ENLARGEMENT PROJECT

S&T Institutions and S&T Policies in the EU Acceding Countries

Challenges for the development of the Knowledge Based Economy

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S&T Institutions and S&T Policies in the EU Acceding Countries

Challenges for the development of the Knowledge Based Economy

Blaž GOLOB

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Table of Contents

PREFACE

This report is the result of desk research carried out by Blaž GOLOB during his stay in the IPTS as a detached national expert and will be published in the Enlargement Futures Report Series of the JRC-IPTS Enlargement project. The aim of the project was to identify and analyse the techno-economic and social challenges which the present and future Member States of the European Union would be likely to face in the process of integration during the next decade. It has started from a broad brush outlook on the main drivers of change, specific to this process, and has analysed ways to achieve and balance the EU's targets of competitiveness and sustainability. In doing so the project has benefited from the active involvement of experts from the acceding and candidate countries. The main focus has been the integration of their countries in the Lisbon process which aims to make the EU the most dynamic knowledge-based economy in the world by 2010.

A first attempt is made in this report to take stock of the research capacities in the accession countries. The country profiles in this report provide a breakdown of the number of researchers by sector: business, government and higher education. Although research output is difficult to measure, an indication of scientific performance is given by the number of publications, properly scaled by population size. Finally, each country's institutional framework for S&T policy-making is briefly described and information is provided on the main political initiatives in the S&T field.

Andries BRANDSMA

ACKNOWLEDGEMENTS

The author would like to thank his colleagues from the IPTS, in particular Gustavo FAHRENKROG, Andries BRANDSMA, Mark BODEN, Ken DUCATEL, Tibor DORY, Constantin CIUPAGEA and Corina PASCU, who all contributed to the study and the preparation of this report, and to Els de RADEMAEKER for editorial assistance. Furthermore the author would like to thank his colleagues from the IPTS that participated in the IPTS internal seminar "Towards the Knowledge Based Economy in the EU Acceding Countries" held on June 17th, 2003.

The author would like to thank the following experts from EU Acceding and Candidate Countries: the country-specific parts of the report benefited substantially from contributions and comments by Mrs. Albena VUTSOVA and Dr. Elisaveta GOUROVA from Bulgaria; Prof. Costas CONSTANTINOU from Cyprus, Dr. Karl AIM from the Czech Republic, Ms. Marek TIITS from Estonia, Dr. Andras SIEGLER, Dr. Tamas BALOGH from Hungary; Prof. Andrejs SILINS from Latvia, Dr. Antanas CENYS from Lithuania; Dr. Jennifer CASSINGENA HARPER from Malta; Dr. Jan KOZLOWSKI and Prof. Jerzy LANGER from Poland; Dr. Victoria CAMPEANU and Dr. Liviu VOINEA from Romania; Mr. Dusan VALACHOVIC from the Slovak Republic; Dr. Miloš KOMAC from Slovenia; and Prof. Turgut TUMER and Dr. Erol TAYMAZ from Turkey.

Blaž GOLOB

INTRODUCTION

The Enlargement of the European Union presents a great challenge for key players in the field of S&T policy making in Europe. The enforcement of the Lisbon / Gothenburg / Barcelona process, the launch of the European Research Area and the e-Learning initiative will provide a period of opportunity for the building up of the Knowledge Based Economy. An important and relevant part for the development of the Knowledge Based Economy in the coming years is the renewal of a science and technology (S&T) base in an enlarged Europe.

The EU membership negotiations have been concluded with the **Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovak Republic and Slovenia**: those countries are called **"Acceding countries"**[1] during the intermediary period between the end of negotiations and effective membership. These countries will join the EU on 1st of May 2004. At present there are three "Candidate countries": **Bulgaria and Romania**, with which negotiations are going on that offer them the prospect of membership in 2007, and Turkey, with which accession negotiations may start in December 2004 if it fulfils the Copenhagen political criteria[2]. Further in the report for practical reasons we use the ''EU Acceding countries'' terminology for all thirteen countries, sometimes abbreviated as "CCs".

The EU Acceding Countries[3] are committed to take part in policy actions and open co-ordination mechanisms[4] which aim to contribute to the Lisbon / Gothenburg / Barcelona process. Many of the EU Acceding Countries prepare or have already adopted policies and strategies in line with the above-mentioned process[5]. During the transition period CCs have gained substantial experience and knowledge about different types of S&T policies and programmes, which constitute a basic knowledge platform for future S&T policy making.

The aim of the "S&T Institutions and S&T Policies in the EU Acceding Countries" study & report is: to present the current state-of-the-art of the investment and performance for the Knowledge Based Economy in the EU Acceding Countries; to identify relevant S&T institutions and other key players that are important for the S&T policy making; and to present relevant S&T policies and strategies according to the policy making analysis of the each of the EU Acceding Countries. The study / report is complementary to the IPTS Staff Working Paper on challenges of the 3% target of the Lisbon / Gothenburg / Barcelona process[6].

[1] : European Commission, 2003. Choosing to grow: Knowledge, innovation and jobs in a cohesive society. Report to the Spring European Council, 21 March 2003 on the Lisbon strategy of economic, social and environmental renewal. COM(2003) 5 final, p.21. EC, Brussels

[2] Geographically speaking thirteen countries included in the report are: The **Baltic republics** of Estonia, Lithuania and Latvia; The **Mediterranean countries** Turkey, Malta and Cyprus; The **Central European** ones Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia (Source: European Commission 2003).

[3] All 13 Countries together are called the EU Candidate Countries

[4] 'Open Method of Coordination" - Lisbon European Council 2000

[5] For more details see Seminar Output – Main Points Arising; E.U. Candidate countries and the 3% of GDP target for R&D – challenges and actions ; Informal Seminar Report; Brussels, 5th March 2003 (Rapporteur: DG JRC IPTS Seville)

[6] See Annex II. of the study / report

State-of–the-art of the investment and performance for the Knowledge Based Economy in the EU Acceding Countries

Statistical data show that there is a positive correlation between the basic indicators of investment and performance for the Knowledge Based Economy and GDP per capita. On this basis, it is not surprising that EU Acceding Countries on average demonstrate lower levels of basic indicators such as GERD and BERD, when compared to other countries where the level of GDP is much higher. Many of the EU Acceding Countries have undergone declines in the level of R&D investment at least up to 2001[7]. The trend for public R&D expenditure was negative for Romania till 1999 (recession period) and Slovakia (till 2000), and the trend on the business expenditure on R&D up to 2000 was negative for Bulgaria (recession period), Lithuania, Poland and Slovakia.

A closer look and analysis of the negative trends is needed for at least two reasons:

- To raise the awareness of policy makers in the EU Acceding Countries of the need for increased competitiveness, and therefore, of the importance of the Barcelona R&D target and the Lisbon objective. This action will help to ensure that the countries will switch from wish-list in the area of R&D to real R&D public support measures

- To define a more precise set of evaluation criteria of the R&D efforts within an economy, as a base for an assessment of competitiveness. These evaluations will serve discussions with current and future EU Member States on the Barcelona targets.

The attempt to increase the level of R&D investment is also dependent on the availability of numbers and quality of human resources. The research capacity went into decline during the transition period in the EU Acceding Countries. The poor conditions of the state-of-the-art research and the low level of salaries discouraged many young people to continue their career as researchers.

The country reports contain statistics available for all CCs and some more specific information for each country. They make no attempt to cover all indicators (*structural indicators*) that are relevant for the development of the Knowledge Based Society. Nevertheless the country profiles provide a clear indication of the relative strengths and weaknesses of each country.

S&T Governance in the EU Acceding Countries – S&T Institutions and S&T Policies

An important problem among the EU Acceding Countries is an underdeveloped system of S&T governance (see also the IPTS Staff Working Paper[8] reproduced in Annex 2). This refers to the mix of formal and informal institutions, mechanisms and procedures for managing S&T infrastructure, designing, delivering, selecting and evaluating S&T policy programmes. The formulation and delivery of policy is hindered by a lack of appropriate procedures and institutions, through which to channel different interests and lobby positions, and balance all relevant inputs in the interest of the best possible policy decisions. Several countries have placed technology funds under the

[7] According to the November 2002 European Innovation Scoreboard

[8] **IPTS Staff Working Paper - Background Document; What specific challenges does the 3% target raise for Candidate Countries, and what actions should be undertaken to address these challenges**? EU Candidate Countries and the 3% of GDP target for R&D – challenges and actions, Seminar held under the auspices of DG RTD K- Knowledge Based Economy and Society - March 2003

management of intermediaries. Funding for industrial R&D centers or centers of excellence is provided either by ministries for science and education or by ministries for economy or industry[9].

The following deficiencies in the area of Research and Innovation are perhaps more typical for the CCs than for the Member States:

- A frequent lack of integration between research agendas and economic policy
- Poor operational links between innovation system actors
- Lack of regional level co-ordination of R&I measures
- Poor integration of stakeholders in the determination of R&I priorities (especially SMEs)
- Imbalance between demand-side issues and supply side interests in setting research agendas
- Major gaps between political rhetoric and action/ effort/ outcomes/ resources available
- A deficit of think-tank and policy research, policy evaluation competence and tradition.
- A deficit of innovation management capacity, innovation-management oriented training and education (for policy and private sector purposes)

Nowadays attention should be oriented to further encourage the use of participative processes for debating and identifying areas for priority action, not only at national level, but also regional and sectoral level. Processes should also involve the broad S&T and innovation stakeholder community. (Foresight is an example of a participative approach to S&T vision and network building which can help 'wire–up' the innovation system, and compensate for formal institutional deficits.) Attention should also be given to corrective action on the deficits in policy inputs (research, evaluation) and economy wide innovation management competence. Today several EU Acceding Countries have adopted policies and programmes related to the development of the Knowledge Based Economy embedded in their National Development Plans. In recent years the EU Acceding Countries also gained substantial experiences and knowledge of different types of S&T policies and strategies and they also have different experiences with the functioning of the S&T institutions.

The aims of the following "S&T Institutions and S&T Policies in the EU Acceding Countries" study / report are:

- To present the state-of-the-art of the investment and performance for the Knowledge Based Economy (KBE) in each EU Acceding Country;
- To identify relevant S&T institutions and other key players that are important for the S&T policy making in each country;
- To present relevant S&T policies and strategies according to the policy making analysis of the each of the EU Acceding Country.

The necessary resources, investment and performance, allocated to the development of the Knowledge Based Economy are important in as much as the proper functioning of the S&T institutions. Throughout the effective S&T institutions the specific S&T policies are delivered in order to contribute to the development of the Knowledge Based Economy. Every country has its own specifics for S&T policy making due to historical experiences, cultural and public understanding of science, general economic development of a country and its international and regional positioning. Due to the multicultural aspect and different levels of development of countries and regions in Europe, every country could contribute, with its specifics, to the future development of the Knowledge Based Economy in an enlarged Europe.

[9] EC (2002) Innovation Policy in Europe 2002. European Trend Chart on Innovation

CHAPTER 1: Republic of BULGARIA

COUNTRY PROFILE[10]

Area:	110,993 km^2
Population (2001):	8,149,500
GDP/capita (PPS; 2001):	6,500 Euros
GDP growth (2000):	5.8%
Unemployment rate (2000):	16.2%
GERD as a % of GDP (1999):	0.57%

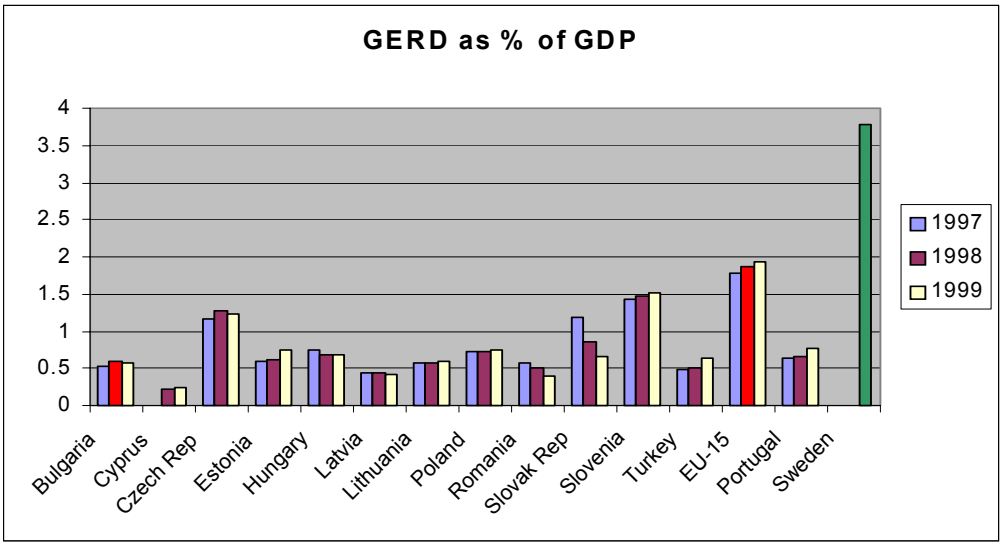
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

I. BASIC INDICATORS OF INVESTMENT AND PERFORMANCE for THE KNOWLEDGE BASED ECONOMY in BULGARIA

A. R&D INVESTMENT AND HUMAN RESOURCES IN S&T

Since the 1996-97 crisis, the country has achieved macro-economic stability and has a stable currency board, low basic interest rate, and substantial foreign-exchange reserves. Real economic growth significantly accelerated from 2.4 percent in 1999 to 5.8 percent in 2000, and this trend has been confirmed by the latest 2001 data (4.5 percent in the first quarter).

Figure 1: GERD as a % of GDP in the EU Candidate Countries – Bulgaria (1997, 1998, 1999)



Source: EUROSTAT, European Commission DG Research

Table 1: GERD in Bulgaria (1999)

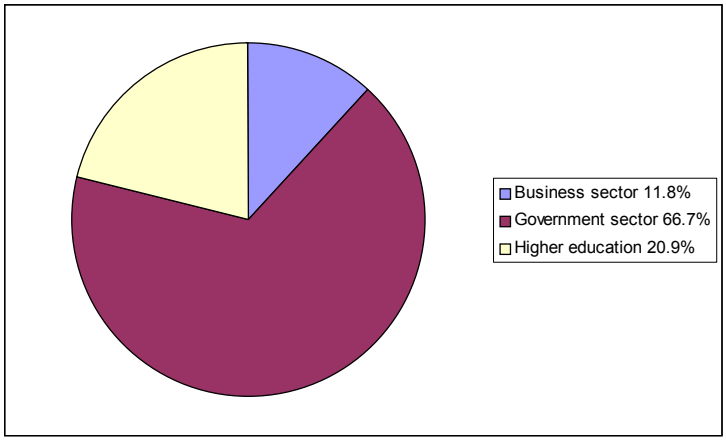
GERD as % of GDP	0.57%	1.93% (EU 15)
GERD financed by business:	22.8%	56.3% (EU 15)

Source: EUROSTAT, European Commission DG Research – Key Figures 2002

[10] The author would like to thank Mrs Albena VUTSOVA Director at the Ministry of Education and Science of the Republic of Bulgaria and Ms Elisaveta GOUROVA Research Fellow at the EC JRC/IPTS for their contributions and comments. Nevertheless the author takes full responsibility for the content of this country analysis.

An important step towards the improvement of the financing of R&D was the introduction of the National Framework for the development of science and research.[11]

Figure 2: Researchers in % by sector in Bulgaria (1999)



Source: EUROSTAT, European Commission DG Research – Key Figures 2002

Total R&D personnel in Bulgaria were 16.087 people in 1999, which represented 0.47% of the labour force in Bulgaria. The distribution of researchers across government, business and the higher education sectors indicates where the capacity to produce and absorb knowledge can be found. The strongest capacity in Bulgaria is in the governmental sector, employs 66.7% of researchers. The business sector employs only 11.8%, which is behind the EU average of 50% employment of researchers in the business sector. Regarding the gender balance Bulgaria is above the EU (30%) average with 44% of female researchers.

Table 2: Human Resources in S&T in Bulgaria (1999)

Type of researchers	Number of researchers	EU total number or EU average in %	Type of researchers as % of labour force
Total number of R&D personnel	**16,087**	1,689,490	0.47%
Number of female R&D Personnel	8,374	-	0.24%
Full-time equivalent (FTE) Total	10,580	919.796	0.31%
Full-time equivalent (FTE) Female	4,656	30%	0.13%
Business sector	**1,248**	**50%**	**0.03%**
Government sector	7,056	14.2%	0.2%
Higher education Sector	2,211	34.3%	0.06%

Source: EUROSTAT, EC DG Research – Key Figures 2002, EC DG Employment and IPTS additional calculation[12].

[11] National Framework for the development of science and research in Bulgaria, 2001. The aim of the programme is to support an annual growth of 0.15% of GERD/GDP. With the implementation of the programme Bulgaria can improve its current position in the field of R&D investment performance.

[12] Labour force in Bulgaria (1999): 3,389,170 – EC DG Employment.
EU-15 (1999): 5.63 researchers (FTE) per 1000 in the labour force (head count).

B. S&T and ECONOMIC PERFORMANCE for THE KNOWLEDGE BASED ECONOMY in BULGARIA

Figure 3: Scientific Performance (publications per million population (1999))

Bulgaria	EU 15	Sweden	Portugal
185	755	1657	333

Source: EUROSTAT, EC DG Research – Key Figures 2002

Bulgaria is lagging behind the EU average and the EU minimum in the field of scientific performance however, the above mentioned figures show that there is a great potential of human resources and a potential for further development of knowledge production measured by scientific performance. The difference between EU average and Bulgaria in the production of scientific knowledge is also bigger than might be a real capacity of the country.

According to the **European Trend Chart on Innovation 2002**[13] the relative weaknesses of Bulgaria are in the field of current business expenditure on R&D, patents applied at the European Patent Office, and the level of internet access of the population. There is also a weakness in the trend for business expenditure on R&D. On the other hand major strengths in innovation are in internet access and inward FDI.

Table 3: S&T and Economic Performance of Bulgaria

GDP per capita in Euros (PPS; 2001):	**6,510**	**23,200 (EU15)**
GDP average annual growth (1995-2000):	**-0.83%**	**2.63% (EU15)**
Patents per million (1999):	**3**	**126 (EU15)**
Publications per million (1999):	**185**	**755 (EU15)**
High-tech exports, as % of total exp.(1999):	**2.3%**	**19.7% (EU15)**

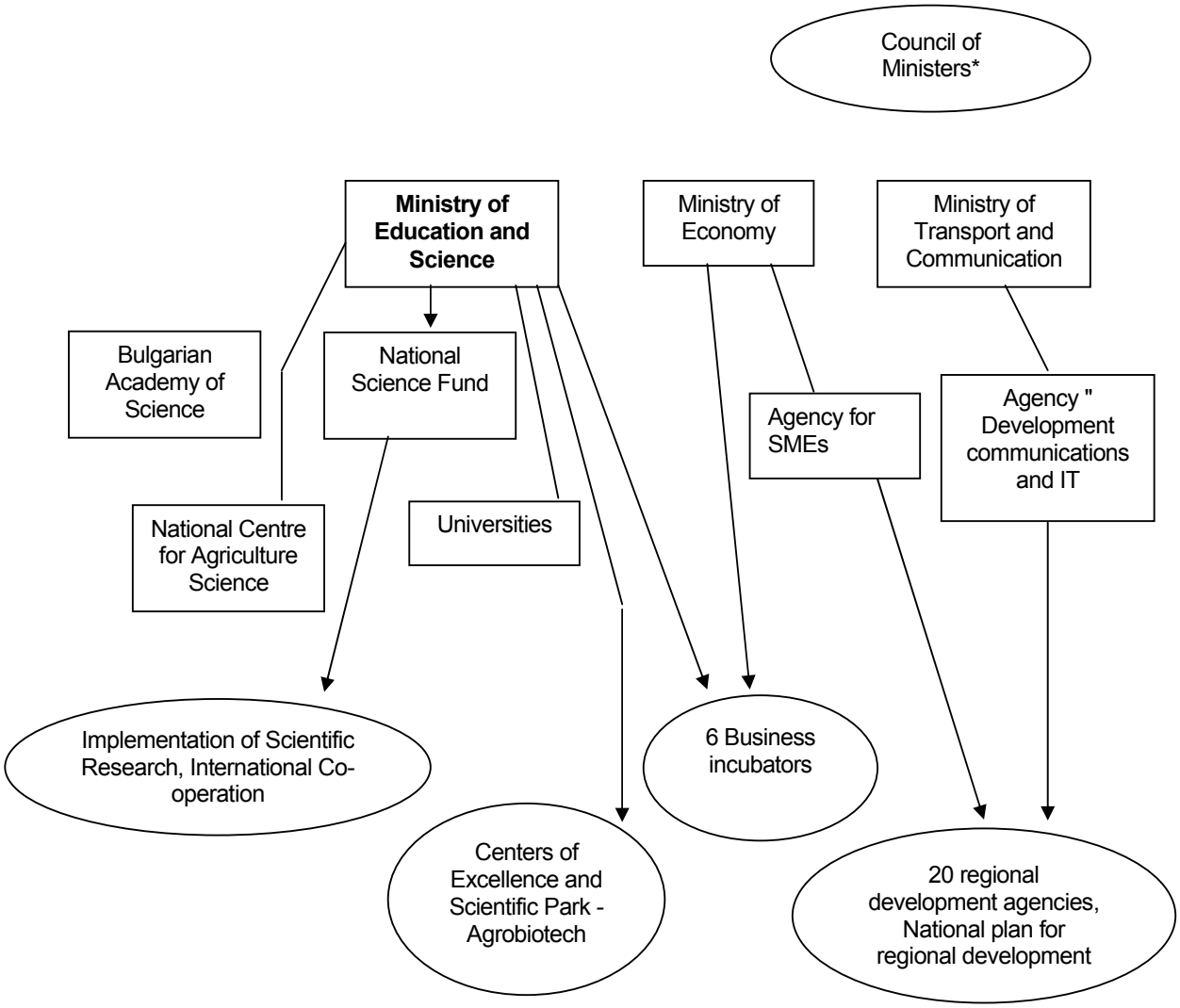
Sources: EUROSTAT, EC DG Research – Key Figures 2002

[13] European Commission DG Enterprise: 2002 European Innovation Scoreboard: Technical Paper No 2 - Candidate Countries, see annex Data Definitions and Sources and annex European Innovation Scoreboard 2002 – Trends (Candidate Countries) (www.cordis.lu/trendchart)

II. INSTITUTIONAL CAPACITY for S&T POLICY MAKING in BULGARIA

The **Ministry of Education and Science** is responsible for R&D and educational policies. The **Ministry of Economy** is involved in development of high-technologies and high-tech activities. Support to small- and medium-sized enterprises (SMEs) is provided by the **Agency for SMEs** according to the legal framework in place.

Figure 4: Institutional Capacity for S&T Policy Making in Bulgaria (2003)



Source: Ministry of Education and Science and author's own compilation

The **Ministry of Transport and Communications** has responsibilities for the activities for promotion of telecommunications, postal infrastructure and information technologies (IT), fulfilled by the Executive **Agency 'Development of communications and IT'**, a special administrative body at the Ministry of Transport and Communications established under the Telecommunications Law. The **National Science Fund is** a self-governing agency of Ministry of Education and Science.

Not included in Figure 4 are the responsibilities of a few other Ministries for research institutes, such as the university hospitals and medical research institutes falling under the Ministry of Health.

The NSF finances and supports implementation of scientific research, evaluates the results thereby obtained, organises and promotes international collaboration.

A National Council for Science, Technology and Innovation is in the process of establishment to represent the national innovation system and to govern Bulgaria's innovation and innovation-policy process. Relevant government departments, industry and science have to be represented, albeit on a individual basis, not through collective organisations. That is, the Council should operate as a unified team of government, business and science and technology leaders, not as a lobby platform. Its first task will be to act on the initiatives proposed above. In a next phase the main tasks of the council will be to monitor, evaluate and improve Bulgaria's Science, Technology and Innovation Policy. According to the EC Innovation policy paper on Bulgaria[14] there is a lack of sufficient co-ordination mechanisms or joint strategic policy development between the various government ministries.

