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Science and Technology Country Report
**The Former Yugoslav Republic of
MACEDONIA**

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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 (the FYR of Macedonia).

The report summarises main papers published by the United Nations Educational, Scientific and Cultural Organisation (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 the FYR of Macedonia. For the complete list of references please see References in chapter 7, starting on page 179 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 (the 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.

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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 2,050,554¹. According to the CIA World Factbook (2006), at the time it gained its independence (without violence²) in September 1991, the FYR of Macedonia was the least developed of the Yugoslav republics, producing merely 5% of the total federal goods and services output.

¹ July 2006 estimation

² Nonetheless, latent tensions between the ethnic Albanian (roughly 30 percent of the total population) and the majority ethnic Macedonian populations raised the possibility of conflict. Ethnic conflict was avoided for a decade despite the social strains of both a weakened economy and the Kosovo crisis. But in early 2001, ethnic Albanian armed groups began a low-grade insurgency that brought the country to the brink of civil war (Mascarell, 2007).

The collapse of Yugoslavia saw an end to transfer payments from the central government and eliminated the advantages of being part of a *de facto* free trade area. Until 1996, economic growth in the FYR of Macedonia was further hindered 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 (CIA, 2006). In 2006 the real GDP growth rate was 3.5% (OECD, 2006). Economic activity accelerated markedly in the first quarter of 2007. Preliminary data points to an increase of real GDP by 7% compared to the same period the year before. The main sources of growth were manufacturing and trade (European Commission, 2007a). The unemployment rate has been declining, in 2005 it was 37.3%, while in 2006 36%. In 2007 unemployment remained relatively stable on a very high level (European Commission, 2007a).

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 (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.³

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 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 22nd March 2004. After a thorough revision of the application, the European Commission adopted its opinion on 9th November 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,

³ 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) (European Commission, 2003).

2007c).

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, 2007c).

Following the Commission's recommendation, the European Council decided to grant candidate status to the FYR of Macedonia on 17th December 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 30th January 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, 2007c). On 8th November 2006, after acquiring candidate country status, the Progress Report for the FYR of Macedonia was released by the European Commission. In this report, general remarks on the achievements and difficulties were given (Stefov, 2007). The second Progress Report for the FYR of Macedonia was released on 6th November 2007 by the EU Commission, covering the period from October 2006 to October 2007. The general assessment based on the decision taken, legislation adopted and measures implemented, is that the FYR of Macedonia has made progress and most of the obligations have been fulfilled in the field of competition, industrial property rights and telecommunication market, however, further progress is needed (European Commission, 2007b).

On 18th September 2007, the European Union (EU) and five West Balkan nations (among them, the FYR of Macedonia) signed nine agreements on visa facilitation and readmission, which will bring the two sides closer in cooperation in migration and movement of persons. The signature of the agreements is an important political decision toward closer cooperation between the EU and the Western Balkan countries in the sensitive areas of migration and movement of persons (see-science.eu, 2007a).

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 1991⁴. The S&T system of the former Socialist Federation Republic of Yugoslavia, 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, 2007c).

⁴ The FYR of Macedonia declared its independence from SFRY on 17th September 1991.

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). The Ministry of Education and Science has at its disposal the following financial instruments for the support of scientific research (Government of the FYR of Macedonia, 2007a):

- financing the national research and technology development projects;
- awarding scholarships for post-graduate and doctoral studies at local and foreign universities;
- financial support for research workers participating at international conferences;
- financial support in organising international scientific conferences;
- contribution for publishing scientific and research publications;
- development of the research and technology development (RTD) infrastructure.

The MES's activities are largely restricted to co-financing activities such as (Polenakovik and Pinto, 2007; Sumanovska, 2007):

- Developmental and innovation projects (up to 30% of total cost);
- 45 scientific journals per year;
- Publication of approximately 200 scientific books per year;
- Participation in around 50 domestic scientific conferences;
- Participation in international conferences, seminars, etc. (500 people);
- International study visits for around 100 young scientists;
- About 300 research projects in 2003 and some 186 projects in 2004;
- About 150 innovative projects supported by the Ministry in the period 2003 to 2007.

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 excellence⁵. 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; UNESCO Office Venice, 2004; Government of the Republic of Macedonia, 2005b; Popovski, 2005).

The primary national institution to promote the development of science, research, innovation and new technologies is the Macedonian Academy of Sciences and Arts (MASA). MASA is facing serious problems such as a lack of funding, a low level of human capital, outdated

⁵ 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).

equipment, with the consequence that it is not in a position to fulfil its role satisfactorily. MASA implements its activities through five departments (Linguistic and Literary Sciences; Social Sciences; Mathematical and Technical Sciences; Biological and Medical Sciences; and Arts) and five research centres (Research Centre for Genetic Engineering and Biotechnology, Research Centre for Energy, Informatics and Materials, Centre for Strategic Research, Centre for Linguistics and the Lexicographical Centre). The first two centres are internationally recognised for their research, but there is an overlap in the focus of the other three centres and other scientific institutions such as the Institute of Economics, the Institute for Sociological, Political and Juridical Research, the Institute for Macedonian Language and the Institute for Macedonian Literature. MASA's difficulties are compounded by the fact that researchers and scientists are not always allowed to apply for MES research projects (Polenakovik and Pinto, 2007).

According to the National Report on Bologna Process, state universities are expected to be managed from a central structure for the sake of enabling strategic and transparent management. This innovation was aimed towards transforming public, state-funded universities into an integral structure, and creating faculties that will become parts of universities and lose their status of independent units. This will integrate fragmented universities and create a possibility for internal mobility of studies, programmes and staff (Uzelac, 2006).

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 scientific institutes (for example, the Institute for Seismologic Engineering, the Economic Institute, the Veterinary Medicine Institute, the Agriculture Institute etc.) and a few R&D institutions within industry and independent researchers (Dall, 2005; 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 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.

Three public universities in Skopje, Bitola and Tetovo educate some 45,000 students. Although they combine education with science and research, the level of contact with industry is insufficient. Research and scientific papers are used by the scientific and research staff primarily for the purpose of career development. The weak link between the universities and the economy has been noted in the past and continues to be an issue (Polenakovik and Pinto, 2007).

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 en-

courage 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 (Dall, 2005).

Another important institution in the science and technology area is the Euro- Regional Technology Centre - Bitola. This is a foundation established on 31st July 2003 by the Faculty of Technical Sciences - Bitola and the Council of Municipality Bitola, with support from GTZ (German Technical Cooperation) through their Project for Technology Transfer. The Euro-Regional Technology Centre - Bitola acts in the field of technological brokerage and facilitation of the transfer of technology, technology information and knowledge between research centres and private enterprises, primarily SMEs, in order to become competitive on EU markets. It also supports and helps the research institutes sustain and enhance their research activities, and stimulates technology - oriented entrepreneurship initiatives in the region, if they comply with regional technology requirements. All this is meant to lead towards accomplishing the aim – creation of a regional system of innovation which would be the future driving force of regional development (The Euro-Regional Technology Center - Bitola, 2004).

Another institution worth mentioned is the Euro-Balkan Institute. Its mission is to advocate, concert and disseminate the EU principles and values in the FYR of Macedonia and to promote transatlantic cooperation and interdependence. The areas in which Euro-Balkan Institute is particularly striving to promote and introduce these values are the research-based policy development and the democratic and multicultural higher education incorporating the contemporary standards of excellence in teaching (Euro-Balkan Institute, 2007).

