher Education R&D Expenditure (HERD)[15]

	1997	2000	2003	2004
Higher Education Sector Expenditure (in thousands of denars)	271,663	626,506	206,172	298,754

[14] Source: State Statistical Office, data for 2004 provided by Stefov (2007)

[15] Source: State Statistical Office, data for 2004 provided by data for 2004 provided by Stefov (2007)

3.5 Human Resources in R&D

Human resources are key factors in the development of a knowledge based economy and society. The best-known indicator of human resource use for technological and economic purposes is the number of R&D personnel by sector (i.e. in the higher education, government and business enterprise sector). A further indicator is the numbers of students in science and engineering (S&E), the university level fields most relevant to S&T (Fischer 2006).

Table 3.6: R&D Personnel by Sector[16]

	1997	2000	2003	2004
Government Sector	916	1,044	829	754
Business Enterprise Sector	370	241	67	136
Higher Education Sector	1,650	1,809	1,693	1,662
TOTAL	**2,936**	**3,094**	**2,589**	**2,552**

Among R&D personnel, a distinction is made between researchers (i.e. researchers, scientists and engineers [RSEs]) and technicians and other support staff. According to Fischer (2006), 1990 researchers were working in the FYR of Macedonia in 2003[17], although between 1997 and 2003 the number of researchers recorded a negative growth rate of −0.8 %. Nevertheless, it is important to stress that the FYR of Macedonia has the highest proportion (76.9 %) of researchers within total R&D personnel, which places it on a par with Portugal's 75.7 % (1999), thus reaching the highest levels in the EU-15 (Fischer 2006).

Table 3.7: R&D Personnel Total by Occupation[18]

	1997	2000	2003	2004
Researchers	2,088	2,246	1,990	1,887
Technicians and Equivalent Staff	382	397	228	306
Other Supporting Staff	466	451	371	359
TOTAL	**2,936**	**3,094**	**2,589**	**2,552**

The share of researchers in the labour force signifies the relative importance of RSE jobs in the labour market and can thus be seen as an appropriate indicator for examining the knowledge base of an economy. In 2003, the FYR of Macedonia reported 2.3 researchers per 1,000 labour force, compared to 5.4 researchers per 1,000 labour force in the EU-15 area (Fischer 2006).

[16] Source: State Statistical Office, data for 2004 provided by Stefov (2007)
[17] Source: State Statistical Office, data for 2004 provided by Stefov (2007)
[18] Source: State Statistical Office, data for 2004 provided by Stefov (2007)

However, it is important to stress that researchers, scientists and engineers are not the only category of employees engaged in R&D activities. Indicators such as the total number of R&D personnel and the percentage of RSEs within that total must also be considered. In the FYR of Macedonia, there were three R&D workers per 1,000 labour force in the year 2003, which places the country significantly below the EU-15 average of 9.8 R&D workers per 1,000 (1999) (Fischer 2006).

Table 3.8: R&D Personnel by Scientific Fields[19]

	1997	2000	2003	2004
Natural Sciences	287	370	32[20]	40
Engineering and Technology	850	674	594	632
Medical Sciences	710	632	735	758
Agricultural Sciences	388	418	392	380
Social Sciences	185	285	299	223
Humanities	516	715	537	519
TOTAL	**2,936**	**3,049**	**2,589**	**2,552**

Table 4.5 : R&D Personnel by Age[21]

	1997	2000	2003	2004
Below 29	147	203	152	119
30-59	2,169	2,254	1,905	1932
Above 60	154	186	161	142
TOTAL	**2,470**	**2,643**	**2,218**	**2,193**

Table 3.9: Number of Students Enrolled in Tertiary Educational Institutions by Scientific Field[22]

	1997	2000	2003	2004
Natural Sciences	2,589	3,090	2,963	2,843
Engineering and Technology	8,450	8,825	9,143	9,125
Medical Sciences	3,224	3,388	3,639	3,788
Agricultural Sciences	2,468	3,270	3,228	3,140
Social Sciences	11,303	17,250	22,432	26,520
Humanities	4,014	4,423	5,232	3,948
TOTAL	**32,048**	**40,246**	**46,637**	**49,364**

Of the total number of students enrolled in tertiary education in the FYR of Macedonia, 57 % are female and 43 % are male (2003), and the same proportion also remained in 2004.
According to official statistics (2003), the general distribution of the population by gender in the FYR of Macedonia is 50.2 % males and 49.8 % females.