The **National Science Fund** as a special structure at the Ministry of Education and Science for financing of research projects and programmes supported the following main priorities:

- Information Society. Information Technologies, Communications Environment (methods and tools for information communication, knowledge bases, transmission media, multimedia highways, mobile communication);
- Environment, Natural Resources and Their Preservation (biodiversity, ecosystem analysis, management and utilisation, sustainable development, recovery and conservation, monitoring);
- Human Health Preservation (health promotion, disease prevention, diagnostic criteria, socially-significant diseases);
- Human Potential and Social Relations (science, education, culture, social policy, ethnic groups, professional qualifications);
- Structural and Functional Reform (innovation and technological policy, financial-economical relations, market, health preservation);
- Agriculture and Forestry (soil and agricultural plants preservation, development of the agricultural and forest genofund, cattle-breeding and animal health preservation, mountain agriculture, nutritious products and xenobiotic control);
- Technological and Energy Efficiency; Materials (alternative energy sources, materials science, laser, plasma and waste-free technologies).

According to the EC Regular Report 2002 the Bulgarian government should undertake an active restructuring of policy for R&D. The large potential of the buildings, laboratories scientific equipment and of the scientists themselves at the Bulgarian Academy of Sciences (BAS) is not being exploited to its full capacity.

[14] Innovationj policy in 7 candidate countries: The Challenges (vol I.) European Commission DG Enterprise 2003 (Table 15)

III. POLICIES & STRATEGIES FOR THE KNOWLEDGE BASED ECONOMY in BULGARIA

In September 2001 the Government adopted a Programme in which Science was considered a priority in the favor of both economy and society. One of the major objectives in the sector is, together with increasing the financial support for science and approving the R&D programme and project funding on a competitive basis, the further development and optimisation of the scientific and technological infrastructure. With Decision № 550/ 4th July 2001 of the **Council of Ministers**, **5 National Scientific Programs** were approved in the following fields: **Genomics, Information Society, Nanotechnologies and New Materials, Bulgarian Society - Part of Europe and Cosmic Research.**

With the purpose of creating a legislative and fiscal environment compatible with this in the EU Member-states, through optimising the system of higher education as well as the scientific and technological development, a series of measures for improving the normative framework have been taken: new bills and other normative have been adopted, as well as amendments to existing Acts and Laws. Preparation of a National strategy for scientific and technological development and innovation and programme for its implementation was adopted. A **National Strategy for development of High Technology activities in Bulgaria** (1999) outlines the following priority areas for promotion of high-technologies:

- information technologies;
- telecommunications, communication equipment and services;
- microelectronics, micromechanics and microsystems;
- new materials and chemical substances and components;
- pharmaceutics and medical equipment;
- energetics, efficiency and use of alternative and renewable resources;
- systems and devices for automation and robotics;
- electronics, appliances, medical technique and equipment for scientific research;
- biotechnologies, pharmacy, precise chemistry;
- new sorts of plants and animal breeds, gene engineering;
- medicine, improvement of quality of life;
- prevention and control of environmental pollution, sustainable development;
- governance technologies.

There are no specific measures directly related to innovation policy. The aim of the Bulgarian government is the overall improvement of the business climate through simplification of administrative procedures, improvement of credit possibilities and reduction of tax burdens. The emphasis is on greater support for SMEs and in particular regional development. **The Law for SMEs (1999)** contains specific measures to promote the establishment and the development of SMEs, including:

- financial support and credit risks guarantees;
- facilitation of the participation of SMEs in the privatisation process and rental of state and community properties;
- facilitation of the participation of SMEs in public procurement.
- R&D grants for main SMEs tasks

An institutional framework of more than 20 **Regional Development Agencies** is created by the BARDA Association and the **Agency for SMEs** for fulfilment of the National Plan for Regional

Development and co-ordination of programmes and other initiatives for regional SMEs, in particular for solving problems in areas/ municipalities with high unemployment. It has been foreseen that almost all of the administrative districts to operate at least one business/agri-business centre or business incubator and Internet bureau.

Specific measures are included in the **Action Plan for the development of SMEs (2000-2006):**

- support of SMEs through ensuring information connections to the global trade and other networks in existing and new information regional centres;
- establishment of a network of specialised incubators with the aim to create conditions for development of highly effective SMEs based on their own resources and intellectual property;
- setting up and enlargement of the regional training centres for support of SMEs development and training of managers of SMEs.

In 2002 the Council of Ministers adopted the National strategy for stimulating the development of the SMEs and the Work programme for its implementation for the period 2002-2006. It foresees the following measures:

- Support for innovation-technology development;
- Support for applied research and commercialisation;
- Establishment of National Innovation System;
- Special consultant services for participation in international programmes;
- Access to R&D results and know-how – IPR assured for SMEs;
- Improvement of enterpreneurship culture and skills.

Box 1: New initiatives related to the development of S&T in Bulgaria

Several new initiatives are in the process of development of S&T in Bulgaria:

- Implementation of Communication Strategy for the preparation of the EU membership of Bulgaria
- Strategy for accelerating Bulgaria's negotiations for EU accession
- Strategy for accelerated economic development in a number of sectors that are important for economy development;
- Strategy for information technologies and Communication whit special supporting measures;
- Pre accession Economic Program;
- National Plan for Economic Development 2003- 2007, where a special part is devoted to the R&D and innovation;
- New Rules for implementation of the Law on State Support- with measures for SMEs and R&D activities;
- Elaboration of an Innovation strategy;
- Implementation of new trends on RD activities targeted to support innovation projects;
- Completion of a preliminary Study on Research landscape by an OECD team;
- Law on encouraging Scientific Research;
- Implementation of a New investment fund supporting High Tech Companies;
- Implementation of new schemes for the additional recruitment of young scientists

Source: Mrs Albena VUTSOVA

New initiatives in Bulgaria also involves the implementation of number of indirect stimulus such us; Amendments to the Act supporting R&D activities to Person incomes Taxation Law, Corporate Income Tax Law, Regulation of Applying the VAT Law; Law on Patents; Law on the ratification of the Convention for using European Patents; Rules governing the implementation of Public Procurement Law; Council of Ministers' Decision) 15 of 9 January 2003 for approving National Scientific Program for research and technological development

Towards the Development of the Knowledge Based Economy in Bulgaria

According to the EC Regular Report, amendments to the Act on Higher Education were adopted in May 2002; they aim at improving the educational process. For the further development of the sector and for an effective integration of Bulgaria into the European Research Area, it is important to increase the gross domestic expenditure on research and technological development. The promotion of science and research in Bulgaria will particularly need a further increase of business expenditure on research and development (BERD), i.e. of expenditure on science and research activities from the industry, small and medium-sized enterprises and the private business sector in general. Furthermore, there is a need to foster research activities in universities. Emigration of young and experienced specialists continues to hamper the development of this sector. An overall framework strategy for the development of research is under preparation. The same goes for legislation dealing with promotion of scientific research as well as with high-tech parks and activities. (Source: EC Regular Report October 2002)

Box 2: RELEVANT INFORMATION SOURCES IN BULGARIA

Bulgarian Government: www.government.bg (Sep. 2003)
Official documents: www.government.bg/eng/oficial_docs/index.html (Sep. 2003)
Bulgarian Ministry of Education and Science: www.minedu.government.bg/english.html (Sep. 2003)
Bulgarian National Science Fund: www.minedu.government.bg/NSFB/about_nsfb.htm (Sep. 2003)
Bulgarian Academy of science: www.bas.bg/ (Sep. 2003)
Ministry of Economy: www.mi.government.bg/eng/ (Sep. 2003)
Agency for SMEs: www.asme.bg/en/default.htm (Sep. 2003)
Ministry of Transport and Communications: www.mtc.government.bg/index.htm (Sep. 2003)

CHAPTER 2: Republic of CYPRUS

COUNTRY PROFILE[15]

Area:	9,251 km^2 (of which "TRNC": 3.355 km^2)
Population (2001):	759,300 people
GDP/capita (PPS; 2001):	18,460 Euros
GDP growth (1995-2000):	3.7 %
Unemployment rate (1999):	4.9 %
GERD as % of GDP (1999):	0.25 %

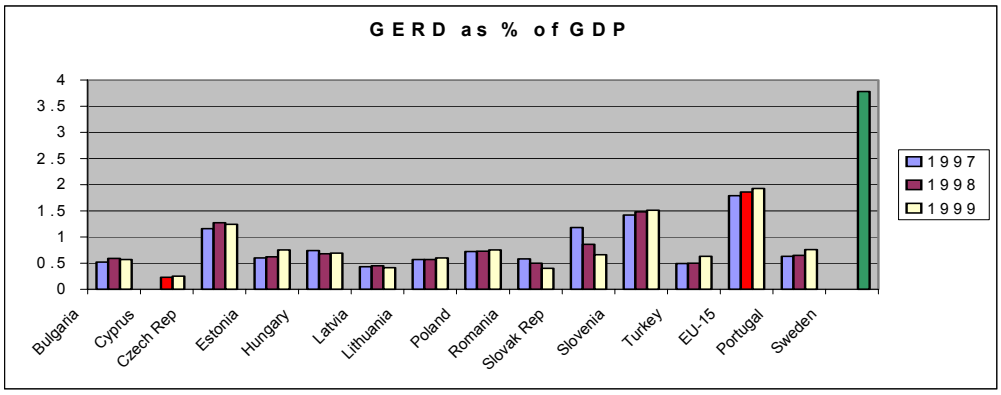
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

I. BASIC INDICATORS OF INVESTMENT AND PERFORMANCE FOR THE KNOWLEDGE BASED ECONOMY in CYPRUS

A. R&D INVESTMENT AND HUMAN RESOURCES IN S&T

A survey carried out by the Cyprus Department of Statistics and Research for the period of 1991-1992, found little evidence of formal research and development activities. Gross expenditure on Research and Development (GERD) in 1992 accounted for only 0.18% of GDP. During the last few years, however, R&D activities in Cyprus have been developing gradually. Nevertheless, the level of R&D activities in Cyprus is still relatively low. In 1999 GERD was 0.25% of GDP and this figure remained steady in 2001.

Figure 5: GERD as a % of GDP in the EU Candidate Countries – Cyprus (1997,1998, 1999)



Source: EUROSTAT, European Commission DG Research

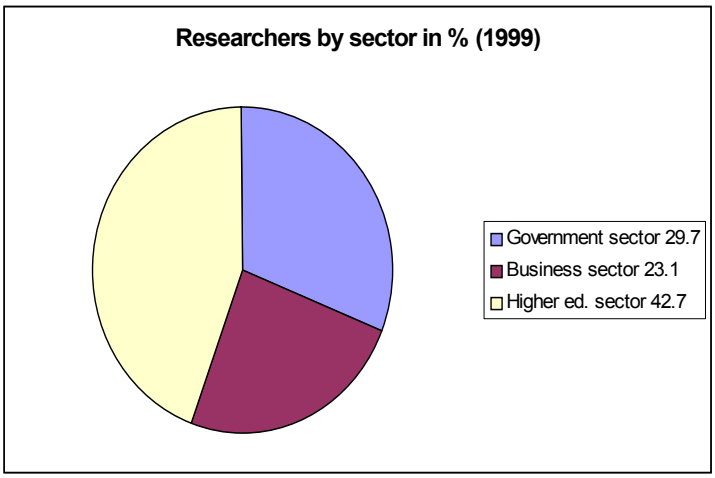
Table 4: GERD in Cyprus (1999)

GERD as % of GDP (2001*)	**0.25%**	**1.93% (EU 15)**
GERD financed by business:	**17.4%**	**56.3% (EU 15)**

Source: European Commission DG Research-Key Figures 2002

[15] The author would like to thank Mr Costas CONSTANTINOU, Professor at University of Cyprus (Department of Educational Science) for his contribution and comments. Nevertheless the author takes full responsibility for the content of this country analysis.

Figure 6: Researchers by sector (%) in Cyprus (1999)



Source: EUROSTAT, European Commission DG Research – Key Figures 2002

Total R&D personnel in Cyprus were 681 people in 1999, which represented 0.24% of the labour force in Cyprus. As a progressive development in the area of investment for the Knowledge Based Economy, the budget for national research programmes increased from €437 500 in 1998 to €1.75 million in 2001[16] which is a concrete step by the Government towards improvement of the investment in R&D. Human resources in S&T enable the capacity to produce scientific and technological knowledge. Due to the fact that Cyprus has only 278 researchers (FTE)[17] and a total R&D personnel of 681 people, the Government introduced measures in order to promote research in Cyprus and to encourage collaboration with scientists from abroad. Regarding the issue of gender balance, the situation in Cyprus (29% women in R&D) is similar to the EU (average of 30% of female researchers (FTE).

Table 5: Human Resources in S&T in Cyprus (1999)

Type of researchers	Number of researchers	EU total number or EU average in %	Type of researchers as % of labour force
Total number of R&D personnel	**681**	**1,689,490**	**0.24%**
Number of female R&D Personnel	255	-	0.09%
Full-time equivalent (FTE) Total	278	919,796	0.09%
Full-time equivalent (FTE) Female	81	30%	0.02%
Business sector	**83**	**50%**	**0.03%**
Government sector	64	14.2%	0.02%
Higher education Sector	119	34.3%	0.04%

Source: EUROSTAT, EC DG Research, EC DG Employment and IPTS additional calculation[18]

[16] EC Regular Report November 2001

[17] Full-time equivalent

[18] Labour force in Cyprus (1999): 281,259 – European Commission DG Employment
EU-15 (1999): 5.63 researchers (FTE) per 1000 in the labour force (head count).

B. S&T and ECONOMIC PERFORMANCE for the KNOWLEDGE BASED ECONOMY in CYPRUS

Figure 7: Scientific Performance (publications per million population (1999))

Cyprus	EU-15	Sweden	Portugal
170	755	1657	333

Source: European Commission DG Research – Key Figures 2002

In many S&T indicators relevant for progress towards *Lisbon/Gothenburg/Barcelona* targets, Cyprus is performing relatively poorly compared to the EU average. Nevertheless, the creation of the Cyprus Research Promotion Foundation (see part III) over the last few years and its substantial efforts to create an infrastructure for funding R&D programmes reflect a new awareness of the importance of R&D and a willingness by the state to support the necessary transition. At the same time, these efforts provide an explanation for the positive trends. However, there is a noticeable R&D gap between Cyprus and the EU which can only be bridged through sustained and substantial efforts.

According to the **European Trend Chart on Innovation 2002**[19] the current relative weaknesses of Cyprus are in the fields of business expenditure on R&D and medium/hi-tech manufacturing employment. There is also a weakness in the trend for inward FDI. On the other hand, major strengths exist in ongoing developments in tertiary education and in the level of internet access by the population. The small size of Cyprus also allows for deviation in some aspects from the EU averages, particularly in relation to efforts to set specific strategic targets and specialisation themes.

Table 6: S&T and Economic Performance of Cyprus

GDP per capita in Euros (PPS; 2001):	**18,460**	**23,200 (EU15)**
GDP average annual growth (1995-2000):	**3.78%**	**2.63% (EU15)**
Patents per million inhabitants (1999):	**7**	**126 (EU15)**
Publications per million inhabitants (1999):	**170**	**755 (EU15)**
High-tech exports, as % of total exp.(1999):	**2.7%**	**19.7% (EU15)**

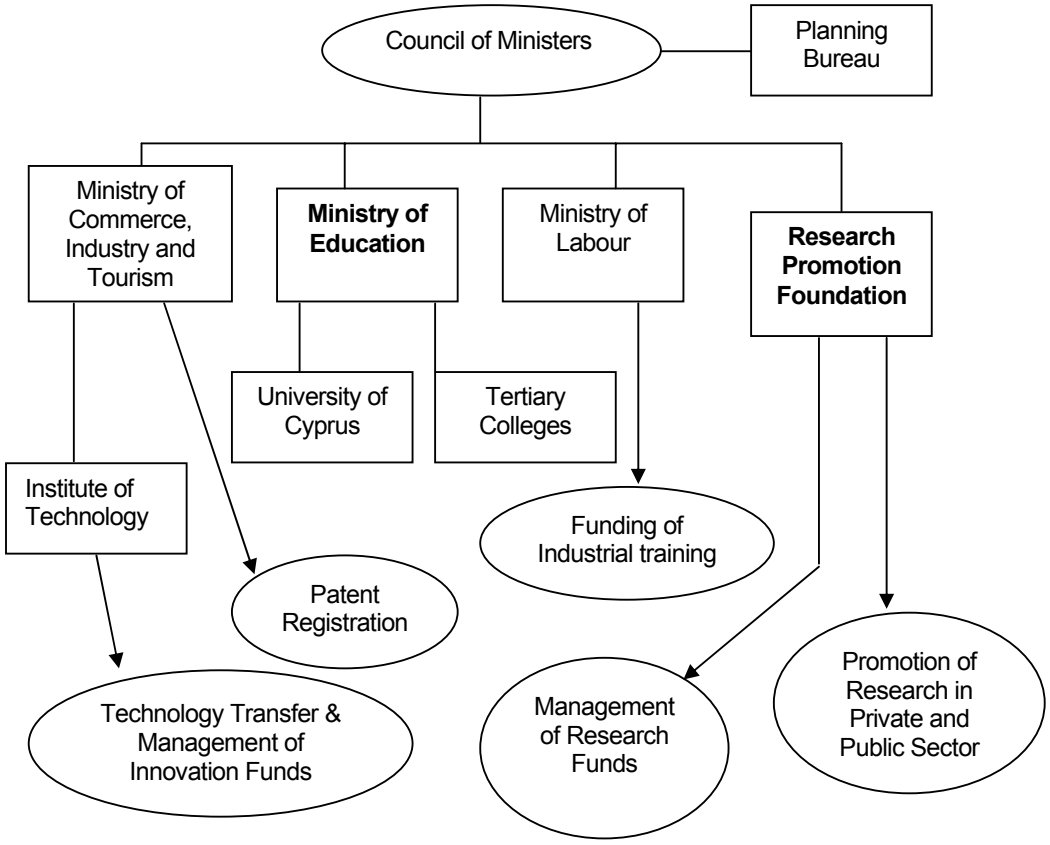
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

[19] European Commission DG Enterprise: 2002 European Innovation Scoreboard: Technical Paper No 2 - Candidate Countries, see annex Data Definitions and Sources and annex European Innovation Scoreboard 2002 – Trends (Candidate Countries) (www.cordis.lu/trendchart)

II. INSTITUTIONAL CAPACITY for S&T POLICY MAKING in CYPRUS

The **Council of Ministers** coordinates all research activities and determines policy in R&D. It undertakes all decision making that relates to the formulation of strategy, the identification of objectives and priorities and the introduction of science policy measures.

Figure 8: Institutional Capacity for S&T Policy Making in Cyprus (2003)



Source: European Commission DG Enterprise and author's own compilation

The **Planning Bureau** is a governmental office that supports the Council of Ministers by providing data and analysis but does not decide on policy. Management of research and innovation grants are entrusted to two private, non-profit foundations, the Cyprus **Institute of Technology** and the **Research Promotion Foundation.**

The **Research Promotion Foundation** (RPF) is a national institution responsible for the support of research activities. The **Research Promotion Foundation** is an independent non-governmental Foundation that has been entrusted with distributing the R&D funding that is allocated by the Government through open competitive procedures. The RPF was established by the initiative of the Government of Cyprus in 1996. RPF is an independent organisation governed by a twelve-member Board of Directors. The Foundation's priorities and objectives are to monitor and coordinate scientific and technological research, to identify appropriate thematic priorities for demand driven research and to develop and implement programmes for the financing of high quality research projects. The Research Promotion Foundation is also involved in the promotion of collaboration networks tying in Cyprus with international research programmes and in the evaluation of researchers and individuals for carrying out research. The Foundation also gives advice to the government on research issues and provides services related to the Cyprus research activities. One of

the RPF objectives is to upgrade the infrastructure for research activities in Cyprus and to increase awareness among the Cypriot public of the importance of research in society.

The **Ministry of Commerce, Industry and Tourism** is the governmental body responsible for implementing industrial policy. Small scale research of an operational nature can also be found in the Ministries of Education and Labour.

The **University of Cyprus** has developed a coherent long term strategy for fundamental research since its establishment in 1992. Its funding relies mostly on external funding related to the EU research programmes and on the smaller funding provided by the Cyprus Research Promotion Foundation. Some private tertiary colleges are also taking initial steps towards developing a research programme.

III. POLICIES & STRATEGIES FOR THE KNOWLEDGE BASED ECONOMY in CYPRUS

Cyprus' main development policy is laid down in the **1999-2003 Strategic Development Plan**. The main objectives of the industrial strategy include support for the restructuring of traditional industrial sectors, assistance to existing production units and the attraction and development of new high-tech industries as well as better exploitation of the industrial potential of policies on innovation, research and technological development. The priorities are mainly economic and socio-economic with technological aspects identified at a subordinate level.

Industrial Competitiveness*:* Improvement of productivity; cost reduction; quality; environmental protection; product differentiation; solution of technological problems faced by SMEs;

Environmental Management*:* Hazardous waste management; monitoring of pollution; soil fertility and water resource management; forest conservation and reforestation;

Socio-Economic Development*:* Innovative technologies in Information Sciences and Telematics applications in service industries (Medicine, Tourism, Environment, Resource Management); medical diagnosis; analysis of risk factors with respect to the incidence of cancer; cardiovascular diseases;

Human Resources: Emphasis on Information Sciences for resource management; pedagogy – curriculum development and evaluation;

Standard of Living*:* Quality evaluation of agricultural products to improve the quality of life (field crops, horticulture, plant protection, plant pathology and biotechnology, animal production and agricultural economics, conservation of endangered species).

For the development of S&T in Cyprus the Research Promotion Foundation (RFP) Programmes are of great significance. The RFP Programmes cover a wide range of thematic areas and are open to researchers of private entities, including SME's and enterprises with appropriate research infrastructure. The partners involved are teaching and research staff of the University of Cyprus, private tertiary education establishments, research centres and different institutes of the public sector. According to the Co-operation protocol between Cyprus and the EU, research organisations and

individual researchers from EU Member States can participate throughout the Framework programmes in the research activities in Cyprus. The RFP budget has been steadily increasing from 270.000 CYP in 1997 to 1.180.000 CYP in 2002. Between 1997 and 2002 the Foundation has allocated a total of 3.450.000 CYP (6.000.000 Euros)[20] to the Annual Programme for the financing of research projects.

The annual programme for the **Financing of Research Projects** was launched for the first time in 1997. The aims and objectives of the Programme are:

- to encourage the implementation of projects
- to develop research networks on European, regional and local level
- to upgrade the research infrastructure in Cyprus and activating the research manpower of Cyprus in specific research areas
- to secure the substantial utilisation of research results

Box 3: The Programme for the support of Young Researchers – PENEK

The programme was launched for the first time in 2000 and since then a call for proposals is announced on an annual basis. The aim of the programme is to provide research training and further education to young researchers under the age of 35. The priorities of the programme are technology intensive sectors that can contribute to the technological, productive and social development of Cyprus with the aim of improving the human research potential and engagement in research activities. The first two calls for proposal 2000 and 2001 have attracted 56 research proposals, out of which 18 have been selected for financing. The total budget for the first two calls was 35.000 CYP, while the budget for 2002 is 250.000 CYP.

Box 4: The Programme "Pupils in Research – MERA"

The Foundation launched, together with Ministry of Education and Culture and the University of Cyprus the MERA programme in 2001. The programme's main objective is to involve pupils and their teachers in research activities. The MERA programme offers financial awards, commemorative plaques and certificates to the participants. The experiences gained from this first call were very positive thus making the prospects of "MERA" very promising in the future.

In Cyprus **S&T research priorities** include water resources management; protection and sustainable development of land, coastal and aquatic environment, preservation of cultural treasure, development of innovative educational system, restructuring public institutions, tourism management and alternative energy sources[21].

In the framework of the "**New industrial policy** of the government for the development of high-technology industry in Cyprus", the concept of incubators for high-technology companies and centers for applied research is promoted.

[20] Research Promotion Foundation of Cyprus, 2002

[21] IPTS Enlargement Futures Report on Technology, Knowledge and Learning - 2001

The strengthening of the research infrastructure is considered to be the cornerstone for the support of RTD activities in Cyprus and constitutes one of the main priorities of the Government, which is in the process of examining the organisational structure and operation of selected Centres of Excellence abroad, in order to promote the establishment of similar centres in Cyprus.

The "**New Industrial Policy – Incentives and Support Schemes"(1999)** covers innovative organisational and management practices. It includes a wide number of on-going actions including standards, certification, infrastructure, research and access to the information society. Particular support is given for the creation of start-ups and the high technology industry in Cyprus through the establishment of incubators. A scheme of subsidies to specialised software in industry aims to contribute to the automation of procedures and processes, saving of resources and increase of productivity. There are specific measures aimed at strengthening the ability of companies, particularly SMEs, to absorb technologies and know-how, e.g. schemes supporting restructuring, consulting accreditation and technology brokerage, grants for upgrading technology, grants to cover expenses for testing, measurements and calibration, etc.