When talking about IT industry and its development, the MASIT organisation should not be ignored. The Macedonian association for informatics technology (MASIT) is a voluntary, non-profit association and it represents an organisational form for all interested private companies that have primary business activities in the area of production, trade and services in IT that are registered in the FYR of Macedonia. MASIT was established in 2000 due to the joint efforts of the managers of 15 leading companies on the Macedonian IT market. It plays an important role in the lobbying with different governmental and other international bodies (MASIT, 2007).

Table 2.1: Main S&T Stakeholders in the FYR of Macedonia (adapted from Dall, 2005; Sumanovska, 2007)

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:	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - Macedonian Academy of Sciences and Arts (MASA) - Council for Science and Research - Council for Entrepreneurship and Competitiveness - The Euro-Regional Technology Centre - Bitola - Euro-Balkan Institute - MARNET - MASIT (Macedonian association for informatics technology) - Agency for development of SMEs - Bureau for Patents - Business Start-up Centre - Union Of The Inventors And Authors Of Technical Improvements Of Macedonia - UATIM <p>Further information on relevant stakeholders is provided in Annex I - List of Further Institutes</p>
Main research institutions / universities	<ul style="list-style-type: none"> - University Ss. Cyril and Methodius, Skopje - University St. Clement of Ohrid, Bitola - University St. Goce Delcev, Stip - University of Tetovo - European University, Skopje - South-East European University, Tetovo - University American College Skopje - 14 Scientific Research Institutes

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 programme⁶, the Stability Pact for South-East Europe, the European Investment Bank⁷, and the European Bank for Reconstruction and Development⁸, while the Tempus programme has been important in the area of higher education. Inclusion of the Western Balkan countries into the 5th and 6th European Framework Programmes for R&D, and their gradual integration into the European Research Area, has also been of particular importance⁹. 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' specialised agencies, such as UNESCO, UNIDO, UNDP and UNECE¹⁰. 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).

The Instrument for Pre-Accession (IPA) replaced CARDS in 2007. The IPA remains focused on institution building and socio-economic development, aims to provide targeted assistance to candidate countries and potential candidate countries with their EU membership applications, and has entirely replaced CARDS and other pre-accession financial instruments. The programming has five components - Transition Assistance and Institution Building; Regional and Cross-Border Co-operation; Regional Development; Human Resource Development and Rural Development - only the first two of which apply to potential candidate countries. The IPA allocates over EUR 11 billion during the 2007-2013 period (see-science.eu, 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

⁶ The programmes wider objective is to support the participation of the countries of the Western Balkans in Stabilisation and Association Process (SAP). Through the programme, EUR 4.6 billion has been provided to this region in the period 2000 to 2006 for investment, institution-building, and other measures to achieve main objectives. It was replaced by IPA - see below.

⁷ As of December 2005, the European Investment Bank had supported projects in the FYR of Macedonia with funds totalling EUR 163 million. These funds were concentrated in the area of transport - in particular road construction and small and medium enterprise financing as well as the energy sector (European Commission, 2006)

⁸ The volume of the Bank's support to the FYR of Macedonia increased modestly during the last Strategy period (mid-2004 through mid-2006) with seven new commitments for EUR 86 million, bringing total cumulative commitments to EUR 403.7 million, 55.7% of which are in the private sector. It is encouraging that two projects were signed with foreign sponsors, despite a general perception about a difficult investment climate in the country (EBRD, 2006)

⁹ 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 runs for a seven-year period from 1st January 2007, and expires in 2013. It is designed to build on the achievements of its predecessor, working for the creation of a European Research Area, but also carries the work further, developing the knowledge economy and society in Europe (CORDIS, 2006)

¹⁰ See Chapter 8 List of Acronyms.

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 and 7th Framework Programme (SEE-ERA.NET, ERA-WEST-BALKAN and ERA-WEST-BALKAN Plus), and in WBC-INCO.NET which will further contribute to better and wider incorporation of the FYR of Macedonia into European scientific research and development activities. Also, the Ministry has already committed a special fund from its Budget for 2008 as a financial contribution of the FYR of Macedonia in the next proposal for SEE-ERA.NET Plus (Stefov, 2007; Sumanovska, 2007).

On 13th June 2007, the FYR of Macedonia (represented by Minister of Education and Science Sulejman Rushiti) signed a Memoranda of Understanding (MoU) with the European Commission (represented Commissioner Janez Potočnik) to enable the FYR of Macedonia to participate fully in the EU's Seventh Research Framework Programme (FP7). Associated status allows the FYR of Macedonia to participate in all calls for proposals, compete on an equal footing with the EU Member States for research co-operation and support actions funded by FP7. The Memorandum of Understanding entered into force on 13th June 2007, but it is applied as from 1st January 2007 (see-science.eu, 2007d).

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 as its main cooperation partners. In the FP6, 44 R&D projects were recorded (according to the evidence available from MES), with awarded grants amounting to a total of EUR 4.5 million. Several National Contact Points (NCPs) 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 and one workshop for all NCPs, which was facilitated by the experts from the agency *Welcomeurope* (Paier and Roediger-Schluga, 2006; Uvalic, 2006; Stefov, 2007; Sumanovska, 2007).

According to the published EU Commission Main List, up to 31st December 2007, 129 applications have been submitted by the FYR of Macedonia in the first calls for proposals in FP7 and 15 have been successfully evaluated for financing. The total amount for these funded projects is EUR 2,023,980 (Sumanovska, 2007).

In addition, for the implementation of FP7, 11 National Contact Points have been nominated for the areas of ICT, Food and Agriculture, Health, JRC, Ideas, Legal and Financial, NPM and SMEs, Energy, Environment, Infrastructure and Transport, SSH, People and SIS (Sumanovska, 2007).

IST2WEB, a project assisting the integration of scientists into the IST Programme of FP6 and SEE-INNOVATION (focusing 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.

The participation of Macedonian scientists in the COST Programme during the last three years has also significantly increased from five actions in 2003 to 31 actions in 2007 (Stefov, 2007; Sumanovska, 2007).

In 2007, the FYR of Macedonia took steps towards joining the pan-EU Network for Industrial R&D. This is just one of the activities aimed at strengthening the competitiveness of the country through support to businesses, research centres and universities and at improving innovative projects, processes and services, with the long-term goal of European integration. During the first EUREKA meeting held under the Slovenian Chairmanship, in Maribor (October 2007), the Former Yugoslav Republic of Macedonia joined as a cooperating NIP country (Sumanovska, 2007; see-science.eu, 2007c). One result of this meeting was the EUREKA Information Day on 30th January 2008 in Skopje, as organised by the Ministry of Education and Science. It is hoped that, having fulfilled all required conditions, the FYR of Macedonia can become a full member of the EUREKA Network (Sumanovska, 2007).

In the last few years, the MES has promoted a European-oriented science policy, as well as stimulating and assisting 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, totalling over one hundred bilateral projects. On 23rd July 2007, the FYR of Macedonia and Austria signed a scientific cooperation memorandum, which will provide further opportunity for the mobility of scientists and the existence of joint project proposals in FP7. It is the intention of the Macedonian MES to continue with its policy of widening and develop its scientific cooperation with other countries from the region and beyond (Stefov, 2007; Sumanovska, 2007).

The FYR of Macedonia has allocated a relatively high level of resources to international cooperation in the last few 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, 18 in 2005 and 23 in 2007), Bulgaria (9 in 2005, and 9 in 2006), Serbia (7 in 2005), Croatia (8 in 2005 and 8 in 2007), Albania (6 in 2006), Turkey (4 in 2005), France (3 in 2004) and Germany (2 in 2004) (Stefov, 2007; Sumanovska, 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.

All these activities are intended to facilitate the incorporation of the FYR 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 FYR of Macedonia should not have major difficulties in applying the *acquis* in the medium term" (Government of the Republic of Macedonia, 2005b).