[19] Source: State Statistical Office, data for 2004 provided by Stefov (2007)
[20] Questionnaires from Faculty of Natural sciences and Mathematics were not received.
[21] Source: State Statistical Office, data for 2004 provided by Stefov (2007)
[22] Source: State Statistical Office, data for 2004 provided by Stefov (2007)

4 The Output Side of the National Innovation Systems

The output of an innovation system is manifested through the new knowledge, new products and processes which are produced. Indicators such as the 'Gross Expenditure on Research and Development' and the Number of Researchers' provide a measure of the resources potentially allocated to innovation. This chapter focuses on the results of the innovation processes and their output indicators.

4.1 Patent Activities in the FYR Macedonia

Among other approaches (Hörlesberger 2006), innovative output can also be measured by patent data, the most important advantage of which is the wealth of the information supplied. A patent file granted by the European Patent Office (EPO) provides data on the invention, which is protected by the patent through the title, abstract and technological classification. Furthermore, patent data provide the only output measure available for almost all countries in the world, including the Western Balkan countries (Hörlesberger 2006).

European inventors today have a choice between two alternatives when seeking patent protection for their inventions: the European Patent Office (EPO) and national patent offices. The EPO was set up to provide patent protection through a single procedure, defining the granting of patents in some or all of the contracting states of the European Patent Convention (EPC). The procedure for obtaining a patent at the EPO consists of two phases and sometimes a third phase dealing with possible objections. In contrast to national patents that are valid in only one country, a European patent gives its proprietor equivalent rights to a national patent in each member state. Moreover, European patents may also be effective in some countries that have not acceded to the EPC, including FYR of Macedonia[23] (European Patent Office 2006).

A second barrier to patenting is the cost associated with a patent application. Studies estimate that the cost of an application and the 10-year maintenance of a patent at the EPO are approximately EUR 32,000 (Roland Berger Market Research 2004). In contrast, applications to national patent offices may be less expensive (applications to local patent offices in the Western Balkans in particular can be expected to incur a considerably lower cost than an application to the EPO) (Hörlesberger 2006).

Patent applications to the Macedonian Office of Industrial Property began in 1992 with an insignificant 14 applications; all from the FYR of Macedonia. In 1993 and 1994, the process of transferring applications from the Federal Patent Office of the former Socialist Federal Republic of Yugoslavia led to a large increase in the number of patent applications to the Macedonian Office of Industrial Property (Hörlesberger 2006).

[23] The FYR of Macedonia has a so-called "Extension state" status at the EPO – this means it recognises the European Patents, although it is formally not a member of the organisation.

Between the years 1997 and 2003, 438 national patent applications and another 855 foreign patent applications were received in the FYR of Macedonia, either through the Patent Cooperation Treaty or the European Patent Office (as many as 591). The total number submitted to the State Office for Industrial Property for this seven-year period was 1,293 patents. In the category of national patents, the number of annual applications has continuously declined, from 66 in 1997 to 47 in 2003, whereas foreign patent applications have, on the contrary, increased, especially during the last few years – from only 65 in 1997 to 388 in 2003.

In accordance with the classification proposed by the OECD, all patents have been assigned to one of the following six broad technological fields according to their IPC classification:

- Electricity - Electronics
- Instruments
- Chemicals, Pharmaceuticals
- Process Engineering
- Mechanical Engineering, Machinery
- Consumer Goods, Civil Engineering

More recently, patent applications (and thus patents granted) in the FYR of Macedonia have centred on the field of drug production and medical applications (about 1,250 patent applications representing 50 % of all applications) including: organic fine chemistry (705), pharmaceuticals, cosmetics (386), the chemical industry and petrol industry, basic materials chemistry (82) and medical engineering (75). Other important fields for patent applications include civil engineering, building and mining (122), agriculture and food (92) electrical devices and electrical engineering (89), materials and metallurgy (68), machine tools and engines, pumps, turbines (97) etc. (Hörlesberger 2006).

4.2 Publication Activity in the FYR Macedonia

The FYR of Macedonia is a member of the COBISS system which is a shared cataloguing system adopted by the former Association of the Yugoslav National Libraries as a common platform for the library information system and the system of scientific and technological information in Yugoslavia. It is now managed by the Institute of Information Science (IZUM) in Maribor, Slovenia.

Regarding scientific output, the overall number of scientific publications in 2003 was higher than six years before (a total of 1,659 in 2003, in comparison with 1,174 in 1997), though the number has since stagnated. There are, however, some scientific fields, e.g. Biotechnology, where the scientific publication output has significantly increased in the last three years. The largest contribution to scientific publications has been made by researchers employed in the higher education sector (54 %) and in the governmental research sector (45 %), while only a small percentage is contributed by the business sector (less than 1 %) (Uvalic 2006).