Box 5: "Cyprus Regional Innovation Strategy" project and international partnership.

The Research Promotion Foundation[22] launched a project with two participating partner regions (Kent and Central Macedonia). Based on the evaluation of the strengths and weaknesses of the innovation system in Cyprus, the project will elaborate and promote an Action Plan, aiming at strengthening the innovation support services, upgrading the innovation infrastructure and increasing the competitiveness of the SMEs. This will ultimately lead to the upgrading of the role of innovation in the development process and the creation of an innovation culture in Cyprus.

Source: Research Promotion Foundation of Cyprus – November 2002

Towards the Development of the Knowledge Based Economy in Cyprus

According to the EC 2002 Regular Report, Cyprus continued to be fully associated with the Fifth Framework programme and expressed an interest in being associated with the Sixth Framework programme (2002-2006). Cyprus has recently increased its R&D spending in order to fill the gap with respect to EC average spending on R&D. The planning Bureau and the Research promotion Foundation are actively involved in the formulation and implementation of the national science and research policy. In order to complete preparations for membership and ERA, Cyprus's efforts should continue to focus on measures needed to promote and enhance research and development, to further encourage research that supplies relevant technology to small and medium-sized enterprises, and to increase European co-operation in this field. (Source: EC Regular Report October 2002)

Box 6: RELEVANT INFORMATION SOURCES IN CYPRUS

Cyprus government: www.pio.gov.cy/ (Sep. 2003)
Planning Bureau of Cyprus: www.planning.gov.cy// (Sep. 2003)
Cyprus Chamber of Commerce and Industry (Euro Info Centre): www.ccci.org.cy/ (Sep. 2003)
FEMIRC (Cyprus Institute for Technology): www.industry.cy.net (Sep. 2003)
The University of Cyprus: www.ucy.ac.cy (Sep. 2003)

[22] RPF successfully submitted a proposal to the EC Fifth Framework Programme

CHAPTER 3: The CZECH Republic

COUNTRY PROFILE[23]

Area:	78,866 km^2
Population:	10.3 million people
GDP/capita (PPS; 2001):	13,280 Euros
GDP growth (1995-2000):	1.22%
Unemployment rate (1999):	8.8%
GERD as % of GDP (1999):	1.24%

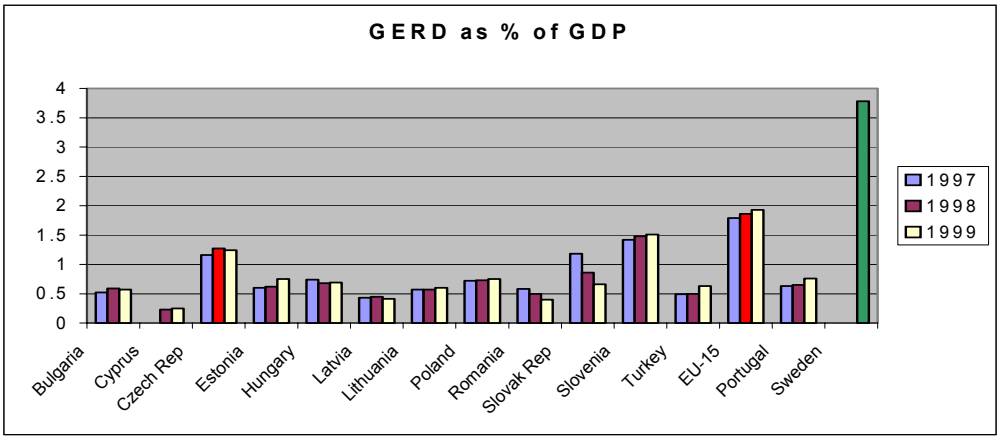
Source: EUROSTAT, European Commission DG Research - Key Figures 2002

I. BASIC INDICATORS OF INVESTMENT & PERFORMANCE FOR THE KNOWLEDGE BASED ECONOMY in the CZECH REPUBLIC

A. R&D INVESTMENT AND HUMAN RESOURCES IN S&T

Business is by far the largest contributor and the largest recipient of research and development funding, employing more than the half of all researchers. Czech gross domestic expenditure on R&D (GERD) was 1.24% in 1999, of which 52.6% was financed by the business sector[24]. The largest expenditure on R&D is in the sector of manufacturing of motor vehicles, followed by manufacturing of transport equipment, of machines and equipment, chemicals, etc.

Figure 9: GERD as a % of GDP in the EU Candidate Countries - the Czech Republic (1997,1998, 1999)



Source: EUROSTAT, European Commission DG Research

Table 7: GERD in the Czech Republic (1999)

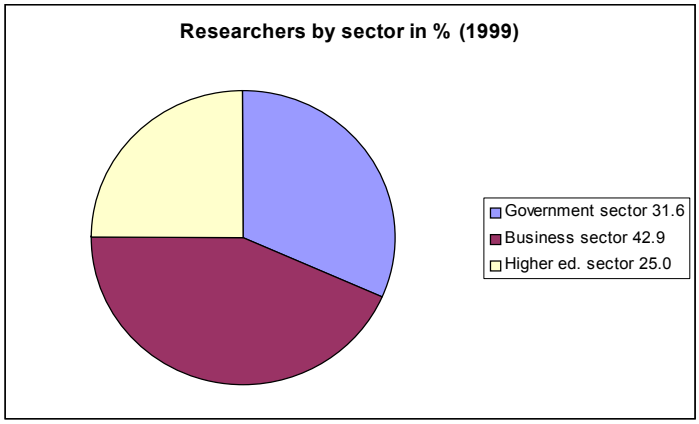
GERD as % of GDP:	1.24%	1.93% (EU 15)
GERD financed by business:	52.6%	56.3% (EU 15)

Source: European Commission DG Research – Key Figures 2002

23 The author would like to thank Dr. Karel AIM, member of the Academy Council of the Czech Republic, Institute of Chemical Process Fundamentals in Prague for his contribution and comments. Nevertheless the author takes full responsibility for the content of this country analysis.

24 According to Mr. Aim the data on public (or state) expenditure on R&D as a percentage of GDP are easily available and much better defined and transparent than the corresponding business expenditures. This information (and especially the trends in recent years) would be very illustrative in relation to the Lisbon strategy.

Figure 10: Researchers (converted to FTE) by sector (%) in the Czech Republic (1999)



Source: EUROSTAT, European Commission DG Research – Key Figures 2002

Total R&D personnel in the Czech Republic were 24,106 people in 1999, which represented 0.47% of the labour force in the Czech Republic. Human resources in S&T enable capacity to produce scientific and technological knowledge. The distribution of researchers across government, business and the higher education sectors indicates where the capacity to produce and absorb knowledge can be found. The share of researchers employed in business sector in the Czech Republic is 42.9% which is lower than the EU average (50%) but still better than Greece (15.6%), Portugal (12.7%), Spain (24.7%), Italy (40.4%) or Finland (41.6%).

Table 8: Human Resources in S&T in the Czech Republic (1999)

Type of researchers	Number of researchers	EU total number or EU average in %	Share of researchers as % of labour force
Total number of R&D personnel	**24,106**	**1,689,490**	**0.47%**
Number of female R&D Personnel	-	-	
Full-time equivalent (FTE) Total	13,535	919,796	0.26%
Full-time equivalent (FTE) Female	-	30%	
Business sector	**5,807**	**50%**	0.11%
Government sector	4,277	14.2%	0.08%
Higher education Sector	3,384	34.3%	0.06%

Source: EUROSTAT, EC DG Research, EC DG Employment and IPTS additional calculation[25]

[25] Labour force in Czech Republic (1999): 5,088,250 – European Commission DG Employment
EU-15 (1999): 5.63 researchers (FTE) per 1000 in the labour force (head count).

B. S&T and ECONOMIC PERFORMANCE for THE KNOWLEDGE BASED ECONOMY in the CZECH REPUBLIC

Figure 11: Scientific Performance (publications per million population (1999))

The Czech Republic	EU - 15	Portugal	Sweden
352	755	333	1657

Source: European Commission DG Research – Key Figures 2002

In producing scientific knowledge the Czech Republic performs higher than most of the EU Candidate Countries. The Czech Republic share of high-tech exports in total export reaches 7.8%, which is below the EU average of 19.7%.

According to the European Trend Chart on Innovation 2002[26] a relative weakness of the Czech Republic is in the field of education. On the other hand major strengths in innovation are medium/hi-tech manufacturing employment, business expenditure on R&D and the number of patents applied at the European patent office.

Table 9: S&T and Economic Performance of the Czech Republic

GDP per capita in Euros (PPS; 2001):	**13,280**	**23,200 (EU15)**
GDP average annual growth (1995-2000):	**1.22%**	**2.63% (EU15)**
Patents per million inhabitants (1999):	**10**	**126 (EU15)**
Publications per million inhabitants (1999):	**352**	**755 (EU15)**
High-tech exports, as % of total exp.(1999):	**7.8%**	**19.7% (EU15)**

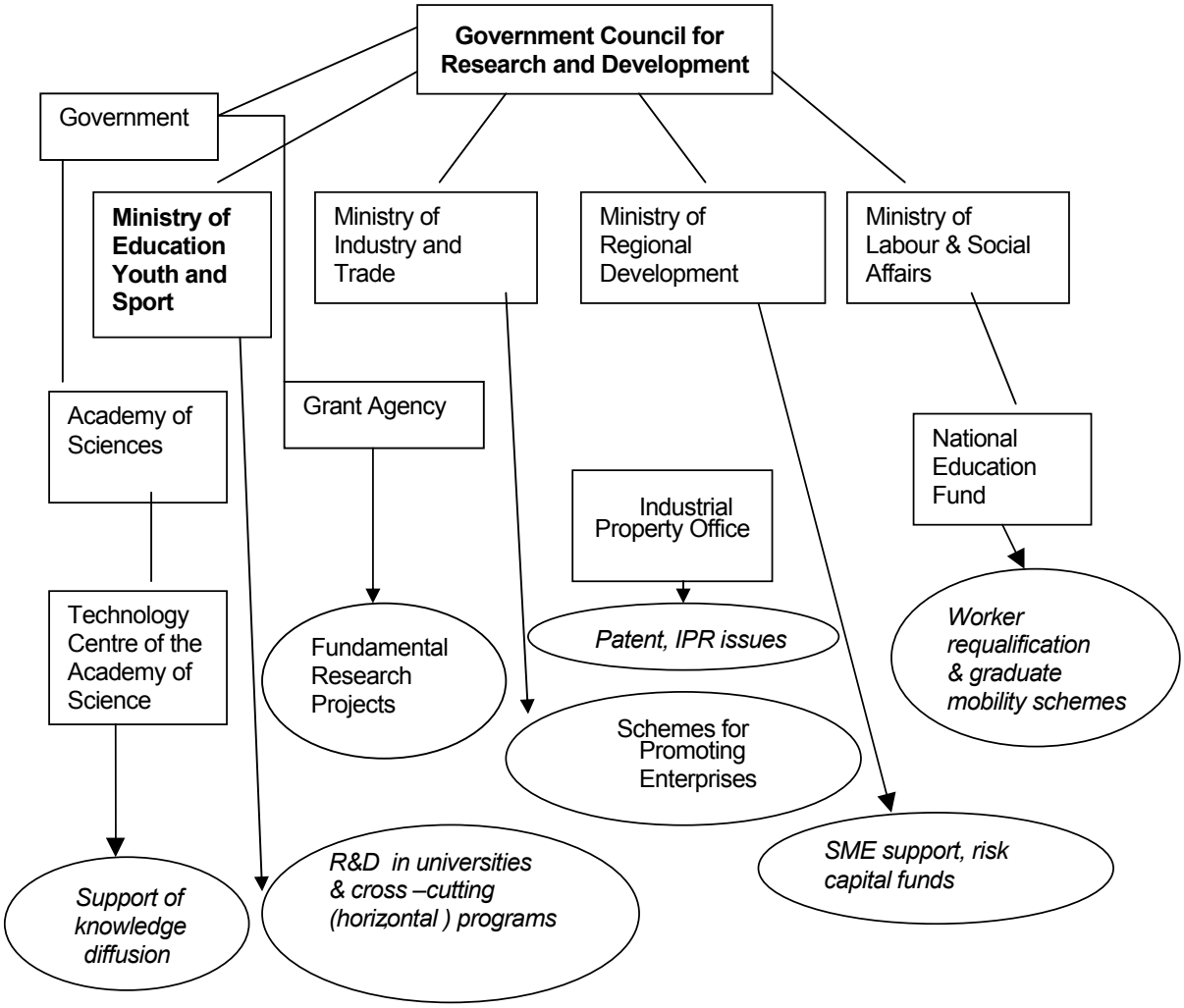
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

[26] European Commission DG Enterprise: 2002 European Innovation Scoreboard: Technical Paper No 2 - Candidate Countries, see annex Data Definitions and Sources and annex European Innovation Scoreboard 2002 – Trends (Candidate Countries) (www.cordis.lu/trendchart)

II. INSTITUTIONAL CAPACITY for S&T POLICY MAKING in the CZECH REPUBLIC

The **Ministry of Education, Youth and Sports** is the central authority of the state administration for educational and science policy and the preparation of appropriate legislative standards and executive and operational activities. The Ministry also funds research in universities and some other research institutions. The **Council for Research and Development** is an advisory body of the government with the main task of considering legislative documents related to S&T and to recommend proposals for the allocation of financial resources for S&T among central bodies.[27] The Council also elaborates annual comparative analyses on R&D and maintains databases of S&T projects and results.

Figure 12: Institutional Capacity for S&T Policy Making in the Czech Republic (2003)



Source: European Commission DG Enterprise and authors' own compilation

[27] The Council for R&D proposes the budget and interacts with the Government.

The **Ministry of Industry and Trade** is involved in supporting technological development and industrial research activities. The Ministry has the greatest influence on innovation related issues via several programmes.

The **Academy of Sciences of the Czech Republic** is preparing the Fundamental Research Interdisciplinary Program. Research institutes of the Academy of Science display comparatively strong research capacities in basic disciplines, while the industrial research is more dependent on the R&D funding from the business sector. The **Grant Agency of the Czech Republic** is supporting fundamental research projects**.**

The implementation of SME policy is monitored by the Ministry of Industry and Trade and by the **Ministry for Regional Development**.

III. POLICIES & STRATEGIES FOR THE KNOWLEDGE BASED ECONOMY in the CZECH REPUBLIC

The Government approves **National Research and Development Policy Report**. This document determines the long-term aims and directions of the research and development sponsored from public and other funds. Measures leading to the implementation of S&T policy for the next 4 to 5 years are also included. The National R&D Policy Report for the period from 2000 to 2003 was adopted in January 2000. The **National Programme of Orientated Research (NPOR)** consisting of five thematic programmes and three cross-cutting programmes will become part of the reporting.

In March 2002 Czech Republic concluded its first Technology Foresight Program. The goal was to define and elaborate the R&D priorities to be realised and supported within NPOR. The results of the project were the basis for the **National Research Program,** which consist of 5 major thematic programmes and 3 major horizontal programmes (currently further divided into 15 programmes). After the approval of the National Research Program by the Government in April 2003, the implementation and funding of the programme should start in January 2004.

Box 7: Example of Technology Foresight in the Czech Republic

For the needs of the project, 18 panels – 14 thematic, 3 cross-cutting and 1 systematic panel – were established: Thematic panels: Agriculture and food, Environment, Health care, Pharmaceutics, Civil Engineering, Urbanism and Housing, Information Society, materials and Technologies of their production, Discrete manufacturing and Products, Instruments and Devices, Machinery and Equipment, Chemical Products and Processes, Transport Systems, Power Engineering and Mineral Resources, Social Transformation.

Cross-cutting panels: Human Resources for Research and Development, Integrated Research and Development, Regional and International Cooperation in Research and Development. Systematic panel: Management and Implementation of the National Research Program

Proposal of the National research program: Technology Foresight in the Czech Republic, Ministry of Education & Research and Development Council (2002)

Source: Ministry of Education (2002)

The Academy of Sciences is preparing the **Fundamental Research Interdisciplinary Program** involving the following projects:

- Physical, chemical, and biological fundamentals of modern technologies
- Mathematical modelling, information science, and integration of science into society
- The Earth, the Space, and the basic laws of Nature
- Biological fundamentals of the prevention and therapy of diseases
- Ecological systems, their function and protection
- Economical, legal, and social aspects of the European integration and globalisation
- Cultural heritage and national identity.

The Grant Agency of the Czech Republic is supporting **fundamental research projects** through grants in the following areas:

- Technical sciences – mechanical engineering, electrical engineering and cybernetics, civil engineering, architecture and transport, technical chemistry, mining, metallurgy and materials science;
- Natural sciences – mathematics and information science , physics, chemistry, cell and molecular biology, Earth and space sciences, general and ecological biology
- Medical and health sciences –molecular biology, genetics and human development, biochemistry and pathobiochemistry, morphology, normal physiology, pathological and clinical physiology, pharmacology, experimental surgery, neuroscience, microbiology and immunology, metabolism and nutrition, general oncology, epidemiology and hygiene
- Human and social sciences – philosophy and theology, economic sciences, sociology, historical sciences, ethnography, art history, philology, psychology, legal sciences and politology, aesthetics and musicology, history of the 19th and 20th century
- Agricultural sciences – plant production, genetics and breeding, phytopathology and plant physiology, animal production, genetics and breeding, animal physiology and pathology, agricultural products, food technology and ecotoxicology, ecology, forestry, soil science

In 2002, the Czech Republic endorsed the **European Charter for Small Enterprises** as the basis for its action to support and develop small enterprises. The implementation of the 2001-2004 Long and Medium-term Policy for SMEs has continued. It consist of 10 nation-wide and 7 regional programmes for structurally affected and economically weak regions, aimed at facilitating business plans, improving competitiveness, assisting entrepreneurs and creating new jobs.

The Act on State Support to Research and Technological Development[28] outlines the rights and duties of private and legal entities dealing with research and development, establishes an evaluation system, and lays down the tasks and obligations of the relevant Government bodies. The Act also provides the guidelines for allocation of public funds to research and development.

Government **innovation policy** appears to focus mainly on industry as the only three programmes developed in this policy area are aimed at industry: **Action Plan for Supporting the Competitive Ability of Czech Industry (1999); Support of Enterprise Activities (1999), and Support of Enterprise Activities (2000).** Although the Czech Republic has achieved good results in adopting EU legislation on SMEs, the innovation policy toward SMEs remains between the legislative and

[28] The Act on State Support to Research and Technological Development was adopted in March 2002.

launching stages. The majority of the measures addressing the issue of innovation support and development in industry are focused on SME support trough training of employees, provision of government bank guarantees for loans, as well as consultation and information services. No particular measures are dealing with regional innovation, only some tax incentives are offered to foreign investors in the depressed regions of Moravia and Bohemia. Some efforts are also needed towards more regionally-based structures.

Example of Czech cooperation between industry, R&D and universities: To improve links between SMEs and industry, and R&D institutes and universities, the Ministry of Industry and Trade runs three specialised support programmes for SMEs aimed at research, development and innovative business (Technos, Transfer and Park).

Towards the development of the Knowledge Based Economy in the Czech Republic

In order to successfully integrate into the European Research Area the Czech Republic's efforts need to focus on increasing the gross domestic expenditure on research and technological development, and on encouraging enterprises to commit higher expenditures to research. This will contribute to the further development of the sector and to the effective integration of the Czech Republic into ERA, as well as to its successful association with the relevant Community programmes. (Source: EC Regular Report – October 2002)

Box 8: RELEVANT INFORMATION SOURCES IN THE CZECH REPUBLIC

Central Website on R&D in the Czech Republic: http://www.vyzkum.cz/index.asp?cp=en (Sep. 2003)
Czech Government, R&D Council (Older Page with Analysis Report for 1993-97):
http://www.vlada.cz/1250/eng/vrk/vybory/vybory.htm (Sep. 2003)
Czech Government, R&D Council (Newer Page with Analysis Report for 1998-2001):
http://wtd.vlada.cz/eng/vybory.htm (Sep. 2003)
Czech Ministry of Education, Youth and Sports: http://www.msmt.cz/defaultx.asp?language=en (Sep. 2003)
Ministry of Industry and Trade: http://www.mpo.cz/eng/ (Sep. 2003)
Academy of Sciences of the Czech Republic: http://www.cas.cz/ (Sep. 2003)
Grant Agency of the Czech Republic: http://www.gacr.cz/gacr/menueng.htm(Sep. 2003)
Technology Centre of the Academy of Sciences (CIRC): http://www.tc.cas.cz, http://www.circ.cz (Sep. 2003)
Czech Technology Foresight Program: http://www.foresight.cz (Sep. 2003)
RTD Info and Partner Search: http://www.czechrtd.info/www/ (Sep. 2003)

CHAPTER 4: Republic of ESTONIA

Country Profile[29]

Area:	43,431 km^2
Population:	1.36 million people
GDP/capita (PPS; 2001):	9,820 Euros
GDP growth (1995-2000):	4.9%
Unemployment rate (2000):	13.2%
GERD as % GDP (2000):	0.66%

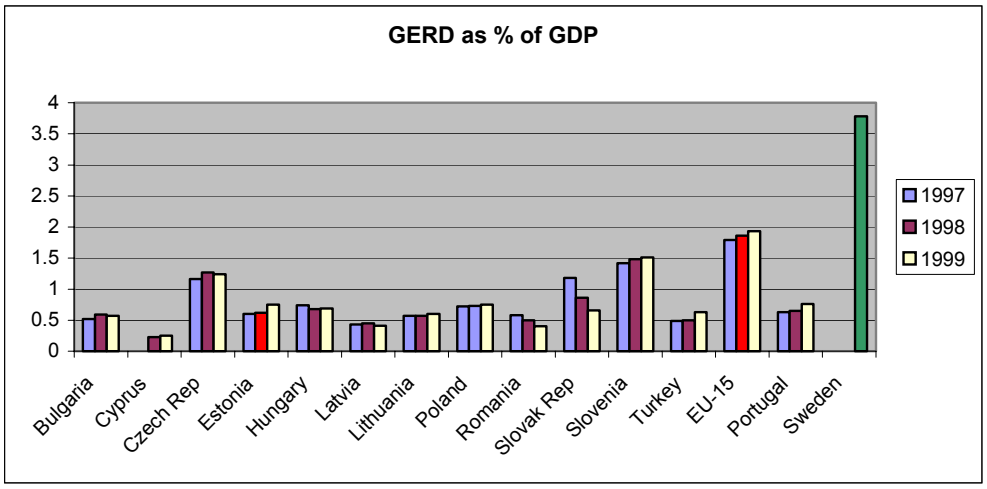
Source: EUROSTAT, European Commission DG Research - Key Figures 2002

I. BASIC INDICATORS OF INVESTMENT AND PERFORMANCE FOR THE KNOWLEDGE BASED ECONOMY in ESTONIA

A. R&D INVESTMENT AND HUMAN RESOURCES IN S&T

Estonian GERD is still low (0.75%) compared to the EU average of 1.93%. In 2001 GERD has increased and it is planned to reach 1.5% of GDP for R&D and innovation by 2006.[30] Promoting science and research in Estonia required a further increase in business expenditure on research and development. In 1999 GERD was financed by business sector with 24.2% which is below the EU average of 56.3%.

Figure 13: GERD as a % of GDP in the EU Candidate Countries – Estonia (1997,1998,1999)



Source: EUROSTAT, European Commission DG Research

Table 10: GERD in Estonia (1999)

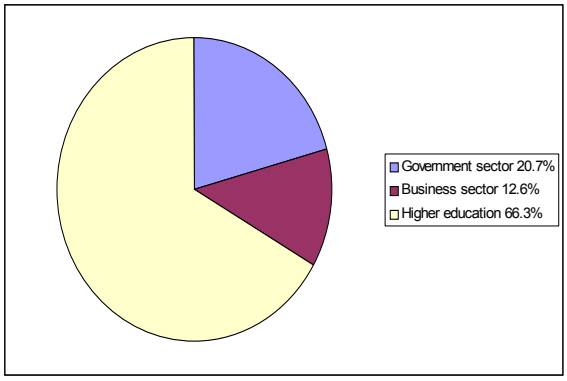
GERD as % of GDP (1999):	0.75	1.93 (EU 15)
GERD financed by business:	24.2%	56.3% (EU 15)

Sources: European Commission DG Research – Key Figures 2002

[29] The author would like to thank Ms. Marek TIITS, Permanent Secretary of the Estonian Research and Development Council for his contribution and comments. Nevertheless the author takes full responsibility for the content of this country analysis.

[30] According to the Estonian Research and Development Strategy 2002-2006 adopted by the Estonian Parliament in December 2001.