For these purposes, the Ministry has adopted the Action Plan for 2008. According to the 2008 Government Programme, its implementation will be supported by the 34.97% increase in the budget for R&D (Sumanovska, 2007).

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 Eastern Europe. In 2007, a decision was made to transfer the responsibilities of the Stability Pact to locally managed bodies in the region. This decision came into force in Sofia, on 27th February 2008, when the Special Co-ordinator of the Stability Pact for South Eastern Europe, Erhard Busek, handed over the responsibility for regional cooperation in South Eastern Europe to the Regional Cooperation Council and its Secretary General, Hido Biscevic. The Regional Co-operation Council will play a key role in consolidating achievements of the Stability Pact to date and in making further progress in the different areas of co-operation. It will also continue to provide a platform for supporting further Euro-Atlantic integration of South Eastern Europe (Stability Pact for South Eastern Europe, 2008).

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 26th-27th June 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).

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 in the COST programme (Uvalic, 2006; Stefov, 2007).

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

- WIPO (World Intellectual Property Organisation)
- UNIDO (United Nations Industrial Development Organisation)
- WHO (World Health Organisation)
- 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)

The Norwegian Centre for International Cooperation in Higher Education 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 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, 2006).

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

2.2.2 Participation of the FYR of Macedonia in Education Programmes

The Trans-European mobility scheme for university studies (TEMPUS) programme is especially important for the higher education sector, which carries out most of the educational activities in the FYR of Macedonia. Within TEMPUS, during 1996-2006, there were 93 joint European projects, 23 structural and complementary measures, 10 compact measures, 333 individual mobility grants and 3 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) (Uvalic, 2006; Stefov, 2007). The FYR 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 (European Commission, 2000; Stefov, 2007; Sumanovska, 2007).

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 Directors-General of DG EAC, AIDCO, RELEX and ELARG have signed a Memorandum of Understanding (MoU) on the implementation of the fourth phase of the Tempus programme that will cover the period from 2007 - 2013. The Tempus IV programme will introduce some important novelties, will strengthen the role of EC Delegation in policy discussions, and will provide closer linkages with National Tempus Offices (Sumanovska, 2007).

Tempus IV finances two types of action through regular calls for proposals. Joint Projects are based on multilateral partnerships between higher education institutions in the EU and the partner countries. They can develop, modernise and disseminate new curricula, teaching methods or materials, boost a quality assurance culture, and modernise the management and governance of higher education institutions. Structural Measures contribute to the development and reform of higher education institutions and systems in partner countries, to enhance their quality and relevance, and increase their convergence with EU developments. The first call for proposals was issued in January 2008, with the deadline for submission of proposals on 28th April 2008. The total budget for this call amounts to approximately EUR 51 million in total, and for individual projects from EUR 0.5 to EUR 1.5 million (European Commission, 2008c).

For the academic year 2008/2009, new opportunities for students and higher education institutions are opened for students of the FYR of Macedonia through the Erasmus Mundus External Co-operation programme. The European Commission adopted a financing decision, which allows for the possibility of awarding a limited number of scholarships (Action 2) for nationals of the FYR of Macedonia who submit their applications to Erasmus Mundus Masters Courses selected under Action 1 for the academic year 2008/2009 (European Commission, 2008a; European Commission, 2008c).

In addition, the FYR of Macedonia has participated in the CEEPUS programme since 2006. This programme supports student and academic mobility in the countries from the South East European region (Sumanovska, 2007).

The FYR of Macedonia became a member of the Bologna Process in 2003, having begun the changes in the higher education system earlier on in 2000 when the Ministry of Education and Science passed the new Law on Higher Education. The Law requires universities to start introducing the ECTS and designing study and subject programs according to the principles of the Bologna Process. Updating of the laws, bylaws and other legal instruments in the field of higher education and in areas linked to its development, especially the financial legislation, legislation on labour and social security and movement of citizens will be necessary. The FYR of Macedonia pays special attention to development of the European dimension in higher education. Numerous modules, courses and curricula with European content have already been developed and implemented under the EC Tempus Programme, the Council of Europe, as well as some EU Member States through bilateral projects. However the main emphasis in the entire implementation of the Bologna Process needs to be placed on its level of quality (Macedonian Bologna Group, 2005). The commitment of the FYR of Macedonia to reforming its higher education system in compliance with the pledges declared in Bologna Declaration is very strong. The FYR of Macedonia has already endorsed a concept that fully corresponds to the needs related to joining the European integration process (Uzelac, 2006).

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 and the 2001 Ohrid Framework Agreement (between the FYR of Macedonia and Albania). In education, the decentralisation process started in July 2005 and the MES 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 in 2005. It was aimed at: promoting education for all; introducing reforms in all subsystems of education; increasing social partnerships, supporting activities of non-governmental and voluntary associations in the field of lifelong learning, linking formal and informal education, increasing the opportunities for educational mobility and raising adults' professional and social competences (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 (NAPE) 2004 - 2005 developed under the EU CARDS 2002 Employment Policy I project. While initially implementation proved to be difficult due to the lack of resources, gradually new IT equipment was provided and 11 pilot projects for active labour market measures (ALMMs) were funded.

This was followed by the CARDS 2004 Employment Policy II project, which assisted the ministry with the development of a National Employment Strategy (NES) 2010 and a new NAPE for 2006-2008. Two working groups were set up - one on policy-making and the other on administrative matters, intended to be permanent bodies for monitoring NES and NAPE implementation and its revision (ETF, 2006). A third Employment Policy project is currently being prepared.

In 2007, with a view to streamline and unite all pre-accession assistance in a single framework, the new Instrument for Pre-accession Assistance (IPA) replaced CARDS and the other pre-accession programmes (following an EU Council decision on 17th July 2006). As a candidate country to the EU, the IPA was open to the FYR of Macedonia. The four strategic areas that the IPA concentrates on are: supporting institution building; improving cross-border cooperation; preparing for participation in the Community's cohesion and rural development policy; and preparing for decentralised management of EU funds (European Commission, 2007b). The programme adopted by the Government of the FYR of Macedonia on 3rd April 2007 defined the activities that would be conducted in relations to the IPA funds and the strategic priorities for the start of the negotiation of its EU membership.

Another new law was introduced in 2007, establishing a national agency for the Youth in Action programme and the EU integrated Lifelong Learning programme. The latter programme consists of four sub-programmes: Comenius (for schools), Erasmus (for higher education), Leonardo da Vinci (for vocational education and training - VET) and Grundtvig (for adult education), as well as a transversal programme and the Jean Monnet programme. Further progress has been made towards implementing EU Lifelong Learning objectives through the amended law on secondary education provides that from the academic year 2008/2009 onwards, secondary education (including VET and general education for students aged 15-18), will become compulsory (European Commission, 2007b; European Commission, 2008b). It is expected that the FYR of Macedonia and Croatia will be the first countries in the South Eastern Europe region to have access to both of these programmes, depending on the full implementation of all educational reforms.

Further important actors involved in this field are the German Gesellschaft für Technische Zusammenarbeit, 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 (for example, the share spent in terms of the gross domestic product (GDP), volumes and growth rates) 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 contribute to the low investment rates in the R&D sector. Although financial assistance received from abroad is significant, it is not usually provided on a continuous basis (Uvalic, 2006).