The available data shows the low share of articles published when compared to Croatia for example, the most advanced country in the region (Simeonova 2006), although the available data is rather old:

Table 4.1: Number of Articles Published (NSI data base), see (Simeonova 2006)

	FYR of Macedonia	Croatia
Number of current contents articles, 1993	1,397	11,505
Number of ISI articles 1991-2004	1,779	14,272

For the first time in Macedonia, during 2004 and 2005, a complete database of publications from scientific journals with impact factors (journals referred in Science Citation Index (SCI) and citations of institutions and researchers) was built up. A database of all patent activities in the country was also built. (Stefov 2007)

5 National R&D Strategy and Legal Framework

In this chapter, the innovation policies applied in the FYR of Macedonia are analysed, i.e. the official public documents that influence the policies on technical change, scientific development, innovation support, etc. Furthermore, the legal framework and the strategies which have been adopted are presented. The aim is to acquire knowledge about the existing national strategies and programmes and their implementation mechanisms, taking into account policy aspects in the educational system, the development of Information and Communication Technologies, intellectual property protection, tax regimes, etc. .

5.1 Legal Framework for the National S&T System

A legal framework is indispensable in the organisation of R&D institutes, the innovation infrastructure and programmes that provide grants to research organisations and innovative companies. Most commonly, laws are prepared separately for the areas of S&T and higher education. Legislation in Macedonia is still undergoing a process of transition; new laws are subject to public debate, with ministerial regulations and governmental decisions also playing important roles. Legislation has improved and will further improve due to the stabilisation and association processes[24] (Dall 2006).

In accordance with Article 47 of the Macedonian Constitution, the state has an obligation to stimulate and facilitate scientific research and technological development. Issues related to R&D are regulated by the following laws:

[24] The FYR of Macedonia was the first country in the region to sign the Stabilisation and Association Agreement in April 2001. Leaders of the EU granted the country candidate status on December 17, 2005.

Table 5.1: Overview of the Important Laws in the Legal S&T Framework of FYR of Macedonia, see (Dall 2006, p. 187)

Law on Scientific Research Activities	Regulates the system, principles, public interest, forms of organisation and management of research
Law on Stimulation and Facilitation of Technological Development	Regulates the stimulation and facilitation of technological development and also of programming- and financing-related activities
Law on the Macedonian Academy of Sciences and Arts	Defines the Academy as the highest autonomous scientific and art institution in the FYR of Macedonia
Law on Stimulation and Assistance of the Technical Culture	Regulates the dissemination of research results, stimulates research excellence, and technical and vocational education and training, especially among young people
Law on Higher Education	Insists upon equal opportunities for access to higher education, gives autonomy to all higher education institutions, provides a system for quality assessment of higher education, specifies degrees offered and qualifications granted
Law on Industrial and Intellectual Property Protection Law on Copyright and Related Rights	Determine intellectual property rights and the conditions regarding the enforcement and protection of copyright of the original work of authorship, including research studies
Law on Small Enterprise Development Support and the Establishment of an Agency for Supporting Entrepreneurship	Has recently been adopted; a strategy for implementing the principles of the European Charter for Small Enterprises has also been set up

The bylaws to the law on Scientific Research Activities (rulebooks) determine the conditions and criteria regarding the allocation of resources for the stimulation and facilitation of scientific research, as well as governing the procedure for technological development, training scientists, and implementing annual programmes in these domains. In 2005, the Ministry of Education and Science reached the final phase in adopting new regulations on the funding of scientific research and also finalised a draft proposal for a new Law on Science and Technological Development, bringing legislation closer to European regulations. This law was scheduled in the Working Plan of the Ministry for the year 2006 (Ministry of Education and Science of Republic of Macedonia 2005b). After the election of the new government on July 5, 2006, the drafts of the strategic and programmatic documents were still waiting to be approved. The legislation on industry and intellectual property is based on the Law on Industrial and Intellectual Property Protection and several bylaws, such as the Patent Rulebook, the Rulebook on Industrial Design, on Trademarks, on the Product Mark of Origin and Geographic Marking and the Law on Copyright and Related Rights. Industrial property and patent rights protection comes under the remit of the State Bureau of Industrial Property. The Macedonian Customs Law exempts the import of donated equipment intended for research projects at higher education

institutions and other public research institutions from customs duty and value added tax (Dall 2006).