Figure 14: Researchers in % by sector in Estonia (1999)



Source: EUROSTAT, European Commission DG Research – Key Figures 2002

Total R&D personnel in Estonia were 4.545 people in 1999, which represented 0.66% of the labour force in Estonia. The highest share of researchers comes from the Higher education sector (1990). The distribution of researchers across government, business and the higher education sector indicates where the capacity to produce and absorb knowledge can be found. The share of researchers employed in the business sector (18.3%) in Estonia is still low compared to the EU average of 50% but better then the EU 15 minimum level of 12.7% and Portugal and Greece with 15.6%. Total personnel employed in R&D represent 0.66% of the labour force in Estonia. In gender balance, Estonia performs better then the EU average of 30%, with 41% of female researchers. The number of female researcher's not declining as is the case in some other EU Candidate countries but is stable. Regarding the gender balance Estonia, as most of the other EU Candidate countries, performs better than EU (30%) average with 41% of female researchers (FTE).

Table 11: Human Resources in S&T in Estonia (1999)

Type of researchers	Number of researchers	EU total number or EU average in %	Type of researchers as % of labour force
Total number of R&D personnel	**4,545**	**1,689,490**	**0.66%**
Number of female R&D Personnel	2,346	-	0.34%
Full-time equivalent (FTE) Total	3,002	919,796	0.44%
Full-time equivalent (FTE) Female	1,252	30%	0.18%
Business sector	**378**	**50%**	**0.05%**
Government sector	621	14.2%	0.09%
Higher education Sector	1,990	34.3%	0.29%

Source: EUROSTAT, EC DG Research, EC DG Employment and IPTS additional calculation[31]

[31] Labour force in Estonia (1999): 679,168 – European Commission DG Employment
EU-15 (1999): 5.63 researchers (FTE) per 1000 in the labour force (head count).

B. S&T and ECONOMIC PERFORMANCE for THE KNOWLEDGE BASED ECONOMY in ESTONIA

Figure 15: Scientific Performance (publications per million population (1999))

Estonia	EU -15	Sweden	Portugal
330	755	1657	333

Sources: European Commission DG Research – Key figures 2002

Estonia performs seemingly better then EU average in the field of high tech export, however the share of high-tech industries in total manufacturing value added is much lower. Large part of Estonian electronics exports comes from the Tallinn plant of a multinational contract manufacturing company.

In the field of producing scientific knowledge Estonia performs better with publications (330) then most of the EU Candidate Countries. In general together with its human resources potential and relatively good position in the field of S&T and economic performance Estonia could contribute to the further development of the Knowledge Based Society in the Baltic region.

According to the **European Trend Chart on Innovation 2002**[32] a relative weakness of Estonia is in the field of the trend for business expenditure on R&D. As in other acceding countries, inward technology transfer is the main source of innovation and increases in productivity. Major strengths in innovation are in the fields of current tertiary education, the level of internet access of the population and inward FDI.

Table 12: S&T and Economic Performance of Estonia

GDP per capita in Euros (PPS; 2001):	**9,820**	**23,200 (EU 15)**
GDP average annual growth (1995-2000):	**4.90%**	**2.63% (EU15)**
Patents per million (1999):	**2**	**126 (EU15)**
Publications per million (1999):	**330**	**755 (EU15)**
High-tech exports, as % of total exp. (1999):	**21.7%**	**19.7% (EU15)**

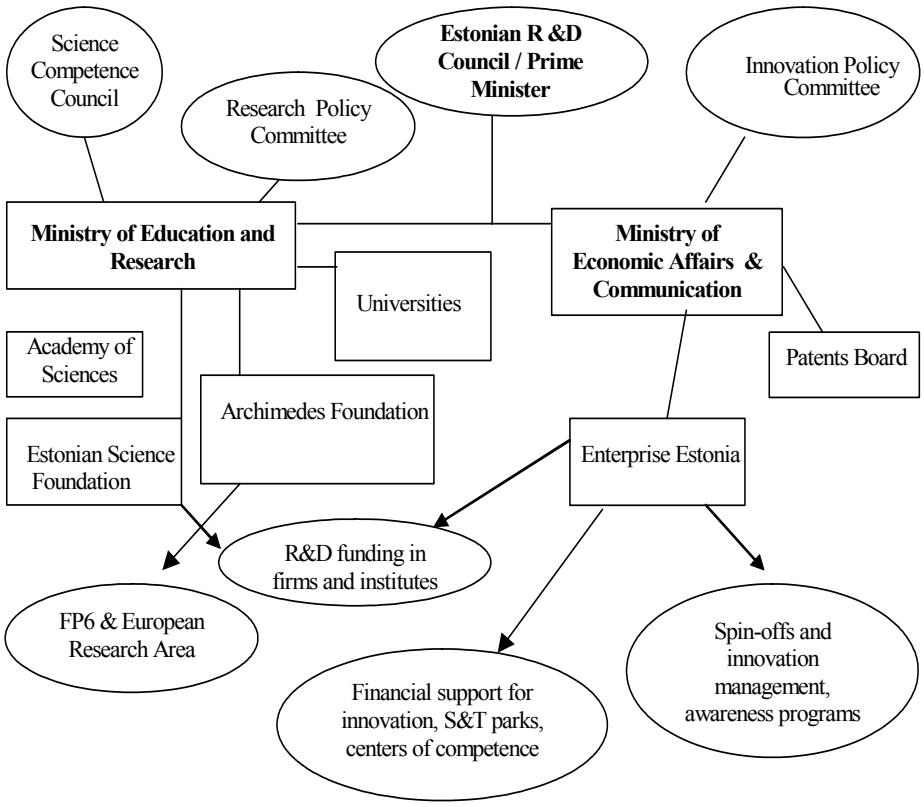
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

[32] European Commission DG Enterprise: 2002 European Innovation Scoreboard: Technical Paper No 2 - Candidate Countries, see annex Data Definitions and Sources and annex European Innovation Scoreboard 2002 – Trends (Candidate Countries) (www.cordis.lu/trendchart)

II. INSTITUTIONAL CAPACITY for S&T POLICY MAKING in ESTONIA

The **Ministry of Education and Research** is responsible for the management of basic and applied research in Estonia. The main advisory body to the government in the field of research and development is the Estonian Research and Development Council, headed by the Prime Minister. The **Ministry of Education and Research** integrates traditional educational values with contemporary development trends. The **Ministry of Economic Affairs and Communication** is the administration responsible for developing and implementing Estonian industrial policy, the technological development and innovation management. The Estonian government has ensured an investor-friendly business climate which contributed to a large number of technological improvements based on FDI.

Figure 16: Institutional capacity for S&T and innovation policy making in Estonia (2003)



Source: European Commission DG Enterprise and authors' own compilation

The Research and Development Council of Estonia is an advisory body to the Government on issues regarding research and development. The Chairman of the R&D Council is the Prime Minister. The Research and Development Council also comprises representatives of the research institutions and economic community. The members of the R&D Council are nominated by the Government for up to three years. The Research and Development Policy Committee (at the Council) together with the Ministry of Education, prepares documents that shape the research and development policy of Estonia.

By analysing the education and research development trends in Estonia and elsewhere, the **Research Policy Committee, Research and Higher Education Quality Assessment Council** and **Science**

Competence Council are involved **together with the Ministry of Education and Research** in shaping research and development policy. **The Innovation Policy Committee** together with the **Ministry of Economic Affairs and Communications**, prepares documents shaping innovation policy in Estonia.

The reform of the system of research and higher education started in 1990 and was focused on the introduction of legislative measures for reorganising and financing science. Most of the previous research institutes of the **Estonian Academy of Sciences,** which is today an independent organisation, were integrated into **universities** with the aim to join basic research better with degree courses and to use the existing research resources more efficiently. Another part of these institutes was transformed into independent state agencies. However, there is still a need to improve the effectiveness of the organisation of R&D system by reinforcing the institutions belonging to the system and by intensifying co-operation between them.

The Archimedes Foundation is actively participating in the network of FP6 National Contact points. Tartu Science Park, Archimedes Foundation, Tallinn Technical University Innovation Centre Foundation, and Enterprise Estonia act jointly, as **Estonian Innovation Relay Centre**, being part of the community network supported by the European Commission DG Enterprise.

Enterprise Estonia is one of the largest institutions within the national support system for entrepreneurship in Estonia. The Agency provides financing products, counseling, co-operation opportunities and training for entrepreneurs, researcher establishments, public and third sector. The objective of the Enterprise Estonia is to assist Estonian research institutions in conducting technology-related and innovative feasibility studies and applied research, by way of financing relevant projects with grants. Besides financial assistance, the knowledge and experience of the agency's specialists help research institutions to prepare research projects and reduce risks accompanying the implementation of the projects.

The **Estonian Science Foundation**, established on July 1990 by Estonian Government, is an expert research-funding organisation. Its main goal is to support the most promising research initiatives in all fields of basic and applied research. The Estonian Science Foundation uses state budget appropriations to award peer-reviewed research grants to individuals and research groups on a competitive basis. The Foundation finances 738 research projects in 2003. The annual budget of the Foundation for research is about 4.5 million Euros. This represents about 22% of total Estonian government research funding in 2000. Every year over 2000 professional researchers, as well as post-graduate and doctoral students at universities and research institutions is working on more than 750 Foundations-funded projects[33].

Science Competence Council advises the Ministry of Education and Research on allocation of targeted funding for research and development. In 2002, total budget of the targeted funding was 12,6 MEUR. All together 266 research themes of average size of 43,000 Euros were funded. In addition 758 grants of 1,200 Euros on average were provided to the PhD students. [34]

[33] Source: The Estonian Science Foundation 2003

[34] Competitiveness and future outlooks of the Estonian economy, Research and Development Council of Estonia, Tallinn 2003, p. 60.

III. POLICIES & STRATEGIES FOR THE KNOWLEDGE BASED ECONOMY in ESTONIA

S&T priorities: The **Strategy of Estonian Research and Development (2001-2006) "Knowledge Based Estonia"** defines strategic objectives of Estonian R&D to improve the quality of life of Estonian people and to increase the competitiveness of Estonian enterprises.

The Estonian R&D Strategy was approved by the Riigikogu (Parliament) on December 2001. On the basis of the R&D Strategy, annual R&D and innovation action plans are developed.

Three **key areas** for Estonian R&D are (Knowledge Based Estonia):

- user-friendly information technology and development of the information society
- biomedicine;
- material technologies.

The **long-term priorities in R&D and innovation** consider:

- development of a knowledge-based society;
- enhancement of the quality of higher education, basic research and research in areas of national interest;
- to narrow the gap between Estonian RTD financing level and that of an "average" EU member state, mainly by increasing substantially state budget expenditure on applied research and technological development;
- development of a national innovation system, improvement of linkages between the R&D system and business sector, encouragement of the private sector participation in R&D and innovation activities;
- promotion of entrepreneurs, particularly SMEs for innovation;
- adjustment of the priorities of RTD and innovation with the appropriate priorities of the EU, active participation in international co-operation, incl. RTD programmes of the EU.

Box 9: Knowledge Based Estonia and the planning of Estonia's future

The strategy Knowledge Based Estonia endorsed by the Government of the Republic of Estonia and the Riigikogu (Parliament) outlines the purpose and general principles of the activities; however, it does not provide a specific strategic action plan how to achieve the desired changes in society and economy. The creation of a knowledge-based economy and society and the preparation of respective action plans presuppose that the situation of the Estonian economy be analysed and deeper insights into the current basis of economic development gained. Only this basis can serve the planning of Estonia's future in a way that would guarantee rapid economic growth and harmonisation of the average wage level in Estonia with that of the European Union.

Source: Competitiveness and future outlooks of the Estonian economy, Research and Development Council of Estonia, Tallinn 2003.

There is an emphasis also on the research needed to ensure the spiritual culture and the preservation and strengthening of national identity. Besides research related to the social sphere and the national security, specific scientific themes focus on **Estonian nation, cultural heritage and history**, Estonian nature (marine sciences focused on the Baltic Sea area, oil shale research), Finno-Ugric studies (in the framework of general linguistics) and language technology-oriented studies.

In order to provide new impetus for economic development, 2/3 of the investment should, like in developed countries, come from the private sector. This is an extremely serious challenge for Estonia where in 2000 companies' investment in R&D was merely 0.15% of the GDP, and exporting companies had on average 1.5 employees dealing with product development.[35]

Box 10: The example of Estonian university – industry relations at Tallinn Technical University

In Estonia the integration of research at university has significantly strengthened the research capacities and intellectual resources of the universities. The Tallinn Technical University (TTU) has combined bottom-up and top-down approaches in extending its industry relations. For several years now TTU has carried out contract research on behalf of large infrastructure companies in the areas of electricity production and distribution and oil shale mining, as well as with manufacturing companies in the fields of signal processing, electrical equipment and power electronics, automotive industry, etc. In the field of telecommunications, TTU has started long-term co-operation with the Estonian Mobile Telephone Company and Ericsson Eesti AS, launching a testing and training laboratory. In addition to contracts with local companies TTU performs contract research for foreign companies as well. Current contracts include large multinational concerns (like Nokia), but also small companies (Fincitec in Finland) and ranges from sector such us chemical technologies, material technologies to information technologies and telecommunications.

Source: Technology, Knowledge and Learning, Enlargement Futures Report / Rein Küttner

High on the policy agenda is increasing the competitiveness of industry, focusing on factors like innovation, education and technical infrastructure. Special efforts are devoted also to the establishment of competence centers and innovation support structures such as science and technology parks, innovation and incubation centers, consulting researchers on IPR and commercialisation of research results, etc. However, some revision of the established structures has been initiated in 2000 in order to achieve the aims for application-oriented studies and connection with industry. In addition, insufficiently developed mechanisms for technology transfer, including the lack of funding for start-ups and low efficiency of business support institutions are seen as main impediments to a commercialisation of R&D results and technology upgrade.

The Ministry of Education and Research has initiated the **Estonian Programme for Centres of Excellence in Research** in order to establish conditions for high – level research and to create a mechanism for elaborating, developing and implementing innovative ideas. The Estonian strategy of "centres of excellence" involves also social sciences and humanities and not only hard science. Six institutes were nominated as "**Estonian Centre of Excellence in Research**" in December 2001, and another four in November 2002. The Estonian Government supports the development of research and technological parks with a full set of services in both Tallinn and Tartu. Government also supports a network of regional innovation and incubation centres in those regions, in which there is sufficient local potential and local initiative.

[35] Competitiveness and future outlooks of the Estonian economy, Research and Development Council of Estonia, Tallinn 2003.

Towards the development of the Knowledge Based Economy in Estonia

According to the EC Report (October 2002) for the further development of the R&D sector and for an effective integration of Estonia into the European Research Area (ERA), it is important to increase the gross domestic expenditure on research and technological development. Further concrete measures are required to stimulate business enterprise expenditure on research and technology development. Measures are needed to promote and enhance the rate of research and development, to further encourage research that supplies relevant technology to small and medium-sized enterprises, and to increase European co-operation in this field. (Source: EC Regular Report – October 2002)

Box 11: RELEVANT INFORMATION SOURCES IN ESTONIA

Government portal: www.riik.ee/en/valitsus/ (Sep. 2003)
Estonian Ministry of Education and Research: www.hm.ee (Sep. 2003)
Ministry of Economic Affairs and Communications: www.mkm.ee (Sep. 2003)
Estonian Research and Development Council: www.tan.ee (Sep. 2003)
Enterprise Estonia : www.eas.ee (Sep. 2003)
Estonian Chamber of Commerce and Industry: www.koda.ee (Sep. 2003)
Estonian review (economy): www.vm.ee/eng/economy/index.html (Sep. 2003)
The Estonian Science Foundation: www.etf.ee (Sep. 2003)

CHAPTER 5: Republic of HUNGARY

COUNTRY PROFILE[36]

Area:	**93,036 km²**
Population:	**10.179 million people**
GDP/capita (PPS; 2001):	**11,880 Euros**
GDP growth (1995-2000):	**4.02%**
Unemployment rate (2002):	**5.6%**
GERD as a % of GDP (2001)[37]:	**0.94%**

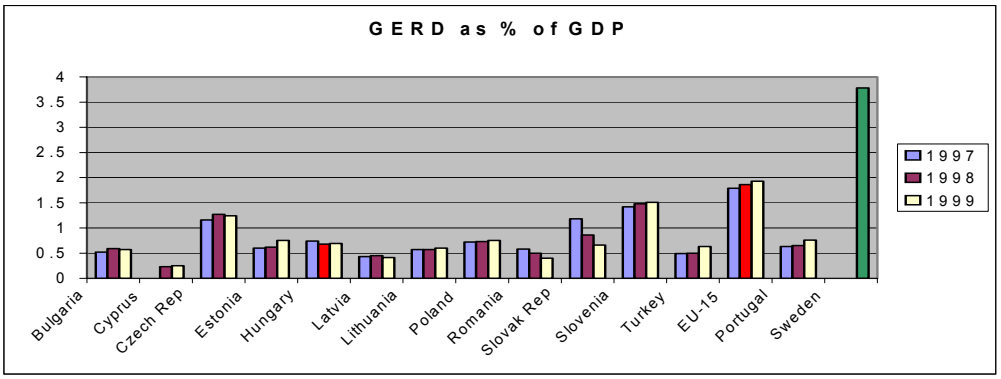
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

I. BASIC INDICATORS OF INVESTMENT & PERFORMANCE FOR THE KNOWLEDGE BASED ECONOMY in HUNGARY

A. R&D INVESTMENT AND HUMAN RESOURCES IN S&T

The Gross domestic expenditure on R&D (GERD) as a percentage of GDP is still fairly low 0.94% compared to the EU average of 1.93%. As a result of the substantial economic and financial challenges that accompanied Hungary's transition to a market economy, state subsidies as well as business spending for R&D and innovation dropped significantly in the 1990s. Between 1990 and 1996, the rate of expenditure spent on R&D relative to the GDP decreased from 1.6% to 0.7% and stayed at this low level for the second half of the decade.

Figure 17: GERD as a % of GDP in the EU Candidate Countries – Hungary (1997, 1998, 1999)



Source: EUROSTAT, European Commission DG Research

Table 13: GERD in Hungary (1999)

GERD as % of GDP:	0.69%	1.93% (EU 15)
GERD financed by business:	38.5%	56.3% (EU 15)

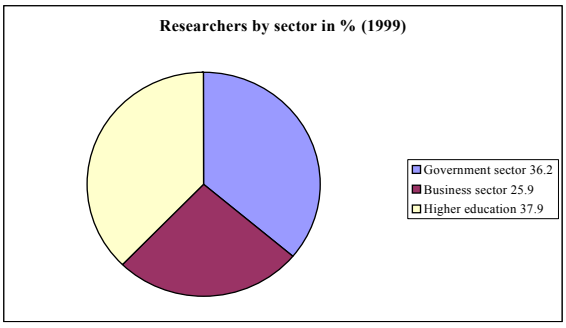
Source: European Commission DG Research – Key Figures 2002

[36] The author would like to thank Mr. Andras SIEGLER Advisor to the State Secretary in charge of R&D of the Ministry of Education of Hungary, and Mr. Tamas BALOGH Senior Head of Department of R&D Strategy, R&D Division of the Ministry of Education of Hungary and Mr. Tibor DORY Research fellow at the EC JRC/IPTS in Seville for their contributions and comments. Nevertheless the author takes full responsibility for the content of this country analysis.

[37] In 2002 GERD/GDP in Hungary was 1.01% according to the preliminary data of CSO (Source: Ministry of Education – Hungary)

The Hungarian government introduced a lot of new measures in order to narrow the gap between the EU average (1.93%) and Hungary (0.69% in 1999), reaching 0.94% in 2001.

Figure 18: Researchers by sector (%) in Hungary (1999)



Source: EUROSTAT, European Commission DG Research – Key Figures 2002

Total R&D personnel in Hungary were 21,329 people in 1999, which represented 0.52% of the labour force in Hungary. Human resources in S&T are an indicator of the capacity to produce scientific and technological knowledge. In full-time equivalents (FTE), Hungary has a total of 12,579 researchers. The distribution of researchers across government, business and the higher education sectors indicates where the capacity to produce and absorb knowledge can be found. The share of the business sector in Hungary is 25.9% of researchers which is lower than the EU average of 50%, but still higher than in Greece (15.6%) or Portugal (12.7%) and similar to Spain (24.7%).

Table 14: Human Resources in S&T in Hungary (1999)

Type of researchers	Number of researchers	EU total number or EU average in %	Type of researchers as % of labour force
Total number of R&D personnel	**21,329**	**1,689,490**	**0.52%**
Number of female R&D Personnel	-	-	-
Full-time equivalent (FTE) Total	12,579	919,796	0.31%
Full-time equivalent (FTE) Female	-	30%	-
Business sector	**3,258**	**50%**	**0.08%**
Government sector	4,554	14.2%	0.11%
Higher education Sector	4,767	34.3%	0.11%

Source: EUROSTAT, EC DG Research, EC DG Employment and IPTS additional calculation[38]

[38] Labour force in Hungary (1999): 4,045,409
EU-15 (1999): 5.63 researchers (FTE) per 1000 in the labour force (head count).

B. S&T and ECONOMIC PERFORMANCE for THE KNOWLEDGE BASED ECONOMY in HUNGARY

Figure 19: Scientific Performance (publications per million population (1999))

Hungary	EU -15	Sweden	Portugal
370	755	1657	333

Source: European Commission DG Research -Key Figures 2002

In producing scientific knowledge Hungary performs well relative to the other EU Candidate countries. The Hungarian share of high-tech exports of total exports reaches 22.9%, the highest among Candidate countries and above the EU average of 19.7%. This is a result of the considerable amount of foreign direct investment (FDI) in high-tech sectors (*see box chapter III*).

According to the **European Trend Chart on Innovation** 2002[39] the relative weaknesses of Hungary are in the trends for S&T graduates and inward FDI. There is also a weakness in the field of current education. On the other hand major strengths in innovation are in the fields of current medium /hi-tech manufacturing employment, patents applied at the European patent office and on trend for the level of internet access of the population.

Table 15: S&T and Economic Performance of Hungary

GDP per capita in Euros (PPS; 2001):	11,880	23,200 (EU15)
GDP average annual growth (1995-2000):	4.02%	2.63% (EU15)
Patents per million inhabitants (1999):	12	126 (EU15)
Publications per million inhabitants (1999):	370	755 (EU15)
High-tech exports, as % of total exp.(1999):	22.9%	19.7% (EU15)

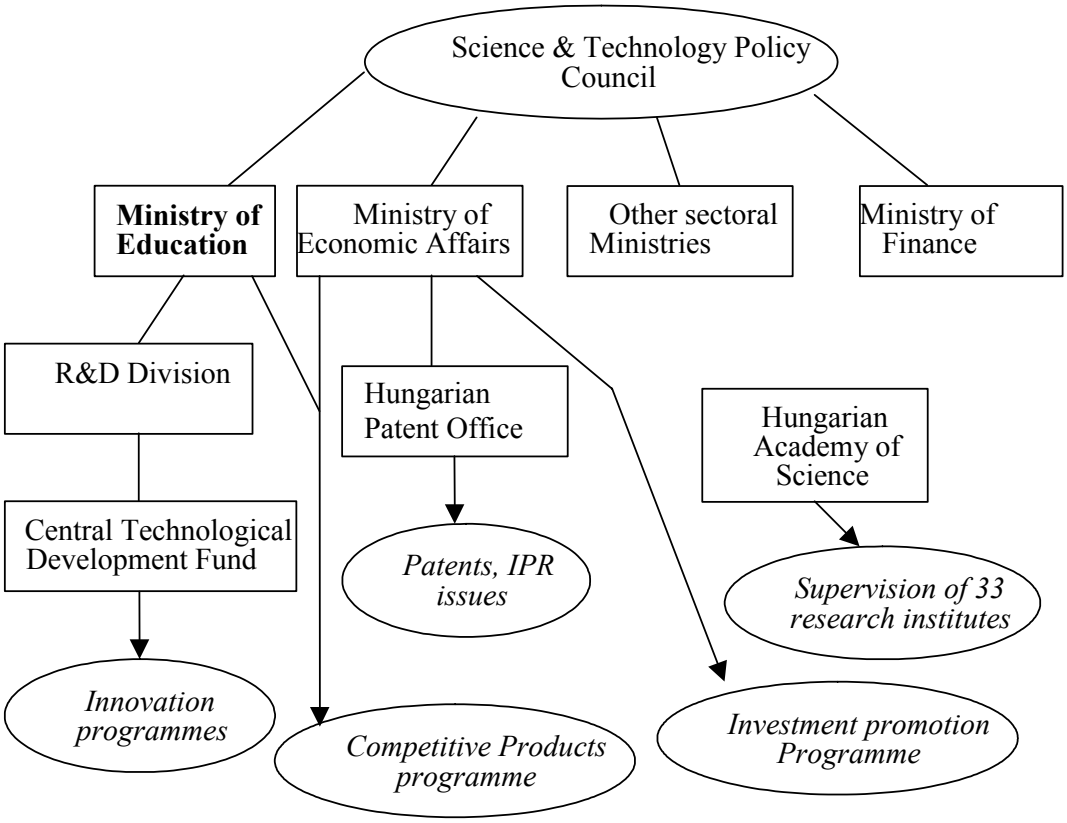
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

[39] European Commission DG Enterprise: 2002 European Innovation Scoreboard: Technical Paper No 2 - Candidate Countries, see annex Data Definitions and Sources and annex European Innovation Scoreboard 2002 – Trends (Candidate Countries) (www.cordis.lu/trendchart)

II. INSTITUTIONAL CAPACITY for S&T POLICY MAKING in HUNGARY

The present[40] Hungarian national S&T system at institutional level consists of three main components; governmental organisations, The Hungarian Academy of Sciences and research and technology institutions. The following diagram illustrates the main players in the field of policy design and delivery in Hungary.