The Unit for Technological development and technical culture (within the Department of Science and Technology of the MES) has responsibility for encouraging and supporting the technological development, innovation and culture of the FYR of Macedonia. This is done mainly through the application and development of research projects, innovative projects, support of technological infrastructure, programs and projects for the development of the technical culture and the promotion of this culture, directed, in particular, at the younger population. These activities are focused on (Sumanovska, 2007):

- encouragement and support of the cooperation between universities and the economy;
- fostering the application of the research results in the economy;
- improvement of the technological capacities of the enterprises in order to increase their competency on the market;
- training as a means of developing the technical, technological and informatics knowledge and skills of the young population;
- Progress in inventive works;
- Sharing the scientific and technological achievements among the young population;
- Support of the creative and scientific work;
- Technical education.

In addition, the Ministry publishes an annual call for proposals for co-financing of applicative and innovative projects to support the technological development of SMEs. It also contributes 30% of the total project value. The actions supported include (Sumanovska, 2007):

- development of the new products and technologies;
- improvement of the existing production processes;
- improvement of the quality of life regarding labour humanisation and environmental protection;
- building the improvement of the existing necessary technological infrastructure.

In the period 2002-2007, the Ministry financially supported about 150 projects. Since 1992, it has also financially supported the establishment of the Regional innovative centre in Stip and assistance and support of technological nucleus at the Faculty of Natural Sciences, Electro-technical Faculty and Faculty of Medicine (Sumanovska, 2007).

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, 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)¹¹. The most recent records show this percentage resting at 0.25% in 2004 and 2005 (UNESCO Institute for Statistics, 2006).

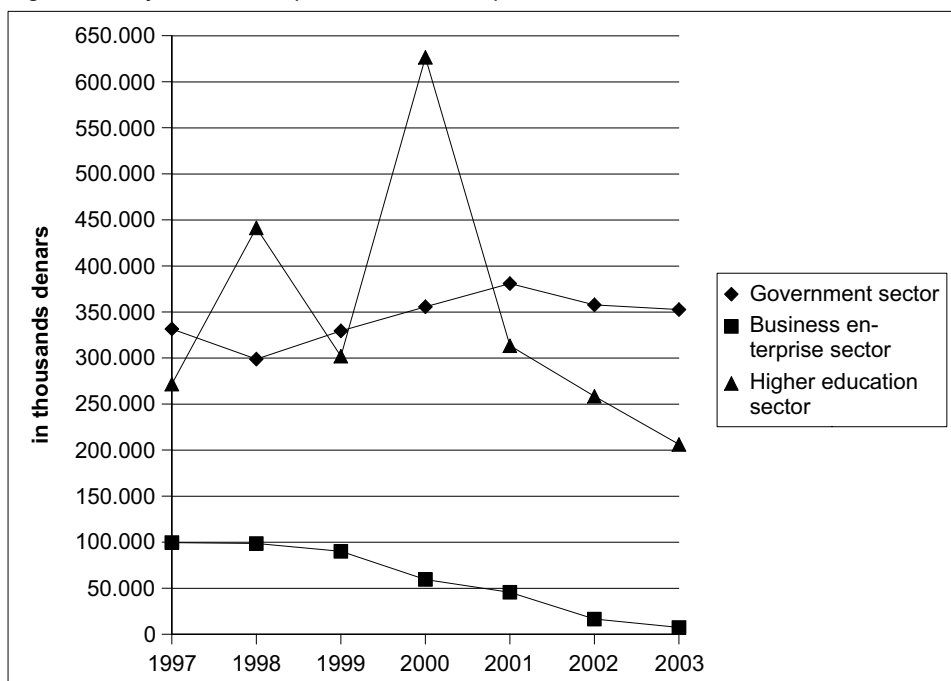
R&D intensity (R&D expenditure or investment as a proportion of GDP) provides a useful measure of how countries invest in R&D in relation to the value of their total production. It is important to stress that the question of the absolute volume of R&D investment and the level of R&D intensity is not only one of money. Both investment and intensity indirectly reflect - and are dependent upon - the availability of a sufficient stock of human resources (discussed in chapter 3.4), 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). In 2004 GERD was only 0.25% (INA - Great-IST, 2007).

Financial sources for R&D are provided by the government budget, as business enterprise funds were rather negligible and decreased after 1997¹². 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 Table 3.3 below). 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).

¹¹ EUR 13 million in 1997, EUR 17 million in 2000 and EUR 9 million in 2003.

¹² In Chapters 3.2, 3.1 and 3.3, 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 income that is more commercial and to 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).¹³

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).

¹³ Percentages differ between the sources. This report has used the data provided by Stefov (2007), data for 2005 by Sumanovska (2007).

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 the FYR of Macedonia between 1997 and 2003 is -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)¹⁴

	1997	2000	2003	2004	2005
Government Sector Expenditure (in thousands of denars)	331,524	355,567	352,518	314,762	325,602

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 1997-2003 (in Euro)¹⁵ (Uvalic, 2006).

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

Table 3.3: Ministry Budget for Science 2004-2006 (in Euro)¹⁶ (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

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

¹⁵ Source: Ministry for Education and Science

¹⁶ Source: Ministry for Education and Science

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-Eastern 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 2000). In the FYR of Macedonia, the level of BERD expenditure as a percentage of GDP was extremely modest - insignificant 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 Europe¹⁷ (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).

Table 3.4: Business Sector R&D Expenditure (BERD)¹⁸

	1997	2000	2003	2004	2005
Business Sector Expenditure (in thousands of denars)	99,464	59,445	7,294	38,954	85,314

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 EUR 5 million 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

¹⁷ Fischer has included Bulgaria and Romania in this calculation but not Albania and BiH – due to the lack of data.

¹⁸ Source: State Statistical Office, data for 2004 provided by Stefov (2007), data for 2005 by Sumanovska (2007)

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)¹⁹

	1997	2000	2003	2004	2005
Higher Education Sector Expenditure (in thousands of denars)	271,663	626,506	206,172	298,754	293,120

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 Sector²⁰

	1997	2000	2003	2004	2005
Government Sector	916	1,044	829	754	754
Business Enterprise Sector	370	241	67	136	158
Higher Education Sector	1,650	1,809	1,693	1,662	1,730
TOTAL	2,936	3,094	2,589	2,552	2,642

Among R&D personnel, a distinction is made between researchers (i.e. researchers, scientists and engineers - RSEs), technicians, and other support staff. According to Fischer (2006), 1990 researchers were working in the FYR of Macedonia in 2003²¹, 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).

¹⁹ Source: State Statistical Office, data for 2004 provided by data for 2004 provided by Stefov (2007)

²⁰ Source: State Statistical Office, data for 2004 provided by Stefov (2007), data for 2005 by Sumanovska (2007)

²¹ Source: State Statistical Office, data for 2004 provided by Stefov (2007), data for 2005 by Sumanovska (2007)

Table 3.7: R&D Personnel Total by Occupation²²

	1997	2000	2003	2004	2005
Researchers	2,088	2,246	1,990	1,887	1,988
Technicians and Equivalent Staff	382	397	228	306	309
Other Supporting Staff	466	451	371	359	345
TOTAL	2,936	3,094	2,589	2,552	2,642

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).

However, it is important to stress that RSEs 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 Fields²³

	1997	2000	2003	2004	2005
Natural Sciences	287	370	32 ²⁴	40	55
Engineering and Technology	850	674	594	632	639
Medical Sciences	710	632	735	758	792
Agricultural Sciences	388	418	392	380	478
Social Sciences	185	285	299	223	130
Humanities	516	715	537	519	548
TOTAL	2,936	3,049	2,589	2,552	2,642

²² Source: State Statistical Office, data for 2004 provided by Stefov (2007), data for 2005 by Sumanovska (2007)

²³ Source: State Statistical Office, data for 2004 provided by Stefov (2007), data for 2005 by Sumanovska (2007)

²⁴ Questionnaires from Faculty of Natural sciences and Mathematics were not received.