5.2 Main Documents Reflecting National Innovation Strategies

In many South East European countries and also in the FYR of Macedonia, innovation is a topic subordinated to science or research policy. Most S&T policies in Western Balkan countries encourage sustainable support for basic research at universities and research institutes, for the development of human resources and for cooperation with the European Union's RTD programmes, joint activities with the European Science Foundation and bilateral agreements. In technology policy, emphasis is placed on linking research institutions as sources of knowledge with industry and SMEs, and on encouraging the establishment and functioning of intermediary institutions – although the success of such institutions in practice is still currently being questioned (Kobal 2005). Policy development is in many ways intertwined with the accession process to the European Union. Negotiations with the European Union on the 31 chapters of the *acquis communautaire* cover various policy fields including research, SME and industry policy. The economic accession criteria, such as withstanding competitive pressure and forces in a functioning market economy within the European Union, require policies and strategies to create an innovative knowledge-based economy (Dall 2006).

The process of becoming a European Union candidate country and starting membership negotiations has resulted in the preparation of a National Strategy for Integration of the FYR of Macedonia into the European Union and the Action Plan for the European Partnership. In 2006 the government accepted a programme for the development of scientific research activities in the Republic of Macedonia during the period of 2006-2010. This is the first official document regarding the development of R&D adopted by government in the independent Macedonia. The programme was prepared over the course of one year by experts and officials from all fields of science. The future activities are set in the Action Plan of this Programme (Government of Macedonia 2006; Stefov 2007). In this work programme the new government admits that science needs to undergo a substantive reform. Among the steps listed in the Action plan are: an increase in public investment in S&T, provision of incentives for science through taxation policy, devising strict criteria for the selection of researchers in institutes, etc. Nevertheless, economic reform also remains the top priority for this government (Government of Macedonia 2006). In the meantime, the Ministry of Education and Science has established several programmes for which the government is attempting to provide funds (Popovski, Stefov 2005), such as the Programme for Encouraging and Supporting National RTD Projects, the Programme for Granting Fellowships for Postgraduate and Doctoral Studies, both at home and abroad, the Programme for Supporting Researchers for Participation in International Meetings, a target Research Programme for Coordination of RTD Activities within Governmental Bodies, a Programme for Development of RTD Infrastructure and finally a Programme for Encouraging and Supporting Technological Development for the 2002-2006 period. The latter encompasses the objectives and activities of the Ministry of Education and Science for stimulating and facilitating

technological development as well as criteria for priority setting. Annual programmes stipulate the co-financing of RTD projects. Projects of mutual interest for science and economics are implemented in accordance with the Annual Scientific Research Programme of the Ministry of Education and Science. Within the framework of the ongoing educational reforms, the ministry is making efforts to transform higher education with the objective of improving collaboration and knowledge transfer with the business sector. The latest valid document for the Education Development Strategy concerns the 2001-2010 period (OECD 2001).

The process of formulating a national information society policy and action plan resulted in the identification of activities and the formulation of a legal and fiscal framework necessary for implementing e-governance and education, e-business initiatives and the development of the ICT infrastructure (Committee for Information Technology 2005; Government of the Republic of Macedonia 2005a). In 2002, the Assembly of the Republic of Macedonia adopted the e-Declaration 2002, which makes the development of the information society and the knowledge-based society a national priority. In the same year, the Committee for Information Technology and the National Task Force for the Information Society prepared a draft of the National Strategy on Information Society Technologies for Development. The strategy is divided into seven basic development pillars: infrastructure, e-business, e-Government, e-education, e-health, e-citizenship and legislation. Education and science are mentioned as priority areas for strategic activities and the continuous development of the National Academic Research Network MARNet is one of the basic priorities for infrastructure development (Government of the Republic of Macedonia 2005a, 2005b).

The National Environmental Action Plan developed by the Ministry of Environment and Physical Planning identifies priorities and determines the investments and obligations deriving from international agreements (Government of the Republic of Macedonia 2005b; Ministry of Environment and Physical Planning of the Republic of Macedonia 2005).
Research projects from the military domain are under the competence of the Ministry of Defence, which has a special fund for that purpose. The National Security and Defence Concept (Ministry of Defence of the Republic of Macedonia 2003) recognises the importance of improving the scientific, technical, ICT and infrastructural basis of the state to enhance the security capabilities of the FYR of Macedonia. There are, however, no national research and production capacities directly operated by the Ministry of Defence.

Table 5.2: Main Documents Reflecting National Innovation Strategies for Research, Technological Development and Innovation, see (Dall 2006; Stefov 2007)

National Strategy for the Integration of the Republic of Macedonia into the European Union (2004) Action Plan for the European Partnership	Sets out the fundamental aims, policies and priorities in the process of acquiring membership in the European Union.
Programme for development of the scientific research activities in the Republic of Macedonia for the period of 2006-2010 and Action Plan of this programme	The programme provides a platform for all institutions and individuals working in the scientific research area.