Figure 20: Institutional Capacity for S&T Policy Making in Hungary (2003)



Source: European Commission DG Enterprise, Ministry of Education of Hungary and author's own compilation

At the government level, the **Ministry of Education** is responsible for designing and implementing the Hungarian science and technology policy, for the competition based Research and Development programmes. The Ministry of Education is also responsible for promoting international science and technology co-operation of Hungary, including the EU. The **R&D division** of the **Ministry of Education** has the following responsibilities; preparing documents concerning the national science and technology policy, runs technology foresight programs. Ministry also prepares reports and reviews for promoting the acquisition and dissemination of new knowledge and information serving the government's science and technology strategy (in co-operation with social partners, NGOs, industrials and professional associations

[40] According to Mr. BALOGH the current R&D institutional system is under reorganisation, which means that situation will be different after January 2004.

The **R&D Division of the Ministry** is responsible for the implementation of science and technology policy by managing different R&D support programmes financed from the Central Technology Development Fund and the National R&D Programs.

In Hungary the **Science and Technology Policy Council** is the highest governmental body responsible for the research policy. The council assists the government in science and technology policy issues and in the preparation of strategic documents. A **Science Advisory Board** to this Council serves as an advisory, co-ordination and evaluative body for the formulation of the science and technology policy.

The **Ministry of Education** is the successor of the National Committee for Technological Development (OMFB) and a state body responsible for the supervision of both higher education and R&D policy.

The **Ministry of Economic Affairs plays an important role in the formulation of innovation policy**, which supervises the government organisations for measurement, quality management, intellectual property, standardisation, etc. and is also responsible for SME policy.

The **Hungarian Academy of Science** is an independent public body based on the principle of self-government. It consist of members of the Academy – ordinary and honorary members. At present the number of the ordinary members is 214, while the number of honorary members is 86. The Academy's share in Hungarian research capacity is 10% of the total number of R&D organisations. The Academy's share is 20% in the number of total R&D personnel. The research institutes of the Academy deal with natural sciences and mathematics, life sciences and social sciences including humanities.

As the **non-budgetary research establishments** the Bay Zoltan Foundation (BZF) and Collegium Budapest are the most important among the research units of foundations and associations. The BZF is the largest research foundation in Hungary, founded in 1993, comprising three research units: Institute for Biotechnology, Institute for Material Science and Technology and Institute of Logistic and Production Engineering. The Collegium Budapest represents a new type of institute, different from both universities and specialised research institutes. It follows the model of the Princeton Institute for Advanced Studies and the Berlin Wissenschaftszentrum model.

The **innovation activity** of the business sector is growing more and more, which is reflected in the increasing number of R&D units in companies. A number of well-known multi-national companies have set up research laboratories in the country.

Parliament's Education and Science Committee is the highest-level political representative of science and innovation in Hungary.

III. POLICIES & STRATEGIES FOR KNOWLEDGE BASED ECONOMY in HUNGARY

Science and technology policy is defined in the 2002 government programme as an increasingly important government tool to promote the development of the society and economy. According to the government plan direct budget allocations and indirect economy and science policy incentives will provide further continues growth of the R&D expenditure. Policy targeted to production related innovation has a priority in the government programme. Investments are based on advanced technology, a highly skilled workforce and co-operation with local development initiatives. The government defines four priority areas:

- innovation conductive legal framework
- making Hungary attractive as an R&D site
- enhancing the protection of intellectual property
- increasing the sources for innovation in SMEs

The **National Development Plan** places Knowledge society and Knowledge Based Economy in the centre. After joining the European Union by 1 May 2004 Hungary will be entitled to receive subsidies from the Structural Funds of the EU. The primary aim of structural funds is to reduce development differences between regions. The main strategic objectives of NDP are in harmony with the future scenario describing the successful establishment of a knowledge-based society in Hungary. Along the development pathway described in the **"Creative Hungary"** scenario – mainly by efficiently utilising the EU resources – the country will soon successfully step into the ***"innovations development period",*** maintaining the high growth rate that is characteristic for the reconstruction period. Hungary is expecting to catch up with the most developed member states of the EU in several fields by 2015.

In the framework of the **National Development Plan,** R&D and innovation are treated in the Economic Competitiveness Operative Program, along with further important topics such us the Information Society, investment incentives, SME promotion and tourism.

All existing and planned R&D and innovation actions are organised in three large measures:

- Strategic and co-operation research and technology development projects,
- R&D resource and infrastructure development for the research institutions and development of human resources for innovation
- Innovation skills, innovative networks and resources for companies.

Hungary undertook market-type reforms many years before other CEECs. During the reforms after 1989, the R&D potential encountered severe shocks. Due to the passive R&D strategies of companies and the lack of expenditure for research, industrial research was close to collapse. The main problems have been found in the lack of industrial demand for public research, insufficient interaction of research institutes with universities and the internal brain drain.

The new **industrial policy** launched by the **Ministry of Economic Affairs** emphasises support on in-company research and innovation, strengthening the role of FDI for modernisation, accelerating technology transfer and providing support for subcontracting between domestic and foreign companies.

Industrial parks obtain support through the infrastructure development tenders jointly issued by the **Economy Development and Regional Development/Rural Development Funds**. The Economy Development Fund is a separate public fund managed by the **Ministry for Economic Affairs**, which is used to support investment projects. The Rural Development Fund is handled by the **Ministry for Agriculture and Rural Development** and is used to support the development of socially and economically backward regions. An example for promoting investment in R&D was the **"Szechenyi Plan" funding scheme -** a relatively new funding scheme, supporting exclusively business-academy collaborations. Grants or favourable loans were available for practically all Hungarian researchers or organisations (firms, university departments, other R&D units) awarded through three main schemes: - *R&D infrastructure projects, Applied R&D projects and Target-oriented national projects.*

Box 12: Main R&D facilities established in Hungary mainly by multi-national companies

Lighting technique (GE-TUNGSRAM)
Medical equipment (GE-Medicor)
Pharmaceuticals (Sanofi-Chinoin, Astra, Teva-Biogal, Akzo Nobel/Organon)
Information and telecommunication (Ericsson, IBM, Compaq, Nokia, Siemens, Motorola, Tata Consultancy, T-Systems/Matav)
Machinery (Audi, Volkswagen, TEMIC, Michelin, Knorr-Bremse, Mannesmann-Rexroth, Flextronics)
Agrifood (Novartis/Sandoz Seeds)
Household chemicals (Unilever)
New materials (ZOLTEK, Furukawa)

Source: Research and Development in Hungary, Ministry of Education 2002

The data presented explain why the technological performance of Hungary measured as high-tech exports is (together with Estonia) above EU average (see economic and S&T performance of Hungary).

Priorities and Measures of Economic Competitiveness Operational Programme in the National Development Programme (2003)[41].

There are three priorities of the R&D Programme (this is part of the Economic Competitiveness Operational Programme):

- Support to application-oriented co-operative RTD activity;
- Improvement of the conditions for research, technology transfer and co-operation at publicly financed and non-profit research facilities;
- Support to the development of corporate R&D and innovation capabilities Support to the development of corporate R&D capacity and regional innovation capabilities, and R&D and innovation networking

[41] The input on National Development Programme was prepared by Mr. Tibor DORY

Box 13: Objective and contents of the Priorities and Measures of Economic Competitiveness Operational Programme in the National Development Programme of Hungary(2003)

The objective of the Hungarian NDP includes the assistance to innovative start-up enterprises and technology-intensive SMEs, and support for the establishment of the networks that promote the innovative activities of SMEs. In addition, support should be given to the establishment of new individual industrial research bases and units, the dissemination of activities with a high added value, leading to the establishment of R&D infrastructure, and to extend corporate R&D activities. The objective of the measure is to improve the innovative capabilities of regions, strengthen the role of higher education institutions and research and development institutes as regional R&D centers, as well as their relationship and co-operation with small and medium enterprises. It should strengthen the institutional system for regional innovation, co-operation between Government, municipality, regional and corporate players, and the enrichment of the existing business network with innovation components. It should cover innovation partnerships of cross-border regions.

The content of the Hungarian NDP includes: Support for the creation and initial innovation tasks of start-up technology-and knowledge-intensive start-ups and micro enterprises (spin-off); Development of corporate research infrastructure linked to the creation of new research jobs; Encouraging Incentives for SMEs to order sub-contract R&D and acquire the right to utilised use existing R&D achievements results.

Source: National Development Plan of Hungary and Mr. Tibor DORY

Towards the Development of the Knowledge Based Economy in Hungary

The framework for co-operation in the field of science and technology together with the National Contact Points is well established. For the further successful participation of Hungary in the relevant Community R&D programmes, efforts should be made to increase the participation of SMEs. The gross domestic expenditure on R&D is still relatively low and needs to be increased, which is envisaged by the Ministry of Education. (Source: EC Regular Report – October 2002

Box 14: RELEVANT INFORMATION SOURCES IN HUNGARY

Hungarian Government: www.meh.hu/default.htm (Sep. 2003)
Hungarian Ministry of Education: www.om.hu/jg.html (Sep. 2003)
Hungarian Ministry of Industry, Trade and Tourism : www.ikm.iif.hu (Sep. 2003)
National Technical Information Centre & Library of Hungary: www.omikk.hu (Sep. 2003)

CHAPTER 6: Republic of LATVIA

COUNTRY PROFILE[42]

Area:	64,589 km^2
Population:	2.37 million people
GDP/capita (PPS; 2001):	7,710 Euros
GDP growth (1995-2000):	5.28%
Unemployment rate (2000):	14.1%
GERD as % of GDP (1999):	0.41%

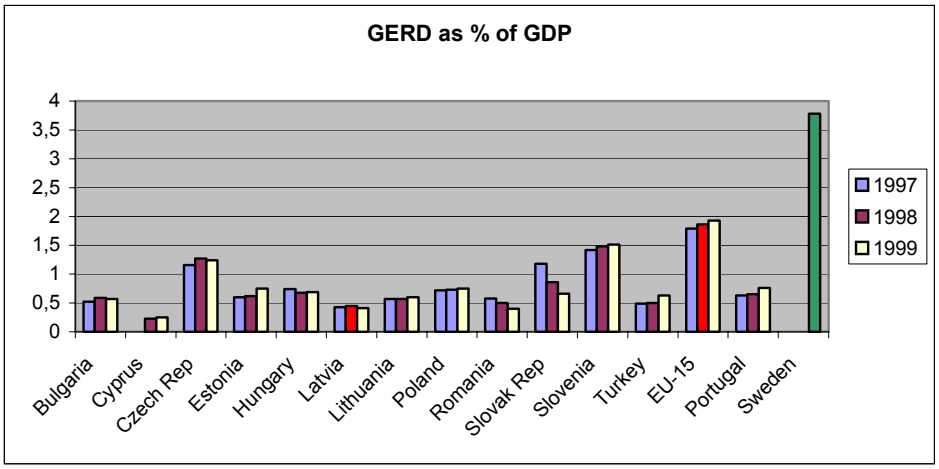
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

I. BASIC INDICATORS OF INVESTMENT AND PERFORMANCE FOR THE KNOWLEDGE BASED ECONOMY in LATVIA

A. R&D INVESTMENT AND HUMAN RESOURCES IN S&T

Latvian expenditure on R&D (GERD) is one of the lowest among the EU Candidate Countries. It is below 0.5% and in 1999 was 0.41% of GDP. GERD financed by the business sector was also relatively low and in 1999 represented only 15.7% of total GERD.

Figure 21: GERD as a % of GDP in the EU Candidate Countries - Latvia (1997, 1998, 1999)



Source: EUROSTAT, European Commission DG Research

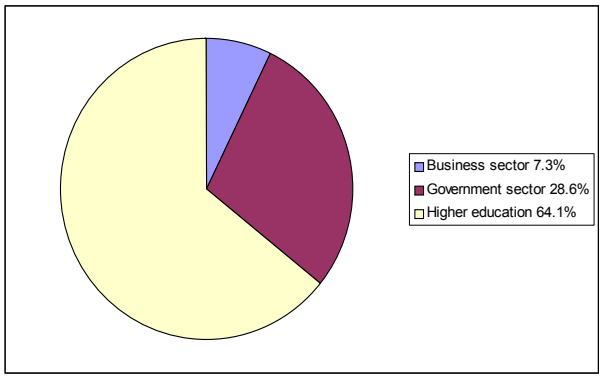
Table 16: GERD in Latvia (1999)

GERD as % of GDP (1999):	0.41%	1.93% (EU 15)
GERD financed by business:	15.7%	56.3% (EU 15)

Sources: European Commission DG Research – Key Figures 2002

[42] The author would like to thank Prof. Andrejs SILINS, Vice President of Latvian Academy of Sciences for his contribution and comments. Nevertheless the author takes full responsibility for the content of this country analysis.

Figure 22: Researchers by sector (%) in Latvia (1999)



Source: EUROSTAT, European Commission DG Research – Key Figures 2002

R&D personnel in Latvia totalled 4,301 people in 1999, which represented 0.38% of the labour force in Latvia. The highest share of researchers in Latvia came from the Higher education sector and presented 64.1% of all researchers. The distribution of researchers across government, the business sector and the higher education sector indicates where the capacity to produce and absorb knowledge can be found. The share of researchers employed in business sector 7.3% is low compared to the EU minimum and EU Candidate countries average. In gender balance Latvia performs better than EU (30%) average with 48% of female researchers (FTE)[43].

Table 17: Human Resources in S&T in Latvia (1999)

Type of researchers	Number of researchers	EU total number or EU average in %	Type of researchers as % of labour force
Total number of R&D personnel	**4,301**	**1,689,490**	**0.38%**
Number of female R&D Personnel	2,212	-	0.19%
Full-time equivalent (FTE) Total	2,626	919,796	0.23%
Full-time equivalent (FTE) Female	1,277	30%	0.11%
Business sector	**191**	**50%**	**0.01%**
Government sector	751	14.2%	0.06%
Higher education Sector	1,683	34.3%	0.14%

Source: EUROSTAT, EC DG Research - Key Figures 2002 , EC DG Employment and IPTS additional calculation[44]

[43] Full-time equivalent female researchers in Latvia (1999): 1,277

[44] Labour force in Latvia (1999): 1,123,980 – European Commission DG Employment
EU-15 (1999): 5.63 researchers (FTE) per 1000 in the labour force (head count).

B. S&T and ECONOMIC PERFORMANCE for THE KNOWLEDGE BASED ECONOMY in LATVIA

Figure 23: Scientific performance (publications per million population (1999))

Latvia	EU – 15	Sweden	Portugal
143	755	1657	333

Sources: European Commission DG Research – Key Figures 2002

In all indicators of the S&T and economic performance, except in the average annual GDP growth between 1995 and 2000, Latvia's performance is relatively low. Nevertheless there is potential in the field of scientific performance measured by scientific publications. With 143 scientific publications per million population in 1999 Latvia performed better than some of the EU Candidate countries minimum but still behind current EU minimum level.

According to the **European Trend Chart on Innovation 2002**[45] the relative weaknesses of Latvia are in the fields of medium/hi-tech manufacturing employment, patents applications at the European patent office and the level of internet access of the population. There is also a weakness in the trend for the level of internet access of the population. On the other hand major strengths in innovation are in the fields of current life-long learning and in trends for medium/hi-tech manufacturing employment and business expenditure on R&D.

Table 18: S&T and Economic Performance of Latvia

GDP per capita in Euros (PPS; 2001):	7,710	23,200 (EU 15)
GDP average annual growth (1995-2000):	5.28%	2.63% (EU15)
Patents per million (1999):	3	126 (EU15)
Publications per million (1999):	143	755 (EU15)
High-tech exports, as % of total exp. (1999):	2.2%	9.7% (EU15)

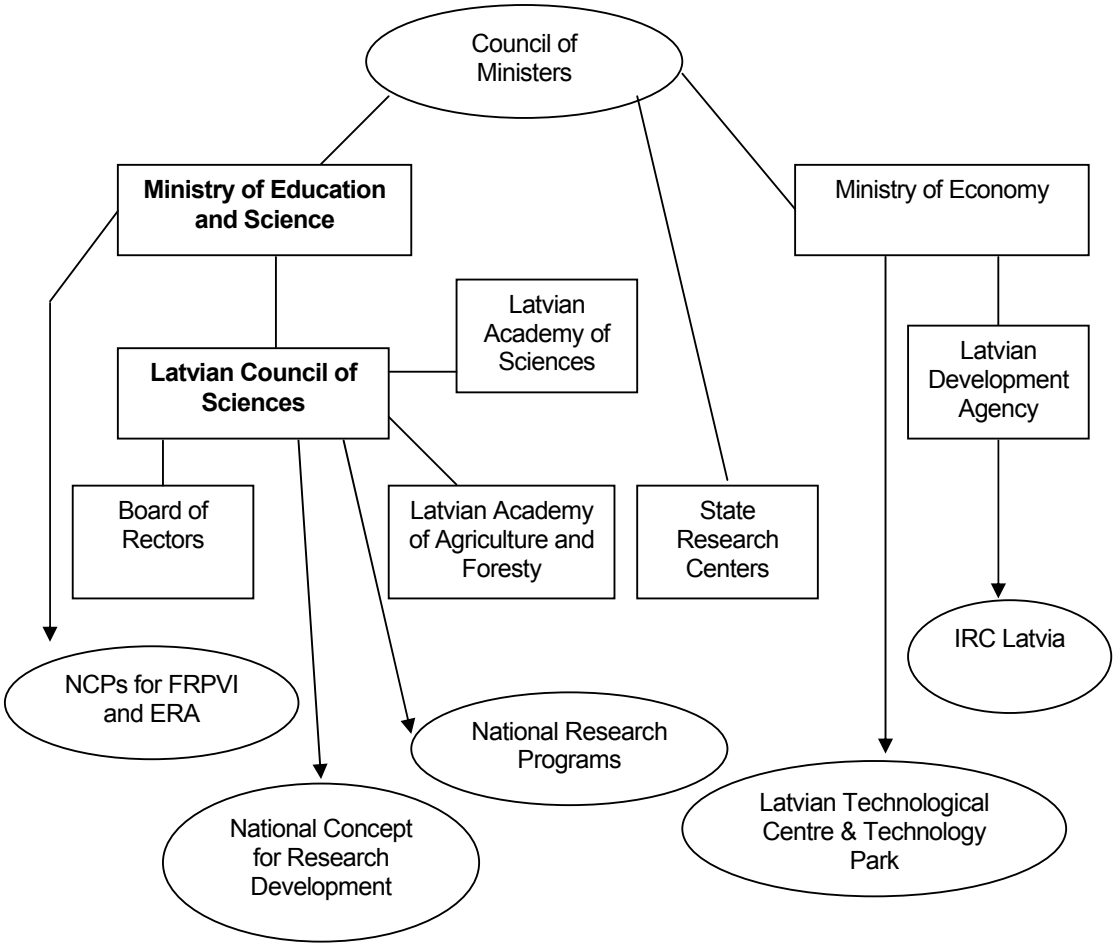
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

[45] European Commission DG Enterprise: 2002 European Innovation Scoreboard: Technical Paper No 2 - Candidate Countries, see annex Data Definitions and Sources and annex European Innovation Scoreboard 2002 – Trends (Candidate Countries) (www.cordis.lu/trendchart)

II. INSTITUTIONAL CAPACITY for S&T POLICY MAKING in LATVIA

The **Ministry of Education and Science** is the central state institution responsible for the development and implementation of state S&T policy. The **Latvian Council of Science** is a collegial body of researchers established by decision of the **Council of Ministers**. The Council's tasks include advancement, evaluation, financing and co-ordination of scientific research in Latvia.

Figure 24: Institutional Capacity for S&T Policy Making in Latvia



Source: Latvian Council of Science and Authors' own compilation

The **Latvian Council of Science** is the governmental body controlling the main science budget, allocated through the grant system to particular projects. Approximately 62% of the governmental funds are for basic and applied research, and 10% for projects ordered by state institutions/ ministries. The Council consists of *25* members: 14 Council members are elected from 14 branches of science, 5 additional members are included from Joint expert commissions of natural sciences, engineering sciences, biology and medical sciences, agricultural and forestry sciences and humanities and social sciences. The Latvian Council of Science also includes 6 members in accordance with their positions and they represent the following institutions/ associations: Ministry of Education and Science, Latvian Academy of Science, Board of Rectors of the higher education institutions, Association of Latvian Scientists and Latvian Academy of Agricultural and Forestry Sciences.

The **Ministry of Economy** is the governmental body responsible for the innovation policy.

State research centres represent complex research on a high scientific level, which participate in the top level study programmes at the higher educational institutions and encourage the utilisation of research results in the national economy, culture and social sector. The state research centres are established on the basis of scientific institutions, their structural units and the structural units of higher educational institutions. The main task of the centres is to conduct research within the frames of national research programmes / projects. The infrastructure of the centres is maintained by the state.

According to the Latvian National Concept on Research & Development the main criteria for the establishment of these centres are:

- the scientific research is conducted at a high internationally recognised level and its technical supply meets international requirements,
- active, internationally recognised collaboration in research and teaching thus ensuring that the studies for Master's degree and Doctor's degree meet the contemporary research requirements and demands of Latvia's labour market,
- sector-related applied and basic research ensuring the growth of national economy,
- research of national relevance and importance conducted in humanities and social sciences,
- the centre can serve as an incubator for innovative technologies and small business enterprises, a
- the innovative nature of research and adherence to economy, culture and social sector.

The state research centres (even small) have to be developed with priority in research areas in which Latvia would be able to achieve relevance at international or national level in the future.

III. POLICIES & STRATEGIES FOR THE KNOWLEDGE BASED ECONOMY in LATVIA

The government has adopted a **National concept on Research Development** (1998) which determines the development of research in **Latvia up to 2010**[46]. The main tasks of Latvian science are as follows:

- to create an intellectual environment for the development of good university education and society at large,
- to lay foundations for the development of innovative technologies and the elaboration of technology transfer mechanisms, as well as to encourage wider application of scientific methods and manners in public administration and the national economy
- to promote dynamic and sustainable social development and economic growth,
- to ensure the research and preservation of national identity and cultural heritage.

Striving to fulfil these tasks it is necessary **to increase the budgetary financing of research on the whole.**[47] As soon as the programme was introduced, the government funding was supposed to be increased at least for a sum necessary to cover the participation fee bound with the access of Latvia

[46] The document National Concept of the Republic of Latvia on Research Development was used as a back-ground paper during the Knowledge Economy Forum that was held in Helsinki, Finland in March 2003

[47] By 2010 this figure has to be annually increased at least for 0.1% from GDP.

to the EU Framework Programme and other S&T programmes. According to the Latvian national concept of Research & Development, general principles in the setting of priorities are as following:

- To ensure the availability and development of the Latvian research potential,
- To ensure a higher education in agreement with the national concept,
- To have an orientation towards the development of innovative research areas,
- To analyse and preserve the national identity and cultural heritage as an integral part of European culture,
- To ensure the development of the national economy,
- To create the possibilities for utilisation of knowledge-intensive technologies in the areas of national relevance,
- To participate in the research directions which are supported by the EU.

Box 15: Priorities of Research Development in Latvia

- Information technology,
- Material sciences,
- Forestry and timber technology,
- Organic synthesis, biotechnology, biomedicine and pharmacy,
- Letonics.