Table 3.9: R&D Personnel by Age²⁵

	1997	2000	2003	2004	2005
Below 29	147	203	152	119	122
30-59	2,169	2,254	1,905	1,932	2,000
Above 60	154	186	161	142	174
TOTAL	2,470	2,643	2,218	2,193	2,296

Table 3.10: Number of Students Enrolled in Tertiary Educational Institutions by Scientific Field²⁶

	1997	2000	2003	2004	2005
Natural Sciences	2,589	3,090	2,963	2,843	2,824
Engineering and Technology	8,450	8,825	9,143	9,125	10,468
Medical Sciences	3,224	3,388	3,639	3,788	4,588
Agricultural Sciences	2,468	3,270	3,228	3,140	3,407
Social Sciences	11,303	17,250	22,432	26,520	29,515
Humanities	4,014	4,423	5,232	3,948	6,209
TOTAL	32,048	40,246	46,637	49,364	57,011

Of the total number of students enrolled in tertiary education in the FYR of Macedonia, 54% are female and 46% are male (2006). 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 (Sumanovska, 2007).

The last statistical surveys for doctors of science (for 2006) show that during 2006, 85 persons have gained the title Doctor of sciences. The majority of candidates (32.9% - 28 candidates) received the doctorate in the field of social sciences, in humanities - 21 candidates (24.7%) and 10 candidates (11.8%) received their doctorate in the field of medical sciences. The rest gained their doctorate in the field of technical-technological sciences, natural-mathematics and biotechnical sciences. From the total number of the persons that have gained the title Doctor of sciences, 63 of them are working in University institutions, 10 persons are working in health care and social security services and other persons are working in construction and other activities. 49 women candidates (57.6%) gained the title Doctors of sciences in 2006 (State Statistical Office of the FYR of Macedonia, 2007).

According to the National Report on the Bologna Process, almost all doctoral candidates have research activities before defending the doctoral dissertation but the extent varies depending of their scientific commitment. The results of the research carried out by doctoral candidates are assessed and publicised by means of reviews, publication, scholar critiques, assessment of professional experts and application in practice (Uzelac, 2006).

Like other South Eastern European countries, the FYR of Macedonia also deals with the problem of brain drain. A joint UNESCO/Hewlett Packard (HP) project on piloting solutions for alleviating regional brain drain was implemented in 2003 in several Southeast European countries. By providing resources, including technological and financial facilities, to various universities, the initiative has enabled young scientists from the region to work within the framework of joint research projects with their fellow-nationals living abroad. The project

²⁵ Source: State Statistical Office, data for 2004 provided by Stefov (2007), data for 2005 by Sumanovska (2007)

²⁶ Source: State Statistical Office, data for 2004 provided by Stefov (2007), data for 2005 by Sumanovska (2007)

has provided grid technology to various universities from Albania, BiH, Croatia, the FYR of Macedonia, Serbia and Montenegro. Moreover, at the regional level, regular project meetings have also acted as a stimulus for transcending boundaries. Not only has the project strengthened scientific and educational capacities at the national level, it has re-established dialogue among young researchers from the region after years of broken communication. The networks created with UNSECO/HP support function autonomously, with the objective of sharing innovative experiences to help researchers from the region consolidate local capacities and undertake research beyond borders, without leaving their home countries permanently (Preda, 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 that are produced. Whereas indicators such as the Gross Expenditure on Research and Development (GERD) 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 such as patents and scientific papers.

4.1 Patent Activities in the FYR of 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 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. 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 the FYR of Macedonia²⁷ (EPO, 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).

²⁷ 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 1293 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 increased, especially during the last few years – from only 65 in 1997 to 388 in 2003.

Analysis by the Macedonian Office of Industrial Property shows that the industrial property rights are improving (see Table 4.1). The Macedonian Office of Industrial Property is promoting creativity and innovation through initiatives such as the International Intellectual Property day, the Patent of the Year, participation in international exhibition of ideas/inventions/new products, etc (Polenakovik and Pinto, 2007).

Table 4.1: Intellectual property rights (2001-2005)²⁸

	Year				
	2001	2002	2003	2004	2005
Total number of patent applications	125	241	435	452	436
National	65	44	47	44	53
Foreign	60	197	388	408	383
Total number of trademark applications	1186	1035	993	1056	1050
National	440	411	478	458	433
Foreign	746	624	515	598	617
Total number of industrial design applications	80	41	71	47	60
National	75	29	45	31	47
Foreign	5	12	26	16	13

Source: State Office for Industrial Property, Annual Report 2006.

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) (Hörlesberger, 2006).

²⁸ Source: Polenakovik and Pinto, 2007

4.2 Publication Activity in the FYR of Macedonia

The FYR of Macedonia is a member of the Cooperative on-line bibliographic system and services system (COBISS) 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 (1,659 in 2003, in comparison with 1,174 in 1997), though the number has since stagnated. There are, however, some scientific fields, for example, 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 4.2: Number of Articles Published (NSI data base) (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 the FYR of Macedonia, during 2004 and 2005, a complete database of publications from scientific journals with impact factors (journals referred in Science Citation Index and citations of institutions and researchers) was built up. A database of all patent activities in the country was also built (Stefov, 2007).

As an organisational unit within the St. Cyril and Methodius University, the Macedonian Academic and Research Network (MARNeT) was founded in 1994. Its primary mission is to organise and manage the only academic and research network in the country. MARNeT is also responsible for the provision of membership in international networking organisations and associations and participations in projects of interest for the academic community.

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 and innovation support. Furthermore, the legal framework and the strategies that 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, and so on.

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 the FYR of 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 processes²⁹ (Dall, 2005).

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:

Table 5.1: Overview of the Important Laws in the Legal S&T Framework of the FYR of Macedonia (Dall, 2005, 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 programming- and financing-related activities. Its goal is to foster and support the technological development at a national level, and to programme and fund these 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 Amendment and Supplement to the Law on Higher Education	In the line with the principles of the Bologna Process, it creates a legal framework for a system of higher education based on three cycles.
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
Law on Electronic communications	Presented in February 2005. Main goals are new foreign investments, protections of users, monopoly abolition, allowing competition and market liberalisation.
Law on Vocational Education and Training	The Law regulates the establishment, management, and operational aspects of vocational education institutions.

²⁹ 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 17th December 2005.

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 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 2006 (Ministry of Education and Science of Republic of Macedonia, 2005b). After the election of the new government on 5th July 2006, the drafts of the strategic and programmatic documents were still waiting to be approved.

Most of the West Balkan countries have adopted some laws (but not all) required for eGovernment, eCommerce and eBusiness infrastructure. Complete legislation in these areas is missing. The FYR of Macedonia still lacks digital signature infrastructure due to lack of five legislative documents (regulations) based on the Digital Signature Law adopted in 2001. Among them is the final document which defines the procedure for establishment of a company which can act as Certificate Authority (Gusev, 2006).

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 (Dall, 2005). According to the European Commission, little progress has been made concerning enforcement and there are still no reliable statistics. An operation led by the state market inspectorate led to almost 400 charges being brought under the Laws on Copyright and Related Rights and on Trade, and eleven criminal charges under the Law on Copyright and Related Rights. The State Market Inspectorate has urged the public to report any illegal sale or renting of pirated materials and has provided a toll-free number for this purpose. There are no developments concerning the seizure and destruction of equipment used to make pirated goods. Enforcement is lagging behind the legal framework (European Commission, 2007c).

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, 2005).

5.2 Main Documents Reflecting National Innovation Strategies

In many South East European countries and 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, 2005).