Technological Development Programme (2002-2006)	Describes the activities which stimulate and facilitate technological development, along with the criteria for setting priority areas.
National Strategy for the Information Society Development and Action plan (2005)	Defines activities in e-government, e-education, e-business initiatives and the development of ICT infrastructure, etc. Education and science are priority areas.
National Environmental Action Plan (2005)	Encourages educational, research and development studies, and organises programmes and projects to protect and improve the environment and nature.
National Security and Defence Concept (2003)	Aims to improve the scientific, technological, IT and infrastructural basis in order to enhance security capabilities.
Education Development Strategy (2001-2010)	Aims to transform the higher education sector and improve knowledge transfer to the business sector.
National Programme for development of Education in Republic of Macedonia 2005-2015	The National Programme is devoted to knowledge development and improvement and to the enhancement of living standards in the Republic of Macedonia. Its goal is to contribute to the realisation of sustainable development and improvement in society, achieving equal status as a member of the European and international surroundings.

5.3 Main Fields of Intervention and Research Priorities

A key challenge for all Western Balkan countries in the process of transition to a market economy is to create stable and favourable conditions for economic growth. Against this background, innovation policy has to enlarge its scope from the current focus on research to include a broad productivity agenda (Dall 2006). As stated by Radošević, innovation policy as such has only recently re-emerged in the Western Balkans, after having been reduced to a secondary role during the transition process. "*In order to be effective, innovation policies in the CEECs should recognise the structural weaknesses of their individual innovation systems. This will require a search for country-specific solutions, as opposed to the rather imitative mode that has so far prevailed*" (Radosevic 2005, p.37).

Serious long-term structural problems that affect the S&T sector need to be solved in order to assure further development. Amongst these structural problems are budgetary constraints and public debt, a generally low level of development, , widespread unemployment, poverty and massive migrations, pointing to the need for industrial restructuring in largely de-industrialised economies (Uvalic 2006). Due to the overall lack of resources, prioritisation is of the utmost importance and research orientation needs to be steered towards present and future economic and social needs. International programmes need to use foresight and support the process of prioritisation (Uvalic 2006), as simply focusing on the RTD Framework Programme or imitating the strategies of other countries is unlikely to bring about positive results.

Priority setting in the S&T sector is intended to facilitate efficient performance of certain identified science and technology fields through a predictable allocation of critical-size funds. However, much remains to be done, such as implementing national foresight studies in order to support the prioritisation process. It would also be worth considering a complementary comparative regional foresight exercise to assist the diverse national attempts (Uvalic 2006).

The 2006-2010 programme outlined by the new government of the Republic of Macedonia identifies the following main areas for improvement: living standards, employment opportunities, interethnic relations, political stability, fight against corruption, development of democracy, and integration of the country into the EU and NATO. The basic economic principles of the programme are economic freedom and equal conditions for everyone, dynamic implementation of structural reforms and establishment of cooperation, especially with the private sector partner, aimed at its faster development and creation of better employment conditions (Stefov 2007).

As a strategic objective, five potential centres of excellence have been identified in the Republic of Macedonia based on their results in scientific research: the Institute of Chemistry at the Faculty of Natural Sciences and Mathematics; the Research Centre for Genetic Engineering and Biotechnology at the Macedonian Academy of Sciences and Arts; the Nephrology Clinic at the Faculty of Medicine; the Research Centre for Energy, Informatics and Material Science at the Macedonian Academy of Sciences and Arts and the Institute for Earthquake Engineering and Engineering Seismology. They are recognised not only within the country, but also internationally through their publications, citations and international cooperation (Government of the Republic of Macedonia 2005b; Stefov 2007)

Furthermore, efforts have been made to attain a credit from the World Bank, which will be used to improve scientific infrastructure and establish centres of excellence in the country.

Table 5.3: Thematic Priorities in the FYR of Macedonia, see (Dall 2006, p. 207).

Sources: (Government of the Republic of Macedonia 2005b; Ministry of Education and Science of Republic of Macedonia 2005a; Popovski, Stefov 2005)	Sustainable development Water resource management Energy New materials Environmental protection Information and communication technologies Health Biotechnology Production of high quality food Geological science and engineering.

6 Summary and Draft Conclusions

S&T governance still represents an important structural problem in the FYR of Macedonia. Nevertheless, a variety of formal and informal institutions,

mechanisms and procedures for managing S&T infrastructure, designing, delivering, selecting and evaluating S&T policy programmes, and specifying and implementing standards can be observed. However, in the Western Balkan countries, discrepancies between the functions described in the laws and their actual implementation often exist; some institutions do not function properly or merely exist 'on paper' (Dall 2006).