Source: National Concept of the Republic of Latvia on Research Development

The priority areas can be supplemented in accordance with the real national requirements and possibilities. In accordance with the EU Subject Programmes on research and technology development and participation of Latvia's scientists in these programmes, the Ministry of Education and Science of the Republic of Latvia has identified the priority research directions in relation to Latvia's co-operation with the European Union. Priorities in cooperation with the EU are as following:

- Information technology and telematics,
- Life sciences and biotechnology (biomedicine, drug construction, biotechnology),
- New materials and technologies,
- Ecology and environmental protection

Box 16: Three good practice examples of R&D development in Latvia[48]

In November 1999 the transfer from simple motion of electro conducting liquid to magneto active (magnetic field generating) dynamo motion was first demonstrated at the Institute of Physics University of Latvia. Until that magneto hydrodynamic (MHD) on Dynamo phenomenon was considered as hypothetical. Obtained results also allow verifying the calculation methods used for investigation of the Earth's magnetic field, as well as fields of other astrophysical objects. In 2000 foreign newspapers and the scientific press have devoted wide attention to the Dynamo experiment, carried out in Latvia (Riga). In 2002 the Riga MHD Dynamo experiment, realised in 1999, won world recognition and a European significance research centre for magneto hydrodynamics was organised.

Plasma technology for the production of different content refractor compounds (nitrides, carbides, oxides, etc.) and their composition in form nanosize powders, developed as a result of long-term investigations carried out at the Institute of Inorganic Chemistry, Riga Technical University, formed the basis of the innovation project "Transnanopowder", included in the EU 5FP. In the course of its implementation the new technology was transferred to the partners in Germany and Austria.

In 2000 the Institute of Solid State Physics (ISSP), University of Latvia, was awarded the status of Excellence Center of the EU for the investigations and technologies of advanced materials. Among 185 projects submitted to the competition the ISSP ranked 5-8 and was the only one from Latvia to receive the status. In 2002 the status of excellence have won: Institute of Physics, University of Latvia; Institute of Atomic Physics and Spectroscopy, University of Latvia; Institute of Materials and Constructions, Riga Technical University; and Latvian State Institute of Wood Chemistry.

Source: Prof. Andrejs Silins

The following directions are relevant for **sustainable development** according to the Latvian national concept on research development:

- Energy technologies,
- Forestry and agriculture research,
- Social and economic research,

The Latvian approach to restructuring R&D is based on integration of the national research potential into universities with the aim of modernising universities and strengthening their research capacities.

Research centres of national significance have been established, selected on the following criteria[49]:

- high international recognised level of research,
- correspondence of the institution profile with national research priorities,
- well developed international collaboration in research and training,
- advanced and innovative expected results.

In the main Latvian policy document related to the research development, an important part is related to the **national identity and human development**.

According to the policy document the directions of Latvia's social sciences and humanities should ensure the research, preservation and development of national identity and cultural heritage, encourage dynamic and sustainable social development and economic growth and favor efficient social and cultural policy.

[49] See also state research centres under the chapter Institutional capacity for S&T policy making in Latvia

Box 17: National Identity and Human Development Sciences in Latvia

The task of these national identity and human development sciences are as following:

- To explore Latvia's cultural, social and economic processes in the Baltic and in the Europe,
- To ensure the preservation replenishment of Latvian data bases, archives and scientific collections,
- To promote the publishing of primary sources on the history of Latvia and Latvians,
- To promote Latvian language and culture,
- To compile encyclopaedia, dictionaries and other scientific issues.

Source: National Concept of the Republic of Latvia on Research Development

An important programme for the creation of the Knowledge Based Economy in Latvia is also the governmental **Concept on the development of the National Innovation System (2001)** which aims to promote development of the economy and the process of the integration of Latvia into the European Union. For the creation of new/improved high-quality products/services the interaction of five main elements is considered necessary: higher education (E), research activities (R), technology development (TD) and implementation (I) – the formula ERTDI.

The **National programme for the development of SMEs (1997)** foresees measures for the support of SMEs, technology-oriented business and development of technology parks, centres and business incubators, as well as development of legislation favourable to the functioning of SMEs, and encouraging their competitiveness. Recently, revisions of tax laws have been discussed to encourage innovation activities in companies. The draft of regulations on the Latvian Innovation Fund has been prepared by the government with the aim supporting innovation activities and technology development in Latvia, ensuring both political and financial support for innovation. In order to support innovation, the following structures have been established; **Latvian technological centre, Latvian technology park, IRC – Latvia (EU Innovation Relay Centre).**

Towards the Development of the Knowledge Based Economy in Latvia

A conceptual document on innovation aimed at promoting the link between research and industry was adopted by the government at the beginning of 2001, and preparations for an action plan to implement the conceptual document started.

In November 2001, Latvia adopted Priority Directions of Science for Financing of Fundamental and Applied Research for the period 2002 to 2005, which cover information technologies, organic synthesis and bio-medicine, material sciences, forestry science and wood technologies. Nevertheless according to the 2002 EC Regular Report[50] the Latvian gross domestic expenditure on research and development as a percentage of GDP remains low and still needs to be increased significantly in order to come closer to the EU average. According to the Report financial constraints limit Latvia's possibilities to participate effectively in the European Research Area.

Promoting science and research in Latvia will also require a further increase in business expenditure on research and development. According to the Report research activities in universities should be fostered and proper risk capital legislation introduced. It has been noted recently that the number of

[50] EC Regular Report on Latvia; European Commission 2002

scientists is slowly decreasing in Latvia, while the number of young researchers working abroad has increased (Source: EC Regular Report October 2002).

BOX 18: RELEVANT INFORMATION SOURCES IN LATVIA

European Integration Bureau- URL: www.eib.lv (Sep. 2003)
Latvian Academy of Sciences: www.lza.lv (Sep. 2003)
Latvian Science Council: www.lzp.lv (Sep. 2003)
Latvian Ministry of Education and Science: www.izm.gov.lv (Sep. 2003)
Latvian Development Agency: www.lda.gov.lv /FEMIRC (Latvian Technological Centre) (Sep. 2003)

CHAPTER 7: Republic of LITHUANIA

COUNTRY PROFILE[51]

Area:	65,300 km2
Population:	3.7 million people
GDP/capita (PPS; 2001):	8,730 Euros
GDP growth (1995-2000):	3.33%
Unemployment rate (2000):	15.6%
GERD as a % of GDP (2000):	0.60%

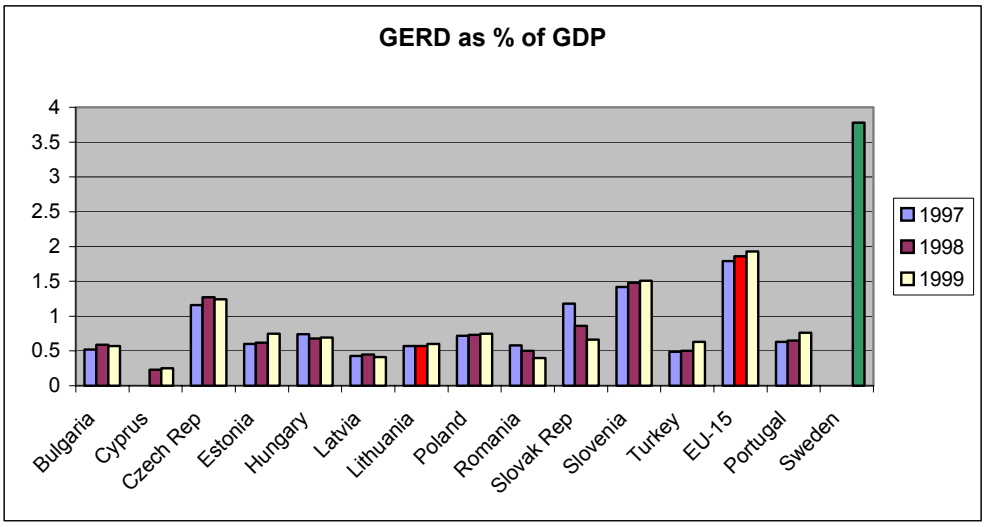
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

I. BASIC INDICATORS OF INVESTMENT AND PERFORMANCE FOR THE KNOWLEDGE BASED ECONOMY in LITHUANIA

A. R&D INVESTMENT AND HUMAN RESOURCES IN S&T

In 1999 the gross domestic expenditure on R&D (GERD) was 0.60% of the national GDP, which is behind the EU minimum (Greece 0.68%) and close to EU Candidate Countries' average of 0.7%. The research is financed mainly from the state budget, through state subsidies or directly by interested ministries for specific projects.

Figure 25: GERD as a % of GDP in the EU Candidate Countries - Lithuania (1997,1998, 1999)



Source: EUROSTAT, European Commission DG Research

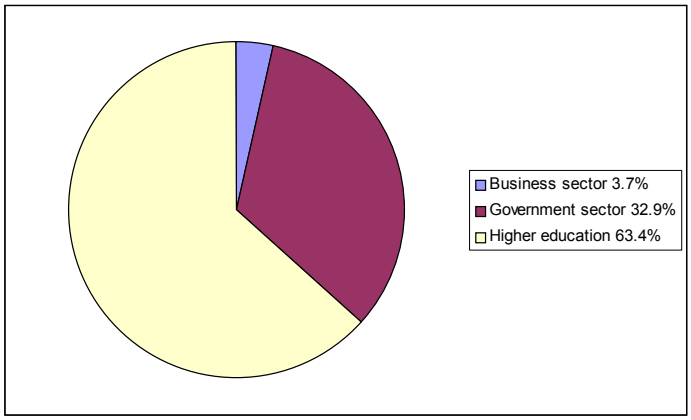
Table 19: GERD in Lithuania

GERD as % of GDP(1999):	0.60%	1.93% (EU 15)
GERD financed by business:	-	56.3% (EU 15)

Source: European Commission DG Research - Key Figures 2002

[51] The author would like to thank Dr. Antanas CENYS, Chairman of Senate (Board) in Lithuania for his contribution and comments. Nevertheless the author takes full responsibility for the content of this country analysis.

Figure 26: Researchers by sector (%) in Lithuania (1999)



Source: EUROSTAT, European Commission DG Research – Key Figures 2002

Total R&D personnel in Lithuania were 11,791 people in 1999, which represented 0.66% of the labour force in Lithuania. The share of R&D personnel in the labour force is one of the highest in all EU Candidate Countries. Human resources in S&T enable production of scientific and technological knowledge. The biggest share of researchers is employed in the Higher education sector, with occupied 63.4% of all researchers. The business sector employed only 3.7% of researchers. In this indicator Lithuania is lagging behind the EU average with 50% of researchers employed in the business sector.

Table 20: Human Resources in S&T in Lithuania (1999)

Type of researchers	Number of researchers	EU total number or EU average in %	Type of researchers as % of the labour force
Total number of R&D personnel	**11,791**	**1,689,490**	**0.66%**
Number of female R&D Personnel		-	
Full-time equivalent (FTE) Total	7,777	919,796	0.43%
Full-time equivalent (FTE) Female		30%	
Business sector	**288**	**50%**	**0.01%**
Government sector	2,559	14.2%	0.14%
Higher education Sector	4,930	34.3%	0.27%

Source: EUROSTAT, EC DG Research, EC DG Employment and IPTS additional calculation[52]

[52] Labour force in Lithuania (1999): 1,767,551 – European Commission DG Employment
EU-15 (1999): 5.63 researchers (FTE) per 1000 in the labour force (head count).

B. S&T and ECONOMIC PERFORMANCE for THE KNOWLEDGE BASED ECONOMY in LITHUANIA

Figure 27: Scientific Performance in Lithuania (publications per million population (1999))

Lithuania	EU - 15	Sweden	Portugal
127	755	1657	333

Source: European Commission DG Research – Key Figures 2002

In the field of economic performance Lithuania is doing better then in the field of S&T performance. Indicators of knowledge production show that Lithuania is behind the EU minimum with the exception of the production of publications (127). This indicator together with the indicator of human resources in S&T, may suggest that there is a human resources potential in Lithuania which can contribute to the future development and S&T performance of the country.

According to the **European Trend Chart on Innovation 2002**[53] the relative weaknesses of Lithuania are in the fields of current business expenditure on R&D, patents applied at the European Patent Office and the level of internet access of the population. On the other hand major strengths in innovation are in the trends on S&T graduates and the level of internet access of the population, and in the current education.

Table 21: S&T and Economic Performance of Lithuania

GDP per capita in Euros (PPS; 2001):	**8,730**	**23,200 (EU 15)**
GDP average annual growth (1995-2000):	**3.33%**	**2.63% (EU15)**
Patents per million (1999):	**1**	**126 (EU15)**
Publications per million (1999):	**127**	**755 (EU15)**
High-tech exports, as % of total exp. (1999):	**2.7%**	**19.7% (EU15)**

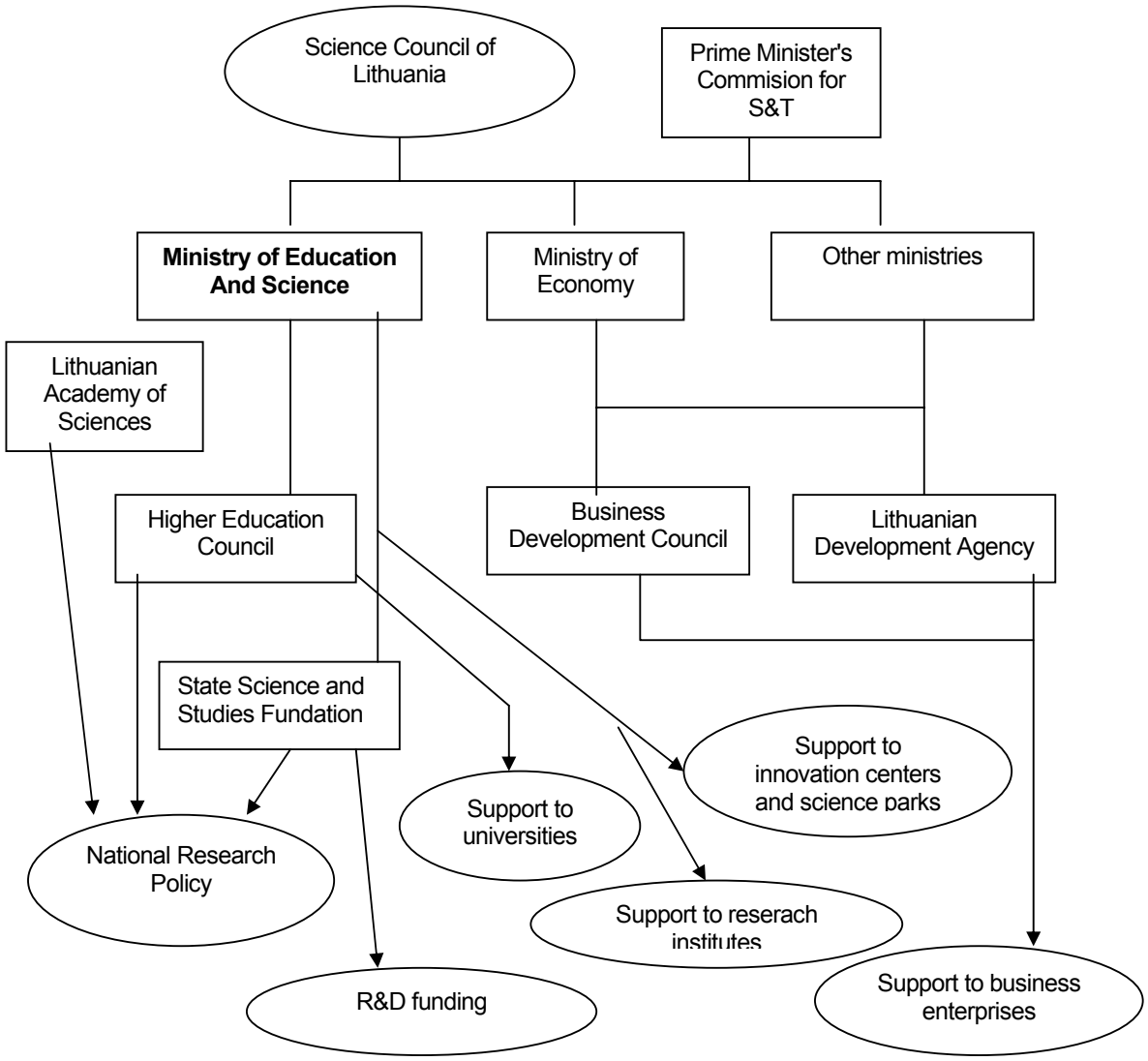
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

[53] European Commission DG Enterprise: 2002 European Innovation Scoreboard: Technical Paper No 2 - Candidate Countries, see annex Data Definitions and Sources and annex European Innovation Scoreboard 2002 – Trends (Candidate Countries) (www.cordis.lu/trendchart)

II. INSTITUTIONAL CAPACITY for S&T POLICY MAKING in LITHUANIA

The **Ministry of Education and Science** is responsible for the national policy in the field of research. It analyses the application of laws and government decrees related to higher education and development of R&D. The Ministry of Education and Science also prepares drafts of laws, coordinates and implements international programmes in education and R&D and makes proposals for the establishment, reorganisation, and in some cases closure of higher education and research institutions.

Figure 28: Institutional Capacity for S&T Policy making in Lithuania (2003)



Source: World Bank Report: Lithuania Aiming for a Knowledge economy 2003 and authors' own compilation

The central body responsible for the formulation and co-ordination of industry policy is the **Ministry of Economy**. A wide range of agencies and governmental bodies are involved in the implementation process of S&T policies.

The Science Council of Lithuania serves as a scientific adviser and consultant to the Seimas (Parliament) and the Government in solving strategic issues of research and higher education. The Council also analyses the situation in the research and higher education system in Lithuania.

Prime Minister's **Commission (Council) for Science and Technology** is chaired by the prime Minister and includes ministers of finance, education and science, economy and businessmen and scientists. The main task of the commission is to coordinate innovation policies among government ministries and the research community. The commission meets irregularly and has no secretariat to support its policy formulation and coordination role.

The **Higher Education Council** advises the Ministry of Higher Education and Science on issues of strategic development in higher education. The main tasks and functions of the council are to analyse and evaluate the development strategy for higher education in Lithuania, advise the Ministry of Higher Education and Science and develop proposals for the ministry.

The Lithuanian **State Science and Studies Foundation** provides the R&D funding on the competitive basis. At the moment it has a limited budget (3.5 million Euros in 2002). Nevertheless the foundation has announced two new programmes to finance R&D: the programme to develop advanced technologies and the programme to support priority R&D development[54].

The **Lithuanian Academy of Sciences** is an autonomous, state-subsidised scientific establishment bringing together distinguished Lithuanian scientists and also foreign scholars whose activities are related to Lithuania. The Academy of Sciences serves as an independent advisory body to the government on scientific, educational, cultural, economic, technical, and social advancement.

The decree on Main fields of activity of state research institutes (1998) establishes main research fields for **29 state research institutes**, including institutes of biochemistry, biotechnology, ecology, physics, energy and agriculture.

According to the World Bank[55] the large number of public institutions involved in R&D is responsible for the slow and insufficient decision-making and policy implementation in Lithuania.

[54] According to Mr. Cenys there were 17.4 million Euros available for the programme to develop advanced technologies in the planned budget for three years but in 2003 there were only 1.2 million Euros provided. The programme to support priority R&D was also for 1.2 million Euros and undefined funds for the future.

[55] World Bank Report: Lithuania Aiming for a Knowledge economy 2003

III. POLICIES AND STRATEGIES FOR THE KNOWLEDGE BASED ECONOMY in LITHUANIA

The Program of the Government of the Republic of Lithuania for 2001-2004[56] prioritises human investment, accelerates the creation of information and knowledge-based society as well as science and technology development. In its chapter related to Education and Science and its chapter related to the Development of Information and Knowledge-Based Society, the Lithuanian government set up main policy objectives related to the development of the Knowledge Based Economy. The S&T policy objectives derived from the basic Lithuanian Governmental programme are as following:

- To develop higher education policies
- To create conditions for institutions of science and studies
- To reorganise the network of science and study institutions
- To establish a network of universities and colleges
- To improve the management of science and study institutions
- To seek the highest possible level of democracy and openness in the activities and decisions of science and study institutions
- To ensure closer co-operation between the Conference of Lithuanian University Rectors, Lithuanian Council of Science, scientists' and students' organisations, Lithuanian Academy of Science, and to define the functions and responsibilities of the above mentioned institutions
- To enforce the autonomy of institutions
- To create and implement a new effective and rational system for financing and crediting studies
- To increase the salaries of people working at institutions of science and studies
- To promote international mobility of lecturers and students

In order to achieve the effective development of Information and Knowledge –Based Society the Lithuanian government recognised the creation of information and knowledge society based on science and innovative technologies as a strategic task of Lithuania and a trend of its economic development. For the purpose of the co-ordination of goals the government intention is to set up a Committee of Information Society Development.

Box 19: Restructuring of R&D in Lithuania

According to the EC Regular Report 2001 an active restructuring R&D policy has not been not developed in Lithuania, leaving the research institutes to suffer the lack of sufficient finance and to be involved in non-research activities. Some industry oriented research institutes moved from basic to applied research and created companies in the area of their research. Industrial R&D is considered to be substantial and innovation directed based mainly on own R&D resources of companies, using human resources of former research institutes. Nevertheless, links between industry and research institutes and universities are generally lacking.

Source: EC Regular Progress Report on Lithuania - 2001

[56] Programme was introduced by the 12th Government of the Republic of Lithuania; Vilnius 2001

The Medium-Term Economic Strategy of Lithuania seeks to achieve higher industrial efficiency and competitiveness. Therefore it puts an emphasis on the introduction of technical and financial instruments in support of small business and state-of-the-art technologies and high quality production. In the medium term support is foreseen to applied research, setting-up of innovation and consultation bodies and conditions for accelerated introduction of R&D results into business.

The **Medium-Term Industrial Development Policy (2000)** emphasises value-added and knowledge intensive industries and the need to encourage investments in sectors such as electronics, IT, manufacturing of precision instruments and pharmaceuticals. In the Economic Strategy some measures are related to cleaner production, ecological industry and environment management systems, reliable, safe and cost-effective supply of energy (alternative oil and oil products supplies, renewable energy resources), environmentally friendly agricultural products and environmental quality in waste treatment facilities, and the development of forest and pulp industry.

The **Business Innovation Program (2000)** aims to speed-up innovation processes in enterprises, providing for specific measures on scientists' work in enterprises and training of enterprises' employees in state research institutions. The programme also aims to integrate research workers into businesses and to improve implementation of research achievements in enterprises. A number of future measures are highlighted in the programme focused on the development of an innovation system with appropriate institutions, financial and legal framework, as well as an innovation-friendly infrastructure. Although there is an uneven regional development of the knowledge infrastructure, and the knowledge institutions are concentrated in the cities, there are no plans for any regional initiatives.

Box 20: Private – public Cooperation " Window to the Future"

A ''Window to the Future''[57] case study shows, how private initiative made the'' Snowball effect'' happen in the Knowledge Society development in Lithuania. The initiative was launched by private companies and was focused on the promotion of the internet in Lithuania. The project was launched at the beginning of 2002 by two biggest telecommunication companies: Lietuvos telekomas and the mobile operator Omnitel, the two biggest banks: Hansa-LTB and Vilniaus bankas and two IT companies: Sonex and Alna. The goal of the project has been set to achieve an average internet penetration of the EU in Lithuania within three years, throughout three phases:

- Establishment of public Internet access points,
- Training of new Internet users, and
- Development of new relevant e-content.

According to the case study presented by Mr. Zabulin all actors, private, public and NGOs, played their roles in preparing the background, making actual planning and investments, promoting the idea and securing the continuity of the project. According to the case study presented during the Helsinki Forum, Window to the Future has emerged as the first concrete and measurable national-wide private/public initiative for the development of the Knowledge Society, with the aim to minimise the digital divide and speed up internet penetration growth in the country. The government encouraged the project from the beginning and after half a year of running the project they joined the Window to the Future project as an equal partner.

Source: Knowledge Economy Forum II. Helsinki 2003

[57] The case study was presented by Mr. Antanas Zabulis, President and CEO of Omnitel Institution during the Knowledge Economy Forum held in Helsinki in March 2003.

In December 2000, the **Law on Long-Term Financing of Science and Education** was approved by the Seimas. The Law aims at reforming the system of research, higher education and education in 2001. In February 2001, the government approved the provisions of the Structural Reform of the Science and Higher Education system. These plan to adopt principles and methods for the State Higher Education Institutions' research and teaching activities, and prepare a Restructuring Plan for the State Research and Higher Education Institutions.