The process of becoming a European Union candidate country and starting membership negotiation 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 FYR 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 FYR of 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 and a provision of incentives for science through taxation policy, devising strict criteria for the selection of researchers in institutes. 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 and 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 FYR 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 that has been approved. 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; Government of the Republic of Macedonia, 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.

The National Economic Programme of the Government (2006 - 2010) sets also goals for the Science and Information Technology area. It states that Macedonian science needs encouragement and essential reform. Enhancement of scientific and research work will create conditions for keeping quality university educated personnel to stay in the country and using scientific-research activity in function of private sector development. The policy of the Government will be motivating for repatriation of scientific personnel from the diaspora. In this respect, the following reform measures and policies are anticipated (Government of the FYR of Macedonia, 2006): increase investments in scientific-research infrastructure to create basis for application of modern research methods; budgetary funds for scientific-research work in function of the private sector, following the example of more developed European countries; encourage and support science through fiscal policy; granting favourable and stimulating loans with payment deadlines up to 30 years for newly-weds with university education; promotion of cooperation with scientific-research institutions abroad for better knowledge transfer; establishment of strict and fair criteria for personnel selection in scientific research institutions; support of the cooperation between scientific-research institutions and economic institutions.

The basic preconditions for decreasing unemployment are economic revival, entry of private domestic and foreign capital, as well as investments in high quality and educated labour force. In this respect, improving the quality of IT education is of highest importance. Accordingly, the primary objective of the Government will be urgent and continuous investment in computer science and IT in order to keep pace with the modern information technologies in Europe and worldwide (Government of the FYR of Macedonia, 2006):

- setting up IT Ministry;
- computerisation of the FYR of Macedonia: supplying 50,000 inexpensive computers in cooperation with the private sector, partly as donations for schools and partly offering to citizens (at purchase price with instalment payment);
- wireless network installations and temporary usage of free Internet services throughout the country;
- wide-encompassing training in computer literacy, Internet usage and office administration programmes, as well as providing second hand computer equipment at acceptable prices;
- introduction of a mandatory IT subject in primary schools, as well as full computerisation of schools;
- implementation of an integrated medical information system and introduction of e-health card;
- digitalisation of the Cadastre and application of geographic-information system (GIS);
- promotion of non-cash payment, e-trade, e-banking and e-government.

Table 5.2: Main Documents Reflecting National Innovation Strategies for Research, Technological Development and Innovation (Dall, 2005; Stefov, 2007)

The National Economic Programme of the Government (2006 - 2010)	It sets many goals, among them as well those considering improvement on education, science, and informatics technology and e-society areas.
National Strategy for the Integration of the FYR 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 FYR 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 that 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 FYR of Macedonia 2005-2015	The National Programme is devoted to knowledge development and improvement and to the enhancement of living standards in the FYR 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.
Governmental Programme for Scientific Research 2006-2010	Includes focus on e-Business, e-Government, e-Education, e-Health, e-Citizenship (INA - Great-IST, 2007).

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, 2005). 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.

The goals of R&D policy are to (Georgievska, 2007):

- Increase the use and transfer of knowledge for economic, social, cultural and environmental development of the FYR of Macedonia;
- Encourage and promote international cooperation and transfer of knowledge from abroad;
- Introduce a monitoring and evaluation system of scientific and technological quality and output of research groups using internationally accepted standards and criteria;
- Increase the use of international funds, technical assistance, etc.;
- Define and establish interdisciplinary programmes for target research

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 FYR 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 FYR 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, (Dall, 2005, p. 207)

Sources: (Government of the Republic of Macedonia, 2005b; Ministry of Education and Science of Republic of Macedonia, 2005a; Popovski and 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.
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Policies and practices around ICT in FYR of Macedonia are still in very early stages. The internet penetration rate is among the lowest in Europe (estimated at 6.4%), while the lack of the overall capacity and access infrastructure results in the low uptake and the slow development of the ICT sector. The entire regulatory environment falls behind, followed by small number of users (private and public) and a very basic ICT-based service oriented culture. The broadband is nearly unheard of outside academic and business communities; in 2004, there were only 2,400 broadband users. Similarly, the number of ISPs in the country did not exceed 15 in 2005, of which very few were operational. The government should thus take robust action to develop the country's infrastructure, especially outside of the capital, and allow more competition to flourish - whilst at the same time create a national strategy to raise awareness of ICT opportunities (eGovernment, eBusiness, e-Health). Thus the major effort underway must not be hampered, the installation of routers and upgrading of connections to cities such as Ochrid, Bitola, Tetovo, Kumanovo and Stip must not be stalled (SBRA- Great-IST, 2007).

On 12th December 2006, new Government projects for IT development have been presented. The first Government project for increase of the degree in IT use envisages a computer for every pupil in 2007, while each citizen can buy one at the price of USD 100 in 12 instalments, stated Vice Premier Zoran Stavreski. He added that half of the funds have been provided from the 2007 budget, while the rest would be allocated from the 2008 budget, with a total project cost of EUR 20-22 million. Stavreski then pointed out that in the framework of the second project, all citizens and children throughout the FYR of Macedonia would be able to receive free training on basic computer skills, in partnership with the private sector. The third project in 2007-2008 will provide free Internet for citizens, while the fourth one, which was scheduled to begin in January 2007, should provide financial assistance for 5,000 students to study informatics at Macedonian faculties, 500 of whom to receive a 4-year fellowship in amount of Denar 5,000 per month (EUR 81.2). According to the Government, the realisation of these projects should make the FYR of Macedonia a leader in the Balkans regarding the level of IT use, supported by a number of international institutions (Government of the FYR of Macedonia, 2007b).

According to SBRA - Great-IST Report there are many developments in the ICT field for the FYR of Macedonia that show a positive trend: a new Law on Electronic communications; major effort to install routers and upgrade connections to cities other than Skopje, like Ochrid, Bitola, Tetovo and Stip; raise of the average speed of dial-up connections; entrance of the second mobile operator; great interest in investment by Slovenia, Greece, Bulgaria, Hungary and Austria; positive regional ICT trends and potential for a "spillover", innovation and

experimentation through peer networks and open communities of knowledge.

However there are some weaknesses and threats on the other side, for example: very limited IT market; especially lagging behind in areas such as electronic communication regulatory framework, e-government, e-business and e-health; large discrepancy between the normative regime and the actual state of affairs in the ICT domain; inaction concerning more robust broadband infrastructure development and uptake (SBRA- Great-IST, 2007).

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, 2005).

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, 2005).

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 and 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 and 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, 2005).

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

7 References

Barbutov, Z. (2004): Research and Development (R&D) in the Republic of Macedonia. Available from: <http://www.jrc.cec.eu.int/enlargement/events/20041026/presentations/barbutov-macedonia-20041026.pdf>, as accessed 20.03.2008.

CIA (2006): The World Factbook - Macedonia. Available from: <https://www.cia.gov/library/publications/the-world-factbook/geos/mk.html>, as accessed 20.07.2007.

Committee for Information Technology (2005): Activities of the Committee for Information Technology. Available from: <http://www.kit.gov.mk/default-en.asp>, as accessed 29.02.2008.

CORDIS (2006): Towards FP7. Available from: www.cordis.europa.eu/fp7/faq.htm, as accessed 03.08.2006.

Dall, E. (2005): National R&D Strategies of the Various Countries in Focus. In: Research and Development in South East Europe. Gesellschaft zur Förderung der Forschung.

EBRD (2006): EBRD Strategy for FYORM. Available from: <http://www.ebrd.com/about/strategy/country/mace/index.htm>, as accessed 14.03.2008.

EPO (2006): How to get a European Patent. Guide for applicants. Available from: http://www-european-patent-office.org/legal/guiapp1/pdf/g1en_net.pdf, as accessed 24.07.2006.