Science policy in the FRY of Macedonia is closely intertwined with higher education but not yet with technology or economic policy. The need to adapt the higher education sector in accordance with European Higher Education Area standards (Bologna Process etc.), means that teaching and learning are consequently of higher priority than investment in scientific research. However, innovation should not just be limited to higher education. It needs to be part of many policies, such as competition, enterprise, research, finance and taxation policy (Dall 2006).

The main difficulties in the FYR of Macedonia revolve around the unsatisfactory level of public budgetary funds for financing S&T activities. The lack of funds results in insufficient infrastructural facilities, equipment and materials; an inefficient institutional infrastructure; insufficiently developed mechanisms for transferring knowledge and research results in the business sector; an unbalanced distribution of researchers by sector; low investments in applied research and innovation and a low level of private investments in the R&D sector, as well as an unsatisfactory number of young researchers as a proportion of the total number of researchers; and serious brain-drain problems (Popovski 2005; Popovski, Stefov 2005). The Macedonian government intends to pay special attention to certain priority tasks, such as developing an academic research network and a library information system, supporting existing technology development capacities, renewing research equipment and stimulating the creation of new R&D units in the business sector, establishing technology transfer centres, and providing favourable working conditions for publicly funded researchers (Ministry of Education and Science of Republic of Macedonia 2005a; Popovski, Stefov 2005). Nevertheless, there is a lack of continuity in the criteria for distributing S&T funds as they tend to change with the different governments. The FYR of Macedonia aims to become better integrated with mainstream international research; in particular it hopes to be able to participate actively in the European Research Area. It is therefore committed to harmonising its research policy with EU policy on research and development. An important step in this direction has been the sharp increase in GERD during the 2006 budget year, albeit from a very low starting point.

It is strongly advisable for the FYR of Macedonia to develop sustainable strategies, taking into account regional and European dimensions. Foresight and the identification of innovation capacities will help in the development of policies and the formation of a long-term strategy in a regional context. A high level of awareness about the relevance of RTD and a dialogue between the economy, academia and the administration will provide the basis for developing a science policy that is in line with economic policies and priorities. Benchmarking and evaluation can help to improve the performance of research institutions and to concentrate capacities in priority areas in coherence with regional development and European integration. A close dialogue with important foreign stakeholders

with shared experiences is inevitable, but since there are no ready-made solutions, simply imitating policy approaches will not produce the desired results (Dall 2006).

The dialogue with the European Union will become increasingly based on a regional approach. The Steering Platform on Research might provide a forum for the Western Balkan countries to communicate their needs and also their potential in research, technological development and innovation. Other projects such as SEE-ERA.NET provide platforms for the integration of the national innovation system in the wider European Research Area.

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8 List of Acronyms

BERD - Business Sector Expenditure on R&D

CARDS - Community Assistance for Reconstruction, Development and Stabilisation

CEI - Central European Initiative

CEEC – Central and Eastern European countries

COBISS - Cooperative on-line bibliographic system and services

COST - 'Co-operation in Science and Technology' Programme

EPC - European Patent Convention

EPO - European Patent Office

ERA - European Research Area

ERA-NET - European Research Area Network

ETF - European Training Foundation

EU – European Union

EUR - Euro, currency

FP6 - Sixth EU Framework Programme for R&D

FP7 - Seventh EU Framework Programme for R&D

FRY – Former Yugoslav Republic

GDP – Gross Domestic Product

GERD - Gross Domestic Expenditure on Research and Development

GOVERD - Government Sector Expenditure on R&D

GTZ - German Gesellschaft für Technische Zusammenarbeit

HE - Higher Education

HERD - Higher Education Sector Expenditure on R&D

IAEA - International Atomic Energy Agency

ICT - Information and Communication Technology (also acronym for the related FP7 'Cooperation Programme' theme)

IZUM - Institute of Information Science, Slovenia

IP - Intellectual Property

IPC - International Patent Classification

IPA - Instrument for Pre-Accession Assistance

IS2WEB - FP6 project "Extending Information Society Networks to the Western Balkan Region"

IST - Information Society Technologies (Programme line in FP6 – in FP7 it changed to ICT)