In 2001 the **White Paper on Science and Technology** was approved. This White Paper will serve as a basis for the development of a strategy for science and technologies. Some progress has been made concerning research and technological development in business enterprises and in non-profit organisations. In order to enhance the effectiveness of the system of research and technological development, the new procedure for allocation of state support for research institutes for 2001-2004 was established in December 2000. According to the EC Regular Report[58] for the first time the State Budget provided funding for state research institutes, taking into consideration effectiveness and quality of research, competitiveness as well as participation in the EU Framework Program. The Commission for co-ordination of Lithuanian participation in the Fifth Framework Program, established in 1999, has been renewed for FP6, bringing into the Commission representatives of the Confederation of Industrialists, the Ministry of Economy and the Lithuanian Academy of Sciences, in order to promote links between research institutions, industry and SMEs.

Towards the Development of the Knowledge Based Economy in Lithuania

According to the EC Regular Report the co-operation between Research and Development institutions and SMEs and industry has been strengthened, but further progress is needed. Concrete measures are also required to increase the financial support for research and development, and particularly to stimulate business enterprise expenditure on research. Priority in Lithuania should be given to the development of a national strategy and programme for the development of science and technology policy. Measures are needed to promote and enhance the rate of research and development, to further encourage research that supplies relevant technology to small and medium-sized enterprises, and to increase European co-operation in this field. *(Source: EC Regular Report – October 2002)*

Box 21: RELEVANT INFORMATION SOURCES IN LITHUANIA

Lithuanian S&T: www.ktl.mii.lt/research/research.html (Sep. 2003)
Lithuanian Ministry of Education and Science: www.smm.lt (Sep. 2003)
Lithuanian Ministry Department of Science and Higher Education: http://193.219.137.48/english (Sep. 2003)
Lithuanian State Science and Studies Foundation: www.vmsfondas.lt (Sep. 2003)
FEMIRC (Lithuanian Innovation Centre): www.lic.lt (Sep. 2003)
Program of the government: www.lrvk.lt/anglu/home_anglo.htm (Sep. 2003)
Lithuanian Ministry of Economy, Medium term economic strategy: www.ekm.lt/muitai/EKMIN/str_a.HTM(Sep. 2003)
Lithuanian Department of Statistics: www.std.lt (Sep. 2003)

[58] EC Regular Report on Lithuania 2001

CHAPTER 8: Republic of MALTA

COUNTRY PROFILE[59]

Population:	390,000 people
Area:	316 km²
GDP/capita (PPS; 2001):	11,900 Euros
GDP growth (1995-2000):	4.37%
Unemployment rate (2001):	6.8%
BERD as a % of GDP (2000)	0.12%
GERD as a % of GDP (1999):	n.a.

Source: EUROSTAT, European Commission DG Research – Key Figures 2002

I. BASIC INDICATORS OF INVESTMENT AND PERFORMANCE FOR THE KNOWLEDGE BASED ECONOMY in MALTA

A. R&D INVESTMENT AND HUMAN RESOURCES IN S&T

Malta is lacking basic statistics on RTDI (e.g. GERD, number of researchers etc), which are to be developed as part of the R&D Audit. On the basis of these statistics and consultations with key players and stakeholders, effective policies and strategies are being designed and implemented. The National RTDI Audit is focused on identifying strengths and weaknesses in R&D and Innovation through quantitative and qualitative surveys.

B. S&T and ECONOMIC PERFORMANCE for THE KNOWLEDGE BASED ECONOMY in MALTA

Figure 29: Scientific performance (publications per million population (1999))

Malta	EU-15	Sweden	Portugal
67	755	1657	333

Source: European Commission DG Research – Key Figures 2002

The EU's Community Innovation Survey III was carried out in 2001, by the National Statistics Office with the technical support of MCST. The main focus of the Survey was to determine the extent of innovation activity in firms and to identify obstacles or bottlenecks to innovation in over 600 local firms. From the results of this Survey, the first Innovation Scoreboard for Malta (2000) was published recently. This reveals Malta's weak and strong innovation indicators in comparison with EU15 and EU25.

The Innovation Scoreboard reveals that Malta's strong indicators are those influenced by FDI activities and these compare well with EU indicators. On the other hand, Malta's weak indicators include: Not enough human resources in science and technology; Significant R&D funding is lacking; and Low innovation activities in SMEs.

According to the **European Trend Chart on Innovation 2002**[60], Malta's weakest indicators relate to level of population with tertiary education, level of SMEs innovating in-house or innovating in

[59] The author would like to thank Ms. Jennifer CASSINGENA HARPER, Director of the Policy Unit at the Malta Council for Science and Technology for her contribution and comments. Nevertheless the author takes full responsibility for the content of this country analysis.

[60] European Commission DG Enterprise: 2002 European Innovation Scoreboard: Technical Paper No 2 - Candidate Countries, see annex Data Definitions and Sources and annex European Innovation Scoreboard 2002 – Trends (Candidate Countries) (www.cordis.lu/trendchart)

cooperation and level of ICT expenditure. On the other hand, major strengths in innovation are in the fields of lifelong learning, inward FDI, and the level and trends of public internet access.

Table 22: S&T and Economic Performance of Malta

GDP per capita in Euros (PPS; 2001):	11,900	23,200 EU15)
GDP average annual growth (1995-2000):	4.37%	2.63% (EU15)
Patents per million (1999):	5	126 (EU15)
Publications per million (1999):	67	755 (EU15)
High-tech exports, as % of total exp. (1999):	64.4%	19.7% (EU15)

Source: EUROSTAT, European Commission DG Research – Key Figures 2002

II. INSTITUTIONAL CAPACITY for S&T POLICY MAKING in MALTA

The Malta Council for Science and Technology (MCST) currently in the process of implementing a number of strategic initiatives in order to develop an effective national strategy to build up capacity locally in research, development and innovation. These include two Cabinet-approved projects, namely:

The National RTDI Audit – this is a comprehensive exercise, covering the whole research and innovation system spanning the public and private sectors, and focusing on both the quantitative and qualitative aspects. The first results are already available but work continues on a number of surveys involving close collaboration with the National Statistics Office. As part of the Audit exercise, an external Review of the Malta Council of Science and Technology was carried out in 2002 by PREST, University of Manchester. The Review was aimed at revising MCST's remit and positioning so that it can fulfil a broader role as a catalyst in the national innovation system and in the transition to the knowledge-based economy. The key recommendations are being discussed and will provide an input in the development of the National RTDI Strategy currently underway.

MCST is also engaged in a Foresight exercise, a complementary project to the national RTDI Audit. Whilst the Audit focuses on mapping Malta's strengths and weaknesses in RTDI, the Foresight exercise takes a forward look at Malta's potential in RTDI and how this can be exploited, by investing wisely now. The exercise is helping to identify niche areas for Malta in 2010/2015 and how Malta can prepare itself to exploit these opportunities. The foresight exercise which is national in its scope, is part of an international collaborative activity involving two other small accession countries, Cyprus and Estonia, funded under the EU's IHP STRATA Programme.

A third project addressing the innovation dimension of the RTDI strategy is the recent setting-up of an Innovation Relay Centre (IRC) in Malta within the FP5 Innovation Programme of the European Community. The Malta Council for Science and Technology is collaborating with a platform of Maltese business support agencies, namely **Malta External Trade Corporation** (METCO), **Institute for the Promotion of Small Enterprise** (IPSE), **Malta Development Corporation** (MDC) and **Federation of Industry**, so as to facilitate the interaction of SMEs with the **Innovation Relay Centre.** MCST also proposed an implementation framework for the Programme which would involve an evaluation process involving broad cross-sectoral representation as well as international inputs. Another interesting development is the twinning up of Malta's IRC with a foremost IRC through a mentoring agreement. This cross-border arrangement has been established with IRC North-Rhine Westphalia and it is envisaged that this networking support will be to the ultimate benefit of Malta's SMEs.

III. POLICIES & STRATEGIES FOR THE KNOWLEDGE BASED ECONOMY in MALTA

Malta is currently in the process of developing a comprehensive national strategy for the knowledge-based economy spanning research and innovation. The outline of this strategy is at an advanced stage and is shortly to be presented to Cabinet for endorsement. The details of the strategy are to be elaborated through further work to be carried out throughout this year on related legislation and policies, as well as the National RTDI Audit and the foresight exercise. It is envisaged that implementation of the strategy will be underway in 2004.

National RTDI Audit

A full assessment of Malta's areas of strength in science and technology, current and potential, is currently underway under the auspices of the Malta Council for Science and Technology with the

support of the National Statistics Office. MCST launched this exercise, the National RTDI Audit, in 2001 with Cabinet approval and has secured the expertise of key local players from University and the public and private sectors as well as from abroad, in particular PREST, The University of Manchester. To date the Audit has produced some important results relating to the CIS III survey and the preliminary Innovation Scoreboard for Malta. A number of other surveys, including the Human Resources in Science and Technology (HRST) are in the process of being launched. A survey of University research was also launched last year and discussions are in hand to supplement this with a review of infrastructure at the University.

A WEF Global Competitiveness survey was carried out for Malta in 2003.

Foresight Exercise

Malta's Foresight exercise (an EU-funded FP5 STRATA project eFORESEE www.eforesee.info) is already yielding important results in terms of the new networks generated both top-down (strategic) and bottom-up (involving community and small players); as well as in vision-building and strategy-development. The first pilot on **Knowledge Futures in ICT and education** built on previous work carried out by MCST in 1993/4 in developing the **National Strategy for Information Technology** (NSIT). The preliminary results of the pilot in 2002 are documented in the Vision Document, a 'live' dossier which has identified some niche areas and priorities for investments in RTDI. The pilot has also set in motion a number of initiatives, including Malta's participation in the Global Competitiveness Index in 2003, FutureChild (encouraging children to think about the future) and Malta Theatre 2020.

Other recommendations currently under consideration relate to:

- The use of foresight in **S&T careers guidance and development**,
- Malta as an eCentre for Lifelong Learning and Creativity;
- the setting up of a **mobility programme** for young researchers and practitioners to encourage public-private sector synergies;
- Strategic Partnership between MCST, MITTS and eMalta Commission to exploit research and innovation opportunities in ICT and KM (knowledge management)
- the setting up of an Open eLearning University specialising in new economy themes catering for the Mediterranean region

The exercise also identified a number of ICT priorities to be considered for funding under the National RTDI Programme, namely :

- Critical Systems
- Open Source Software
- Security; 3G Mobile systems
- e-Learning
- e-Health
- e-banking and in response to specific Knowledge Community needs.

Two other Foresight Pilots are currently underway in the areas of **Marine Sciences** and **Biotechnology** and these should yield important indications on how investments in these areas could be targeted.

From the preliminary results emerging from the RTDI Audit and the Foresight Exercise, the Malta Council for Science and Technology has already identified a number of urgent capacity-building measures that need to be addressed through the setting up of a National RTDI Programme. In the last quarter of 2002, MCST worked on detailed proposals for the design and implementation of such a programme. This was based on an in-depth analysis of similar programmes in Ireland and other member states and candidate countries, attention to the Lisbon Strategy and the targets for increasing GERD and BERD, as well as local strengths, needs and priorities. The proposals recommend that in the first three years, the Programme is targeted primarily at capacity-building and in principle supports research and innovation projects in all areas.

Towards the Development of the Knowledge Based Economy in Malta

The development of the research sector in Malta and its effective integration into the European Research Area will require a further increase in business expenditure on research and development. According to the EC Regular Report 2002, university research activities should be fostered and current efforts to foster the participation of the business community in the Research Framework programmes and to develop joint public-private sector R&D ventures should be sustained. Malta has taken important steps to develop an overall framework strategy for the development of research as a result of the current National Research and Development Audit and Foresight Exercise. Nevertheless the results of the initiative need to be finalised. (Source: EC Regular Report – October 2002)

Box 22: RELEVANT INFORMATION SOURCES IN MALTA

Malta Council for Science and Technology: www.mcst.org.mt (Sep. 2003)
Malta Foresight Project : www.eforesee.info (Sep. 2003)
Malta Ministry of Education: www.education.gov.mt (Sep. 2003)
University of Malta (Research on-line): www.um.edu.mt/pub/research.html (Sep. 2003)
Innovation Relay Centre Malta www.innovationmalta.com/ (Sep. 2003)
The Planning and Priorities Co-ordination Directorate within the Office of the Prime Minister www.opm.gov.mt/regional.policy.directorate.htm (Sep. 2003)
Institute for the promotion of Small Enterprise www.ipse.org.mt (Sep. 2003)
Malta Federation of Industry: www.foi.org.mt (Sep. 2003)

CHAPTER 9: Republic of POLAND

COUNTRY PROFILE[61]

Area:	312,685 km^2
Population:	38.654 million people
GDP/capita (PPS; 2001):	9,210 Euros
GDP growth (1995-2000):	5.14%
Unemployment rate (1999):	16.3%
GERD as % of GDP (2000):	0.75%

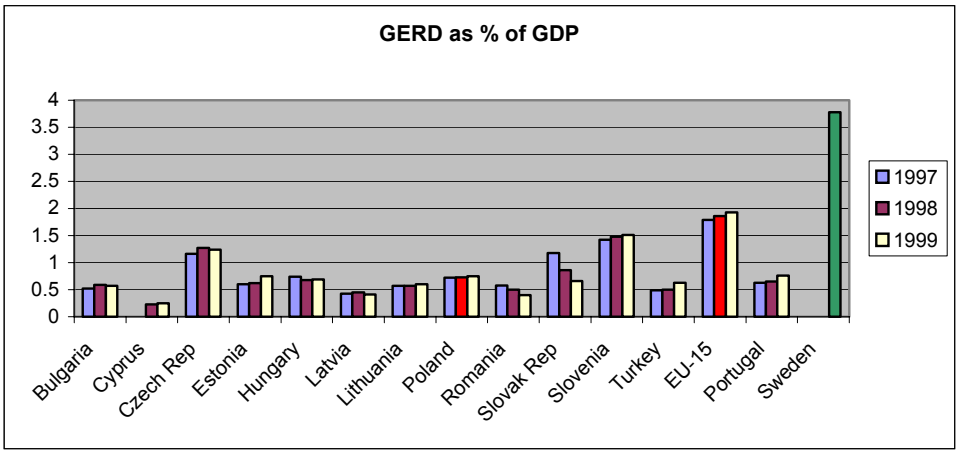
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

I. BASIC INDICATORS OF INVESTMENT & PERFORMANCE FOR THE KNOWLEDGE BASED ECONOMY in POLAND

A. R&D INVESTMENT AND HUMAN RESOURCES IN S&T

In 1999 the gross domestic expenditure on R&D (GERD) was 0.75% of GDP. The Polish GERD as percentage of GDP is still low compared to the EU average and to the OECD countries. As a result of the transition period in Poland, state subsidies as well as business spending for R&D and innovation dropped significantly during the 1990s. GERD financed by the business sector is 38.1% which is not too far from the EU average of 56.3% (the Barcelona target is to have 2/3 of the total share financed by the business sector). Sources of business that finance R&D in Poland presumably differ very much from Western ones[62].

Figure 30: GERD as a % of GDP in the EU Candidate Countries – Poland (1997,1998, 1999)



Source: European Commission DG Research

Table 23: GERD in Poland

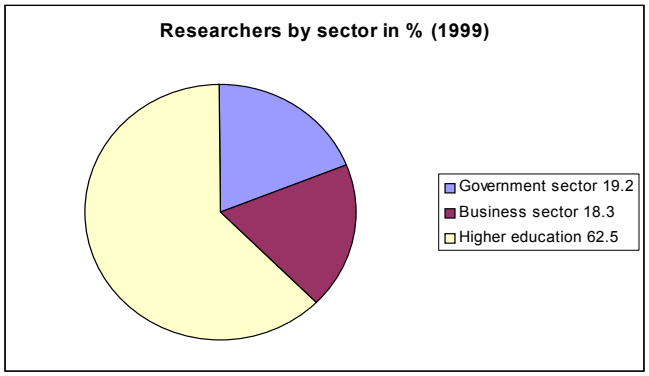
GERD as % of GDP(1999):	0.75%	1.93% (EU 15)
GERD financed by business:	38.1%%	56.3% (EU 15)

Source: European Commission DG Research – Key Figures 2002

[61] The author would like to thank Mr. Jan KOZLOWSKI Visiting Scientist at the European Commission JRC/IPTS and Prof. Jerzy LANGER, Advisor to the President, Polish Academy of Sciences for their contributions and comments. Nevertheless the author takes full responsibility for the content of this country analysis.

[62] According to Mr. Kozlowski it is assumed that one of the most important sources of R&D is renting a (non-used) properties by governmental R&D units. All of them decreased their personnel but kept (usually very huge, factory –like) property intact. This enables them to have a good source for income. According to J. Kozlowski there is a strong possibility that GERD and BERD are underestimated in the EU Candidate Countries. In the case of Poland Mr. Kozlowski (2002) estimates that the underestimation could be as high as 0.17% of GERD.

Figure 31: Researchers by sector (%) in Poland (1999)



Source: EUROSTAT, European Commission DG Research – Key Figures 2002

Poland had a total of 82,368 R&D personnel in 1999, which represented 0.49% of the labour force in Poland and 56,433 researchers in full-time equivalents. The share of the business sector in Poland is 18.3% of researchers, which is much lower than the EU average. The main sector of researchers is the higher education sector with 62.5% of researchers. In EU candidate countries, divisions between the governmental and business sectors are usually unclear.[63]

Table 24: Human Resources in S&T in Poland (1999)

Type of researchers	Number of researchers	EU total number or EU average in %	Type of researchers as % of labour force
Total number of R&D personnel	**82,368**	**1,689,490**	**0.49%**
Number of female R&D Personnel	-	-	-
Full-time equivalent (FTE) Total	56,433	919,796	0.33%
Full-time equivalent (FTE) Female	-	30%	-
Business sector	**10,327**	**50%**	**0.06%**
Government sector	10,835	14.2%	0.06%
Higher education Sector	35,271	34.3%	0.2%

Source: EUROSTAT, EC DG Research, EC DG Employment and IPTS additional calculation[64]

[63] Poland's Statistical Office treats as part of the "business sector" those governmental R&D units that spent more on R&D from business sources than in government subsidies. But "business sources" may mean also renting property. If the Government will reclassify that kind of financing in the future according to the opinion of Mr. Kozlowski the size of BERD and business financing might be drastically lowered. In many Candidate Countries the divisions between esp. governmental and business sectors are equally unclear.

[64] Labour force in Poland (1999): 16,615,947
EU-15 (1999): 5.63 researchers (FTE) per 1000 in the labour force (head count).

B. S&T and ECONOMIC PERFORMANCE for the KNOWLEDGE BASED ECONOMY in POLAND

Figure 32: Scientific performance (publications per million of the population in 1999)

Poland	EU-15	Sweden	Portugal
221	755	1657	333

Sources: European Commission DG Research- Key Figures 2002

In the field of economic performance Poland is doing better than in the field of S&T performance. Nevertheless there is also a big difference between knowledge production indicators. In the area of knowledge production – with 221 scientific publications per million inhabitants – Poland is doing relatively well compared to the other EU Candidate Countries[65].

According to the **European Trend Chart on Innovation 2002**[66] relative weaknesses of Poland are in the fields of current tertiary education, patents applied at the European Patent Office and the level of internet access of population. On the other hand a major strength in innovation is in the field of current medium/hi-tech manufacturing employment.

Table 25: S&T and Economic Performance of Poland

GDP per capita in Euros (PPS; 2001):	**9,210**	**23,200 (EU15)**
GDP average annual growth (1995-2000):	**5.14%**	**2.63% (EU15)**
Patents per million inhabitants (1999):	**1**	**126 (EU15)**
Publications per million inhabitants (1999):	**221**	**755 (EU15)**
High-tech exports, as % of total exp. (2002)[67]:	**3%**	**19.7% (EU15)**

Source: EUROSTAT, European Commission DG Research – Key Figures 2002

[65] It is doubtful whether data concerning different systems of patent application can be truly comparable if the main European procedures for applying for international patents are not yet open to those countries that have applied for EU membership. In addition, different procedures are only now being developed. (L. Wasilewski, S. Kwiatkowski, J. Kozlowski SCIENCE AND TECHNOLOGY FOR DEVELOPMENT, A Comparison of Poland and Europe Contexts, Indicators, Trends, Warsaw 1998. According to Mr. Kozlowski Poland has fewer routes for patenting than western European countries. Systems of patenting are different from country to country in contrast with the situation on publications which at least in theory is the same for all countries.

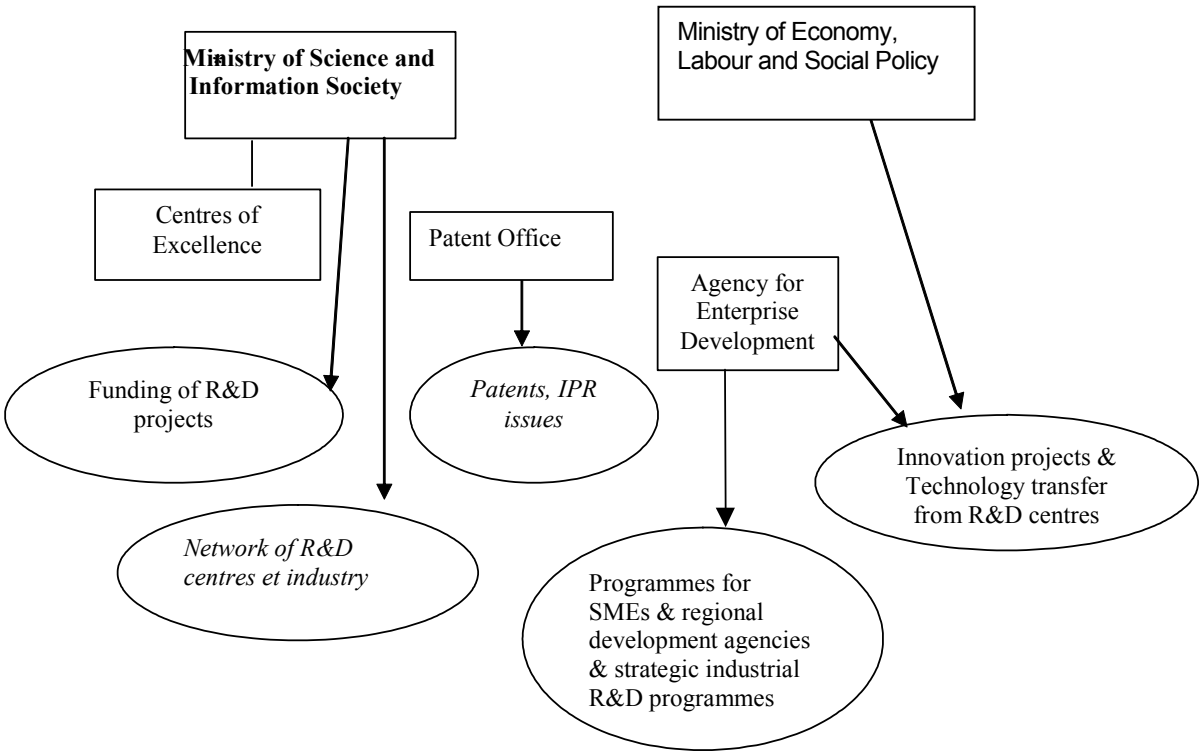
[66] European Commission DG Enterprise: 2002 European Innovation Scoreboard: Technical Paper No 2 - Candidate Countries, see annex Data Definitions and Sources and annex European Innovation Scoreboard 2002 – Trends (Candidate Countries) (www.cordis.lu/trendchart)

[67] 3% according to World Bank Development Indicator 2002

II. INSTITUTIONAL CAPACITY for S&T POLICY MAKING in POLAND

The **Ministry of Science and Information Society** (*former State Committee for Scientific Research (KBN))* is the main state organ responsible for S&T policy making in Poland. The design and implementation of the national innovation policy is driven by the **Ministry of Economy, Labour and Social Policy** which is also responsible for industrial policy, SMEs development and the management of the technical research institutes. The following diagram illustrates the main players in the field of policy design and delivering in Poland.

Figure 33: Institutional capacity for S&T Policy Making in Poland



Source: European Commission DG Enterprise and author's own compilation

In Polish government an **inter-ministerial approach** to developing new policy documents and programmes is often favoured.

The **Ministry of Economy, Labour and Social Policy** of Poland has influential decision-making power in terms of industrial policy, management of technical research institutes and SME development. The Ministry of Economy is also in charge of two foundations related to enterprise policy; the Polish Foundation for SME Promotion and Development and the Agency for Technology, which supports high-tech companies and technology transfer in industry.