ETF (2006): ETF Country Analysis for IPA Programming in the Field of Human Resources Development 2006. Available from: [http://www.etf.europa.eu/pubmgmt.nsf/\(getAttachment\)/AE6E96B7D85AFB51C12571FF003AB174/\\$File/NOTE6UBEH9.pdf](http://www.etf.europa.eu/pubmgmt.nsf/(getAttachment)/AE6E96B7D85AFB51C12571FF003AB174/$File/NOTE6UBEH9.pdf), as accessed 11.02.2008.

Euro-Balkan Institute (2007): Euro-Balkan Institute. Available from: <http://www.euba.org.mk/eng/index.asp>, as accessed 04.07.2007.

European Commission (2000): Tempus III (2000-2006). Available from: <http://europa.eu/scadplus/leg/en/cha/c11020c.htm>, as accessed 20.07.2006.

European Commission (2007a): Candidate and Pre-accession Countries Economies Quarterly. Available from: http://www.esiweb.org/pdf/montenegro_EC-preaccession%20economic%20quarterly-jul2007.pdf, as accessed 20.03.2008.

European Commission (2007b): The Former Yugoslav Republic of Macedonia 2007 Progress Report. Available from: http://ec.europa.eu/enlargement/pdf/key_documents/2007/nov/fyrom_progress_reports_en.pdf, as accessed 11.02.2008.

European Commission (2007c): Relations with the former Yugoslav Republic of Macedonia. Available from: http://ec.europa.eu/enlargement/the_former_yugoslav_republic_of_macedonia/eu_the_former_yugoslav_republic_of_macedonia_relations_en.htm, as accessed 11.02.2008.

European Commission (2008a): Erasmus Mundus - Opportunities for Students (Actions 2 and 3). Available from: http://ec.europa.eu/education/programmes/mundus/student/scholar_en.html, as accessed 15.03.2008.

European Commission (2008b): Lifelong Learning Programme (LLP). Available from: http://ec.europa.eu/education/programmes/llp/index_en.html, as accessed 11.02.2008.

European Commission (2008c): Scholarships to students from the Western Balkans and participation in Community programmes and agencies. Available from: <http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/08/140&format=HTML&aged=0&language=EN&guiLanguage=en>, as accessed 15.03.2008.

Fischer, M. (2006): The Input Side of the National Innovation Systems. In: Research and Development in South East Europe. Gesellschaft zur Förderung der Forschung.

Georgievska, E. (2007): Research and Development Indicators in the Republic of Macedonia. Available from: http://www.uis.unesco.org/ev.php?ID=6891_201&ID2=DO_TOPIC, as accessed 21.03.2008.

Government of Macedonia (2006): Programa za rabota na vladata na Republika Makedonija vo periodot od 2006-2010. Available from: <http://www.vlada.mk/Assets/PROGRAMA%20ZA%20RABOTA%20NA%20VLADAT A-MAK.pdf>, as accessed 20.02.2008.

Government of the FYR of Macedonia (2006): Programme of the Government of the Republic of Macedonia (2006-2010). Available from: <http://www.vlada.mk/assets/program%20of%20the%20government%202006-2010.pdf>, as accessed 11.02.2008.

Government of the FYR of Macedonia (2007a): National Research Landscape. Available from: http://www.see-science.eu/attach/1417_NationalResearchLandscape.pdf, as accessed 21.03.2008.

Government of the FYR of Macedonia (2007b): News. Available from: http://www.vlada.mk/english/index_en.htm, as accessed 11.02.2008.

Government of the Republic of Macedonia (2005a): National Strategy for Information Society Development and Action Plan. Available from: <http://www.kit.gov.mk/WBStorage/Files/National%20Strategy.pdf>, as accessed 17.08.2005.

Government of the Republic of Macedonia (2005b): Questionnaire for the preparation of the European Commission's Opinion on the application for membership of the European Union: FYROM. Available from: <http://www.sei.gov.mk/questionnaire>, as accessed 18.03.2008.

Gusev, M. (2006): Gap Analysis of eGovernment in Western Balkans. Available from: http://www.metamorphosis.org.mk/index.php?option=com_docman&task=doc_details&gid=21&Itemid=16&lang=en, as accessed 11.02.2008.

Hörlesberger, M. (2006): The Output Side of the National Innovation Systems. In: Research and Development in South East Europe. Gesellschaft zur Förderung der Forschung.

INA - Great-IST (2007): The Great-IST Final Report. Available from: <http://www.great-ist.org/docs/GREAT-IST%20Deliverable%20D6.4%20Final%20Report.pdf>, as accessed 25.03.2008.

Kobal, E. (2005): Elements of National Science and Technology Policy. In: Modernisation of Science Policy and Management Approaches in Central and South East Europe. E. Kobal and S. Radosevic, IOS Press: 13-18.

Macedonian Bologna Group (2005): National Report 2004-2005. Available from: http://www.bologna-bergen2005.no/EN/national_impl/00_Nat-rep-05/National_Reports-FYROM_050107.pdf, as accessed 11.02.2008.

Mascarell, C. (2007): The Macedonian Community Development Project: Empowerment through Targeting and Institution Building. Available from: <http://siteresources.worldbank.org/SOCIALPROTECTION/Resources/SP-Discussion-papers/Social-Funds-DP/0710.pdf>, as accessed 11.02.2008.

MASIT (2007): About us. Available from: <http://www.masit.org.mk/?About%20MASIT>, as accessed 05.07.2007.

Ministry of Defence of the Republic of Macedonia (2003): National Security and Defence Concept of The Republic of Macedonia. Available from: <http://www.morm.gov.mk/english/nationalconcept.htm>, as accessed 18.03.2008.

Ministry of Education and Science of Republic of Macedonia (2005a): Questionnaire for SEE-ERA.NET - Former Yugoslav Republic of Macedonia.

Ministry of Education and Science of Republic of Macedonia (2005b): towards the european higher education area bologna process - National Report 2004-2005. Available from: http://www.bologna-bergen2005.no/EN/national_impl/00_Nat-rep-05/National_Reports-FYROM_050107.pdf, as accessed 18.08.2005.

Ministry of Environment and Physical Planning of the Republic of Macedonia (2005): Environmental Policy and the Science.

Ministry of Foreign Affairs of the FYR of Macedonia (2006): List of International Organisations of universal character in which the Republic of Macedonia has a member status. Available from: http://www.mfa.gov.mk/ministerstvo_en.asp?idMeni=6&idKategorija=20, as accessed 20.07.2006.

OECD (2001): Thematic Review of National Policies for Education - FYRoM. Stability Pact for South Eastern Europe Table 1: Task Force on Education. Available from: [http://www.oecd.org/OLIS/2001DOC.NSF/LINKTO/CCNM-DEELSA-ED\(2001\)7-FINAL](http://www.oecd.org/OLIS/2001DOC.NSF/LINKTO/CCNM-DEELSA-ED(2001)7-FINAL), as accessed 20.03.2008.

OECD (2006): Summary of the key macroeconomic indicators in Southeast Europe. Available from: <http://www.investmentcompact.org/dataoecd/50/16/36758426.ppt>, as accessed 20.09.2007.

Paier, M. and Roediger-Schluga, T. (2006): Cooperation with Austrian Enterprises and Research Organisations. In: Research and Development in South East Europe. Gesellschaft zur Förderung der Forschung.

Polenakovik, R. and Pinto, R. (2007): The National Innovation System and its Relation to Small Enterprises - the Case of the FYR of Macedonia.