IZUM - Slovenian Institute of Information Sciences

JICA - Japan International Cooperation Agency

MARNET - Macedonian Academic Research Network

MASA - Macedonian Academy of Sciences and Arts

NATO - North Atlantic Treaty Organisation

NCP - National Contact Point

NGOs - Non-governmental Organisations

OECD - Organisation for Economic Cooperation and Development

PHARE - *Pologne, Hongrie Assistance à la Reconstruction Economique*

R&D - Research and Development

RSE - researchers, scientists and engineers

RTD - Research and Technological Development

RTDI - Research, Technological Development and Innovation

SAA - Stabilisation and Association Agreement

SAP - Stabilisation and Association Process

SEE - South Eastern Europe

SEE-ERA.NET - FP6 project South Eastern European Era-Net

SEE INNOVATION - FP6 project "Facilitating innovation for ICT SMEs in South Eastern Europe"

SEE-SCIENCE.EU - FP6 project "Information Office of the Steering Platform on Research for Western Balkan Countries"

SFRY – Socialist Federation Republic of Yugoslavia

SIU - Norwegian Center for International Cooperation in Higher Education

SMEs - Small and Medium Size Enterprises

S&T - Science and Technology

SSA - Specific Support Action (activity in the Framework Programmes)

STI - Science, Technology and Innovation

TEMPUS - Trans-European Mobility Scheme for University Studies

UNDP - United Nations Development Programme

UNECE - United Nations Economic Commission for Europe

UNESCO - United Nations Educational, Scientific and Cultural Organisation

UNIDO - United Nations Industrial Development Organisation

USAID - United States Aid

USD - US-Dollar (currency of the United States of America)

VET - Vocational Education and Training

WIPO - World Intellectual Property Organisation

WB - Western Balkans

WBC - Western Balkan countries

ZSI – Centre for Social Innovation (Zentrum für Soziale Innovation), Austria

Annex I – List of Further Institutes

Research Center for Energy, Informatics and Materials
Research Centre for Genetic Engineering and Biotechnology
Centre for Strategic Research
Centre for Research and Policy Making
Economic Institute
Institute of Earthquake Engineering and Engineering Seismology
Macedonian Academic Research Network MARNET
Agency for Development and Investments

Annex II – Main Research Institutions Publishing in Scientific Journals

Table: Total Number of Published ISI Scientific Journals Covered by Institutions in FYR of Macedonia for the Period 1971-2004

Institution	Total number of articles	Abstracts	Works published as whole articles	Participation of Institution in the total number of articles published as whole articles
Total	**2061**	**359**	**1702**	
Institute of Chemistry	486	4	482	28.32 %
Faculty of Technology and Metallurgy	190	1	189	11.10 %
Institute of Physics	135	0	135	7.93 %
Macedonian Academy of Sciences & Arts	132	8	124	7.29 %
Faculty of Electrical Engineering	120	0	120	7.05 %
Faculty of Agricultural Sciences and Food	53	0	53	3.11 %
Institute of Mathematics	45	0	45	2.64 %
Faculty of Philosophy	50	7	43	2.53 %
Faculty of Pharmacy	37	1	36	2.11 %
Faculty of Mechanical Engineering	34	0	34	2.00 %
Institute of Biology	30	6	24	1.41 %
Institute of Informatics	23	0	23	1.35 %
Faculty of Technical Sciences, Bitola	18	0	18	1.06 %
Faculty of Veterinary Medicine	16	0	15	0.88 %
Institute of Earthquake Engineering & Eng. Seismology	13	0	13	0.76 %
Museum of Natural History	13	0	13	0.76 %
Hydrobiology Institute, Ohrid	12	0	12	0.70 %
Faculty of Mining & Geology, [tip	9	0	9	0.53 %
Faculty of Civil Engineering	9	0	9	0.53 %
Macedonian National Grid - ESM	9	0	9	0.53 %
OHIS - Chemical Industry	9	0	9	0.53 %
Institute of Ecology	8	0	8	0.47 %
Faculty of Economics, Skopje	8	0	8	0.47 %