Popovski, Z. T. (2005): EU-Macedonia R&D cooperation. Presented at: TRIBINA: Predizvici i senki na naukata - Kakva nauka bara EU?, Macedonian Academy of Science and Arts.

Popovski, Z. T. and Stefov, V. (2005): Research and Development (R&D) in the Republic of Macedonia. In: Modernisation of Science Policy and Management Approaches in Central and South East Europe. E. Kobal and S. Radosevic, IOS Press: 61-67.

Preda, G. (2007): Southeast Europe turns "brain drain" into "gain". Available from: http://www.setimes.com/cocoon/setimes/xhtml/en_GB/features/setimes/articles/2007/06/25/reportage-01, as accessed 20.03.2008.

Radosevic, S. (2005): Transformation of Research and Innovation Policy in New EU Member and Candidate Countries: What Can We Learn from It? Modernisation of Science Policy and Management Approaches in Central and South East Europe. E. Kobal and S. Radosevic, IOS Press: 29-38.

Roland Berger Market Research (2004): Study on the Cost of Patenting in Europe, on behalf of the European Patent Office.

SBRA- Great-IST (2007): Links between IST research and business: impact assessment and recommendations. Available from: <http://www.great-ist.org/docs/GREAT-IST%20D5.2%20final.pdf>, as accessed 20.03.2008.

Schuch, K. (2006): Austrian Cooperation Policy in R&D. In: Research and Development in South East Europe. Gesellschaft zur Förderung der Forschung.

see-science.eu (2006): General Info: What is IPA? eJournal of the SEE-science. Available from: <http://www.see-science.eu/ejournal/519.html>, as accessed 20.03.2008.

see-science.eu (2007a): EU and Western Balkans Countries sign visa deal. Available from: <http://www.wbc-inco.net/news/2300.html>, as accessed 18.02.2008.

see-science.eu (2007c): EUREKA Expanding Towards the Western Balkan Countries. Available from: <http://www.see-science.eu/news/2624.html>, as accessed 11.02.2008.

see-science.eu (2007d): Celebrating Association to FP7. Available from: <http://www.see-science.eu/news/1939.html>, as accessed 29.01.2008.

Simeonova, K. (2006): Models of Science Policy and their Impact on Scientific Communications. In: Science Policy and Human Resources Development in South-Eastern Europe in the Context of European Integration.

SIU (2006): Projects funded under the SIU (Norwegian Centre for International Cooperation in Higher Education). Available from: <http://www.siu.no>, as accessed 20.07.2006.

Small and Medium Size Enterprise Development (2005): Revised National Development Strategy for Small and Medium Sized Enterprises 2006-2012. Technical Assistance to support Ministry of Economy and SME support infrastructure.

Stability Pact for South Eastern Europe (2008): Press Release - Stability Pact for South Eastern Europe passes baton to Regional Cooperation Council. Available from: <http://www.stabilitypact.org/pages/press/detail.asp?y=2008&p=662>, as accessed 15.03.2008.

State Statistical Office of the FYR of Macedonia (2007): Statistical survey. Available from: http://www.stat.gov.mk/english/statistiki_eng.asp?ss=06.01&rbs=7, as accessed 20.03.2008.

Stefov, V. (2007): Review of the S&T Report in January 2007. see-science.eu.

Sumanovska, K. (2007): Review of the S&T Report in December 2007. see-science.eu.

The Euro-Regional Technology Center - Bitola (2004): The Euro-Regional Center - Bitola. Available from: <http://www.unet.com.mk/best/summer04/?vidi1=academic>, as accessed 4.03.2008.

UNESCO Institute for Statistics (2006): Statistics on Research and Development. Available from: <http://stats.uis.unesco.org/unesco/ReportFolders/ReportFolders.aspx>, as accessed 11.02.2008.

UNESCO Office Venice (2004): Science and Technology in the Republic of Macedonia. Available from: http://portal.unesco.org/en/ev.php-URL_ID=22537&URL_DO=DO_TOPIC&URL_SECTION=201.html, as accessed 11.02.2008.

Uvalic, M. (2006): National Systems of Research and Development in the Western Balkan Countries. Available from: <http://www.see-science.eu/doc/1546.html>, as accessed 20.03.2008.

Uzelac, N. (2006): Bologna Process National Report: 2005-2006. Available from: http://www.see-science.eu/attach/1408_CountryReportonBolognaProcessFYROM.pdf, as accessed 11.02.2008.

8 List of Acronmys

ALMMs	Active Labour Market Measures
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
CIA	Central Intelligence Agency
CIT	Committee for Information Technology
COBISS	Cooperative On-line Bibliographic System and Services
CORDIS	Community Research and Development Information Service
COST	“Co-operation in Science and Technology” Programme
DG EAC	Directorate General for Education and Culture
DG AIDCO	Directorate General for External Cooperation Programmes
DG RELEX	Directorate General for External Relations
DG ELARG	Directorate General for Enlargement
EC	European Commission
ECTS	European Credit Transfer and Accumulation System
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
FAO	Food and Agriculture Organisation
FP6	Sixth EU Framework Programme for R&D
FP7	Seventh EU Framework Programme for R&D
FYR	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
ICCROM	International Organisation for Conservation of National Heritage
ICT	Information and Communication Technology (also acronym for the related FP7 'Cooperation Programme' theme)
IFAD	International Fund for Agricultural Development
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"
ISP	Internet Service Provider
IST	Information Society Technologies (Programme line in FP6 - in FP7 it changed to ICT)
ITU	International Telecommunication Union
IZUM	Slovenian Institute of Information Sciences
JICA	Japan International Cooperation Agency
JRC	Joint Research Centre
MARNET	Macedonian Academic Research Network
MASA	Macedonian Academy of Sciences and Arts
MASIT	Macedonian Association for Informatics Technology
MES	Ministry of Education and Science
NAPE	National Action Plan for Employment
NATO	North Atlantic Treaty Organisation
NCP	National Contact Point
NES	National Employment Strategy
NGOs	Non-governmental Organisations
NPM	"Nanosciences, Nanotechnologies, Materials and new Production Technologies" (Programme Line in FP7/Cooperation)
OECD	Organisation for Economic Cooperation and Development
OIML	International Organisation of Legal Metrology
OSCE	Organisation for Security and Co-operation in Europe
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
SBRA	Slovenian Business Research Association
SCI	Science Citation Index

SEE	South Eastern Europe
SEE-ERA.NET	FP6 project "Southeast 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 Centre for International Cooperation in Higher Education
SMEs	Small and Medium Size Enterprises
S&T	Science and Technology
SIS	"Science in Society" (Programme Line in FP7/Capacities)
SSA	Specific Support Action (activity in the Framework Programmes)
SSH	"Socio-economic Sciences and the Humanities" (Programme Line in FP7/Cooperation)
STI	Science, Technology and Innovation
TEMPUS	Trans-European Mobility Scheme for University Studies
UATIM	Union of the Inventors and Authors of Technical Improvements of Macedonia
UN	United Nations
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
WB	Western Balkans
WBC	Western Balkan countries
WHO	World Health Organisation
WIPO	World Intellectual Property Organisation
WMO	World Meteorological Organisation
ZSI	Centre for Social Innovation (Zentrum für Soziale Innovation), Austria

Annex I - List of Further Institutes

Research Centre 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 the 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
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	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 %

Institution	Total number of articles	Abstracts	Works published as whole articles	Participation of Institution in the total number of articles published as whole articles
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	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 %

Institution	Total number of articles	Abstracts	Works published as whole articles	Participation of Institution in the total number of articles published as whole articles
- 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 %

Institution	Total number of articles	Abstracts	Works published as whole articles	Participation of Institution in the total number of articles published as whole articles
- 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 %