Faculty of Philology	8	0	8	0.47 %
Faculty of Biotechnology, Bitola	7	0	7	0.41 %
Alkaloid - Pharmaceutical Industry	7	1	6	0.35 %
Institute of National History	5	0	5	0.29 %
Strezevo - Public Enterprise, Bitola	5	0	5	0.29 %
Institute of Mining & Steel	3	0	3	0.18 %
Higher Agricultural School, Bitola	3	1	2	0.12 %
Faculty of Forestry	2	0	2	0.12 %
Institute of Agricultural	2	0	2	0.12 %
Institute of Animal Breeding	2	0	2	0.12 %
Ministry of Agricultural	2	0	2	0.12 %
Institute of Mining	2	0	2	0.12 %
Tobacco Institute -Prilep	2	0	2	0.12 %
Centre for Radioisotope Application	2	0	2	0.12 %
Faculty of Law	1	0	1	0.06 %
Military Academy	1	0	1	0.06 %
Institute of Geographic	1	0	1	0.06 %
Institute of Hydrometeorology	1	0	1	0.06 %
Pedagogical Faculty, [tip	1	0	1	0.06 %
High Music School	1	0	1	0.06 %
Macedonian Radio Broadcasting Council	1	0	1	0.06 %
Usje - Cement Production Plant	1	0	1	0.06 %
Faculty of Dentistry	1	0	1	0.06 %
Faculty of Architecture	1	1	0	
Faculty of Physical Culture	1	1	0	
Ministry of Internal Affairs	2	2	0	
Others	12	5	8	0.47 %
Medical Institutions in RM	612	323	289	16.98 %
- Faculty of Medicine	15	12	3	0.18 %
- Centre for Clinical Global Health Education	5	5	0	
- Nephrology	127	39	88	5.17 %
- Paediatrics	81	18	63	3.70 %
- Neurology	44	35	9	0.53 %

- Haematology	39	23	16	0.94 %
- Physiology	31	19	12	0.70 %
- Transfusion	27	13	14	0.82 %
- Pathophysiology	25	14	11	0.65 %
- Experimental Biochemistry	23	3	20	1.18 %
- Pulmology	23	22	1	0.06 %
- Institute of Clinical Biochemistry	21	11	10	0.59 %
- Cardiology	21	13	8	0.47 %
- Gynaecology	18	10	8	0.47 %
- Urology	16	3	13	0.76 %
- Immunology	16	9	7	0.41 %
- Pharmacology	16	2	15	0.88 %
- Radiotherapy & Oncology	15	9	6	0.35 %
- Forensic Medicine	14	12	2	0.12 %
- Endocrinology	13	6	7	0.41 %
- Dermatology	11	1	10	0.59 %
- Pathology	11	1	10	0.59 %
- Gastroenterology	10	6	4	0.23 %
- Epidemiology	7	5	2	0.12 %
- Surgery	7	4	3	0.18 %
- Rheumatology	7	5	2	0.12 %
- Radiology	7	3	4	0.23 %
- Psychiatry	6	5	1	0.06 %
- Social Medicine	5	0	5	0.29 %
- Toxicology	5	5	0	
- Abdominal Surgery	5	4	1	0.06 %
- Ophthalmology	5	2	3	0.18 %
- Nuclear Medicine	5	4	1	0.06 %
- Institute of Physiology & Anthropology	4	2	2	0.12 %
- Heart Institute	4	4	0	
- Infective Disease	3	0	3	0.18 %
- Inst. of Spec. Education & Rehabilitation	2	1	1	0.06 %
- Neurology	2	0	2	0.12 %

- Preventive Medicine	2	0	2	0.12 %
- Thoracic Surgery	2	1	1	0.06 %
- Trauma Centre	2	0	2	0.12 %
- Histology	2	2	0	
- Anatomy	1	1	0	
- Digest. Surgery	1	1	0	
- Internal Medicine	1	1	0	
- Inst. of Cardiovascular disease	1	1	0	
- Inst. of Mental Health	1	1	0	
- Inst. of Radiology	1	0	1	0.06 %
- Medical Informatics	1	1	0	
- Microbiology	1	0	1	0.06 %
- Orthopaedics	1	1	0	
- Haemostasis & Thrombosis	1	1	0	
Paediatric Hospital-Kozle	11	5	6	0.35 %
Mental Hospital	9	7	2	0.12 %
Med. Centre Bitola	6	6	0	
Med. Centre Veles	5	0	5	0.29 %
Ins.of Labour Medicine	4	4	0	
Rep.Inst.of Health Protection	4	0	4	0.23 %
Ministry of Health	4	2	2	0.12 %
Med. Centre Strumica	4	1	3	0.18 %
Military Hospital	4	0	4	0.23 %
State Cen. For Persons with Intellectual Disability	3	2	1	0.06 %
Med. Centre Struga	3	1	2	0.12 %
Cardiology Centre Fillip II	2	1	1	0.06 %
Med. Centre Gevgelija	2	0	2	0.12 %
Macedonian Red cross	2	0	2	0.12 %
Health Care Centre- Steel Company	2	2	0	
WHO EUROMH	1	1	0	
Maxi facial Surgery	1	0	1	0.06 %
City Hospital Skopje	1	0	1	0.06 %

Health Centre - Dojran	1	1	0	
Fran-Mac. Association of Oncologists	1	0	1	0.06 %
Gjorgov Private Med. Centre	1	0	1	0.06 %

The Project

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

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