At the parliamentary level the **Economic Commission of the Parliament** is responsible for preparing new laws and formulating opinions on innovation and R&D in industry.

In the field of S&T policy making the major changes were introduced by establishing the **Ministry of Science and Information Society** in 2003.

New organisation leads to:

- Participation in human capital build-up
- Creating an appropriate legal and institutional regime
- Constructing a broadband information infrastructure
- Forming a strong and stable innovation system

Concerning the innovation policy development and stakeholders involved Poland as a large country has a wide range of different players. At the end of 1999 there were some 49 business incubators and technological centres and three technology parks in existence. Due to the size of the country network, initiatives of co-operation between business and innovation intermediaries are considered to be important.

The **Business Centre Club**[68] is on of the most influential business organisations in Poland. Together with different think-thanks such as the Market Economy Research Institute from Gdansk they influence and contribute to policy debate.

UNESCO / EOLSS Chair in Intellectual Entrepreneurship known **us "Knowledge Café"**[69] in Poland is a unique experience of bringing intellectuals together in order to have a discourse about the challenges in the area of Intellectual Entrepreneurship.

III. POLICIES & STRATEGIES FOR THE KNOWLEDGE BASED ECONOMY in POLAND

In the field of S&T policy making, the decision power and influence are shifting from the research community to the government. With the establishment of the new Ministry of Science and Information Society various projects related to S&T policymaking are on the way. Amongst them one of the most important is a new **Act of law on science financing,** which is (June 2003) in the parliamentarian procedure. The new **Act of law on science financing** (draft) determines:

- precise rules for public funds for science
- main concepts like financing, scientific research, development, statutory activity, research supporting activity, research units, research consortia, scientific networks, research project, targeted project, organisation supporting science.
- streams of financing: statutory activity, investments, research projects, targeted projects, international collaboration, science supporting activity and core statutory activity
- investments.

The **Act of law on science financing** also determines the nature and membership of the Science Council: President, Section for Science Policy, Section for Economic-oriented research, defence-oriented research, 70 members including 50 chosen in the general elections. In the new Act of law

[68] The Business Center Club has 500,000 member companies.

[69] It is chaired by professor Stefan Kwiatkowski; Leon Kozminski Academy of Entrepreneurship and Management

on science financing guidelines for reform of science organisation and financing are expressed. The following priorities are introduced in the draft Act:

- Biotechnology
- Microelectronics/nanotechnology
- Robotisation / automatisation
- New materials
- Alternative and renewable sources of energy
- Health protection / environment

The main goal of the act of law is to create an organisational and legal basis for the knowledge-based economy. Up to now purely scientific criteria prevail in science funding. Researchers only decide how to allocate money. From now utilitarian criteria will have a greater impact and the Minister will have a much stronger impact upon decisions.

The next important project is the **Act of law on computerisation of organisations that carry out public tasks.**

The programme of the computerisation of the state and the public sector: governmental administration, new territorial administration, public agencies (excluding state-owned enterprises, state-owned higher schools, government research units, and special intelligence services). This act of law mainly concerns standards and protocols.

The relevant document concerning the S&T policy making in Poland is the **National Plan for Development.** It includes proposals for goals, actions, and interventions. Structural funds and cohesion funds oriented towards diminishing disproportion in socio-economic development between Poland and EU. The National Development Plan also includes a basis for negotiations between Poland and the EU Commission.

Box 23: Example of offset – system of compensation of expenditures made by the country that purchases military equipment

The face value of the offset programme of Poland's purchase of 48 American F-16 multi-role planes is $7.75 billion. Payment for the jets will be spread out over 10 years once the investment has been completed. Taking into consideration the offset coefficients, this amount can increase considerably. Optimists estimate that it will reach as much as $12.5 billion. It would be the largest amount ever offered as part of an offset agreement. The 43 offset proposals agreed upon by the negotiators create enormous development opportunities for a number of Polish companies. Most proposals concern state-of-the-art technologies that will be transferred from the United States to Poland. Minister of Science Michał Kleiber says that the Americans will also invest in the development of Polish science. Offset investments will be allocated to inventions by Polish scientists, such as blue called gensulin at the Institute of Biotechnology and Antibiotics. The US will also help to create a scientific think-thank to look for applications for inventions and innovations.

Source: www.warsawvoice.pl/ 29 Jun 2003

The R&D policy in Poland is also contained in the following documents:

- Directions of National Innovation Policy till 2002 (1999)
- Basis for National S&T Policy (1993, add. 1996)
- Guidelines for innovation policy in Poland (1994, add.)

The government document "**Directions of National Innovation Policy till 2002**" (1999) gives a general framework for public innovation policy. Other governmental documents - "Directions of the government's scientific and technological policy" and "The long-term programme for the development of science, 2000-2010" are under preparation.

Priority areas for the development of scientific policy described in the document are:

- human health protection;
- environment protection;
- agriculture and food processing;
- high-tech industries;
- infrastructure supporting education, science and the transfer of technology to the economy.

According to the Enlargement Futures Report on Technology, Knowledge and Learning[70] in Poland S&T competence exists in basic research in genetic engineering and natural sciences. Research on natural resources is lacking in spite of the large existing coal industry.

The main programme for commercialisation and technology diffusion from the R&D sector is based on a special type of grants funded by the State Committee for Scientific Research – the so called **special purpose grants**. This is supplemented with grants offered by the **Agency for Technology**, which co-finances implementation projects and the purchase of the results of research and development as well as patents and licenses for SMEs. The restructuring and privatisation of scientific institutes has started in 2000. During the transformation period a gradual restructuring policy has been followed, by changing the public funding principles and by ranking institutes. In general, the R&D system has retained the main features and structures of the previous system.

A list of necessary measures have specified in 1996 in the **Guidelines for science and technological policy** related to growth of scientific elite and increase of its role; further development of infrastructure for innovation; bringing Polish research and development systems up to European standards; increased competitiveness in research and its financing; closer links between research and the needs of the market economy. The introduction of respective institutional and legal changes has been also highlighted.

The problems of innovation and technology transfer are included in the governmental document **"Programme for support of development of regional institutions involved in technology transfer"**. The programme is co-ordinated and monitored by the Ministry of Economy and is aimed at the stimulation of innovation in the sector of SMEs by intensification of transfer of modern, pro-ecological technologies with emphasis on information technologies. On the other hand, in 2000 the existing tax preferences for companies investing in technology transfer and know-how have been abolished.

[70] Enlargement Futures Report on Technology, Knowledge and Learning 2001

Towards the Development of the Knowledge Based Economy in Poland

In terms of resources devoted to the S&T there were substantial cuts in the 2002 state budget. In comparison to 2001, the total planned spending was reduced by nearly 20%. In January 2002 an agreement on co-operation with the European Space Agency was signed, providing a framework for the participation of Polish institutions in the Agency's research projects. According to the EC Report an important element in Poland is the diffusion of information about EU Framework funds to, and promoting the involvement of small and medium-sized enterprises in FP6. The functioning of the National Contact Points (NCP) network are envisaged with a view to strengthening science and research and to enable its benefits more broadly available. The share of the business sector in financing the R&D should also be increased in the future according to the EC Report. (Source: EC Regular Report – October 2002)

Box 24: RELEVANT INFORMATION SOURCES IN POLAND

KBN - The State Committee for Scientific Research / Poland
http://web.mg.gov.pl/portalout/index.jsp http://www.mpips.gov.pl/index.php (only Polish) (Sep. 2003)
http://www.parp.gov.pl/en/index1.php (Sep. 2003)
POLISH AGENCY FOR ENTERPRISE DEVELOPMENT
http://www.kbn.gov.pl/ (Sep. 2003)
State Committee for Scientific Research of Poland (http://eris.kbn.gov.pl/en/index.html) (Sep. 2003)
Central Statistical Office of Poland http://www.stat.gov.pl (Sep. 2003)
FEMIRC http://www.opi.org.pl, (Sep. 2003)

CHAPTER 10: Republic of ROMANIA

COUNTRY FROFILE[71]

Population:	22,4 million people
Area:	238,391 km²
GDP/capita (PPS; 2001):	5,800 Euros
GDP growth (1995-2000):	-1.33%
Unemployment rate (2000):	7%
GERD as a % of GDP (1999):	0.40%

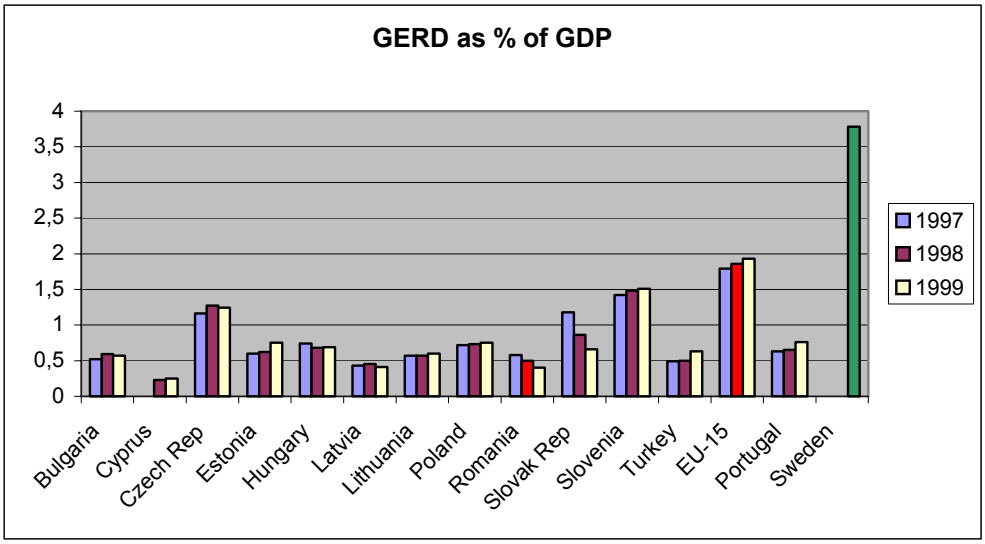
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

I. BASIC INDICATORS OF INVESTMENT AND PERFORMANCE FOR THE KNOWLEDGE BASED ECONOMY in ROMANIA

A. R&D INVESTMENT AND HUMAN RESOURCES IN S&T

In 1999 the gross domestic expenditure on R&D (GERD) was 0.40% of the national GDP. Due to the economic crisis at the end of the 1990s GERD was declining. Nevertheless the share of the business sector in financing GERD is relatively high compared to other EU Candidate Countries and close to the EU average.

Figure 34: GERD as a % of GDP in the EU Candidate Countries – Romania (1997,1998,1999)



Source: EUROSTAT, European Commission DG Research

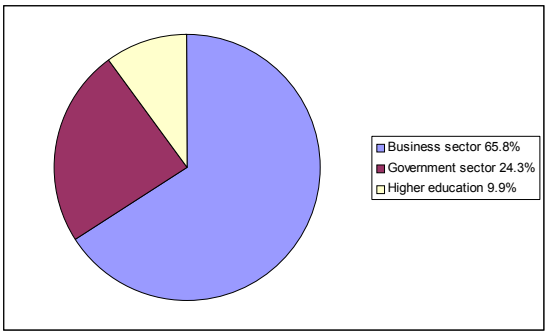
Table 26: GERD in Romania (1999)

GERD as % of GDP (1999):	0.40%	1.93 (EU 15)
GERD financed by business:	50.2%	56.3% (EU 15)

Sources: European Commission DG Research – Key Figures 2002

[71] The author would like to thank Ms. Corina PASCU, Research Fellow at the EC JRC/IPTS , Mr. Constantin CIUPAGEA Detached National Expert at the EC JRC/IPTS, Ms. Victoria CAMPEANU Executive Director of the Institute of World Economy in Romania and Mr. Liviu VOINEA Visiting Researcher at the EC JRC/IPTS for their contributions and comments. Nevertheless the author takes full responsibility for the content of this country analysis.

Figure 35: Researchers by sector (%) in Romania (1999)



Source: EUROSTAT, European Commission DG Research – Key Figures 2002

Total R&D personnel in Romania were 44.091 people in 1999, which represented 0.4% of the labour force in Romania. The share of researchers employed in the business sector is relatively high in Romania. With 65.8% of researchers employed in the business sector, Romania has the highest proportion compared to the EU Candidate Countries and higher than in some of the current EU member states[72]. Human Resources in S&T provide the capacity to produce scientific and technological knowledge. In Romania the capacity to produce and absorb knowledge is the highest in the business sector, which is a promising indicator of the potential future development of the production of knowledge. The business sector occupies also 0.14% of labour force which is of great significant compared to the other EU Candidate Countries and some of the current EU member states. In gender balance Romania performs better than EU (30%) average with 44% of female researchers (FTE)[73].

Table 27: Human Resources in S&T in Romania (1999)

Type of researchers	Number of researchers	EU total number or EU average in %	Type of researchers as % of labour force
Total number of R&D personnel	**44,091**	**1,689,490**	**0.4%**
Number of female R&D Personnel	21,196	-	0.19%
Full-time equivalent (FTE) Total	23,473	919.796	0.22%
Full-time equivalent (FTE) Female	10,335	30%	0.09%
Business sector	**15,445**	**50%**	**0.14%**
Government sector	5,703	14.2%	0.05%
Higher education Sector	2,112	34.3%	0.01%

Source: EUROSTAT, EC DG Research Key Figures 2002, EC DG Employment and IPTS additional calculation[74]

[72] Comment Constantin Ciupaga; Detached National Expert from Romania to the JRC/IPTS

[73] Female full-time equivalent: 10,355

[74] Labour force in Romania (1999): 10,602,899
EU-15 (1999): 5.63 researchers (FTE) per 1000 in the labour force (head count).

B. S&T and ECONOMIC PERFORMANCE for THE KNOWLEDGE BASED ECONOMY in ROMANIA

Figure 36: Scientific Performance (publications per million population (1999))

Romania	**EU-15**	**Sweden**	**Portugal**
70	755	1657	333

Sources: European Commission DG Research – Key Figures 2002

In the field of S&T and Economic performance Romania is behind the current EU minimum level and behind the average of the EU Candidate countries. Nevertheless there is a significant potential of human resources and distribution of human resources in Romania *(see Table 27: Human Resources in S&T in Romania)* if proper measures are taken and sufficient resources invested.

According to the **European Trend Chart on Innovation 2002**[75] relative weaknesses of Romania are currently in life long learning, public expenditure on R&D and patents applied at the European Patent Office. On the other hand, the trend for life long learning is relatively strong.

Table 28: S&T and Economic Performance of Romania

GDP per capita in Euros (PPS; 2001):	**5,860**	**23,200 (EU15)**
GDP average annual growth (1995-2000):	**-1.33%**	**2.63% (EU15)**
Patents per million (1999):	**1**	**126 (EU15)**
Publications per million (1999):	**70**	**755 (EU15)**
High-tech exports, as % of total exp. (1999):	**4.5%**	**19.7% (EU15)**

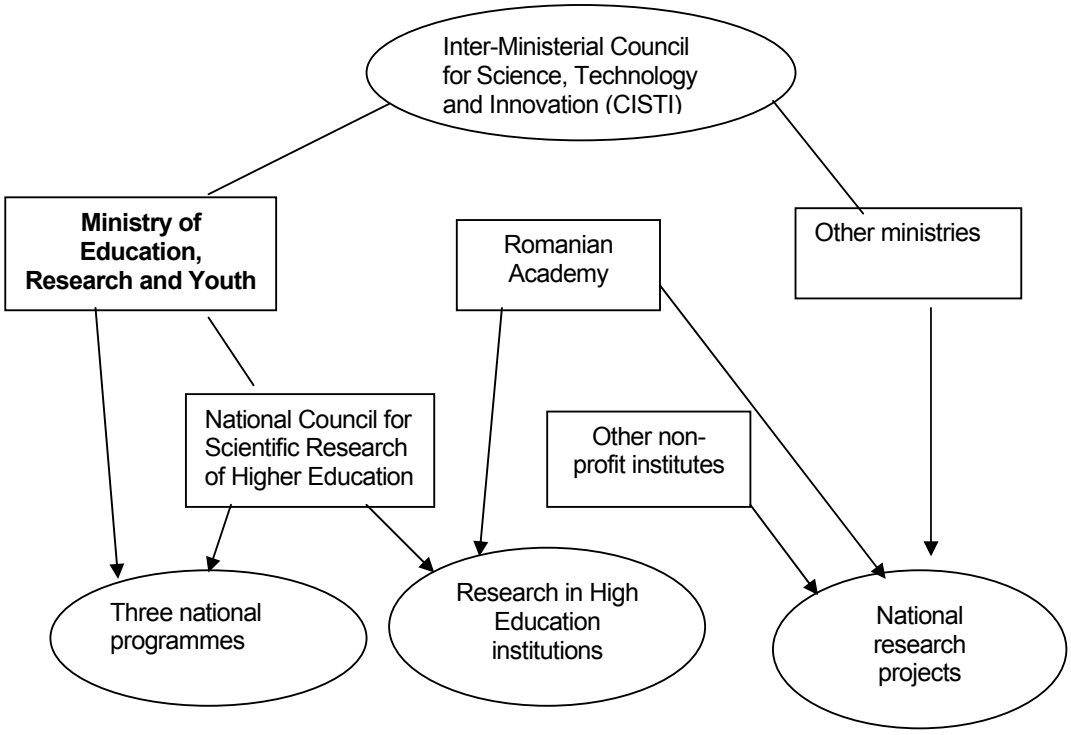
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

[75] European Commission DG Enterprise: 2002 European Innovation Scoreboard: Technical Paper No 2 - Candidate Countries, see annex Data Definitions and Sources and annex European Innovation Scoreboard 2002 – Trends (Candidate Countries) (www.cordis.lu/trendchart)

II. INSTITUTIONAL CAPACITY for S&T POLICY MAKING in ROMANIA

The main bodies which co-ordinate S&T policy making and innovation activities are the Romanian **Ministry of Education, Research and Youth** and the **Romanian Academy.** In Spring 2003, the Ministry of National Education was re-organised as the Ministry of Education, Research and Youth. Previously in 2001 it also took over the responsibilities of the former National Agency for Science, Technology and Innovation (NASTI), with a view to establishing closer links between higher education and research.

Figure 37: Institutional Capacity for S&T Policy Making in Romania (2003)



Source: Author's own compilation

The Inter-ministerial Council for Science, Technology and Innovation (CISTI) was reorganised in December 2001 and given the responsibility for drawing up and implementing strategies and programmes for research, development and innovation. CISTI also advises on proposals for updating the National Plan.[76]

Presently, the national programmes for research and development include: the research-development and innovation programmes coordinated by the Ministry of Education, Research and Youth through the Research department:

- The National plan for research-development
- The Horizon 2000 research-development programme
- The grants programmes for scientific research

[76] EC Regular Report 2002 on Romania (Chapter 17)

The relevant research programmes coordinated by the **Romanian Academy** are mainly: the national priority projects (approaching high complexity scientific and cultural matters, with great impact at national level) and the programme of grants for scientific research. R&D funding comes from at least three sources: state budget (Ministry of Education, Research and Youth, Romanian Academy and other ministries); economic units co-financing; and EU funding. One of the objectives of the medium term strategy in the Science and Technology domain is the increase of the financial allocations through the State Budget for R&D activities.

Box 25: EXAMPLE of RESEARCH ACTIVITIES IN ROMANIA by NON-PROFIT INSTITUTES

Non-profit research centres and think-tanks are an important player in academic research and policy design in Romania[77]. **The Romanian Centre for Economic Policies (RCEP)** has organised, as part of a PHARE financed project, a team of young economists advising The Office of the Prime Minister. RCEP has also maintained close research-policy interaction with the Ministry of Finance and the National Bank of Romania. The **Romanian Academic Society**, worked with the UNDP office in Romania to issue regular Early Warning Reports under the observance of the Romanian Ministry of Foreign Affairs. The **Centre for Policy Studies and Comparative Analysis**, **The Romanian Centre for Economic Modelling, The New Europe College** and numerous other institutes co-operated in numerous foreign financed projects with policy relevant research. Another influential institute, but part of the government, is **The European Institute of Romania**. This institute completed in 2002 the task of preparing, with independent experts, a collection of pre-accession impact studies, one for each chapter of negotiations with the EU.

Source: Liviu VOINEA and Victoria CAMPEANU

III. POLICIES & STRATEGIES FOR THE KNOWLEDGE BASED ECONOMY in ROMANIA

A basic instrument for the implementation of the R&D policy was the **National Plan for Research, Development and Innovation for 1999 – 2005** (1999)[78].

The **Medium Term Strategy 2000-2004 of the Science and Technology Domain** (2000) elaborates the innovation policy of Romania for the medium term. Its main objectives are focused on improvement of the institutional and legal framework for R&D, increase of R&D's contribution to economic development, improvement of the diffusion and absorption capacity of the research results in the socio-economic domain, etc. The R&D system in Romania can be characterised as a predominantly applied research system with strong research potential in the fields of information technologies (including micro-technologies), communications, biology/biotechnology, chemistry, physics, medicine, environment, engineering (materials and processes, avionics, energy, mechanics, vehicles). Emphasis is placed on stimulation of the application of R&D results in SMEs, especially in the high-tech sector; development of specialised infrastructure for the distribution/diffusion of results and knowledge; support for the mobility of researchers, specialists and students from institutes towards firms. SMEs and regional development are key issues of debate, in particular the introduction of effective measures to promote local initiatives, an active partnership between the local authorities, business and research and their co-operation with other European countries in order to promote technological innovation. Depending on the domains and specific profile, the activities within national programmes for R&D and innovation are distributed as follows:

[77] Input on NGOs in the R&D activities in Romania was provided by Liviu VOINEA

[78] In the chapter on Policies and Strategies for the Knowledge Based Economy an input was provided by Corina PASCU

- research oriented towards natural, precise and social – humanistic sciences, carried out mainly through the grants programme coordinated by the Romanian Academy, in which participate especially the institutes coordinated by the Romanian Academy and the branch academies – Academy of Medical Sciences, Academy of Agricultural and Forestry Sciences, which represents about 10% of the R&D total activities;
- research carried out in the higher education institutions, supported mainly through the grant programme coordinated by the Ministry of Education, Research and Youth through the National Council for Scientific Research of High Education (NCSRHE) which represents about 5% from the total of R&D activities;
- technological research, carried out mainly through the National Plan for R&D and innovation and the Horizon 2000 Program, coordinated by the Ministry of Education, Research and Youth and which represents about 85% from the total of R&D activities.

The three national programmes currently coordinated by The Ministry of Education, Research and Youth throughout the Research Department, represents complementary systems of financing from public funds of R&D and innovation activities, differentiated by the following features (85% of total R&D activities): **National Plan for R&D and Innovation, The HORIZON 2000 R&D Programme and The Programme of Grants for Scientific Research**. General objectives of the **National Plan for R&D and Innovation (1**) are generating economic effects in the short or medium term and adaptation to increasing requirements of competitiveness and international integration both in the R&D area and economy and society. The share of the National Plan for R&D and Innovation in the budget used by the Ministry of Education, Research and Youth for financing of the national programmes for R&D and innovation is currently of about 55%.

The **National Plan for R&D and Innovation** includes 14 programmes, grouped according to the following major development objectives:

- modernisation and re-launching of the economy,
- consolidation of the new economy's elements based on knowledge,
- stimulation of the Romanian scientific and technologic community integration in the international community and first of all, in the European Community,
- research supporting the general progress of the technical and scientific knowledge, development of public policies and culture promotion

Box 26: Development objectives of Romania

Agriculture and food (AGRAL)
Life and health (VIASAN)
Environment, energy, resources (MENER)
Territory arrangement and transportation (AMTRANS)
Stimulation of the inventions application (INVENT), oriented towards the achievement of new products and technologies, based on patents own by Romanian inventors;
Economic re-launching by research and innovation (RELANSIN), targeting the modernisation of the products, technologies and services supplied/used by the economic units;
Quality and standardisation (CALIST), supporting the increase of the Romanian products and technologies quality, including in order to facilitate the access on the EU United Market;
Consolidation of the quality infrastructures (INFRAS) supporting the development of the quality infrastructures in accordance with the EU principles and practices;
Informational society (INFOSOC);
Biotechnologies (BIOTECH);

New materials, micro and nano-technologies (MANNANTECH);
Technologies in the spatial and aeronautic field (AEROSPATIAL)
Program for international cooperation and partnership (CORINT);
Program for Fundamental research of social, economic and cultural interest (CERES).

Source: National Plan for R&D and Innovation

General objectives of **The HORIZON 2000 R&D Programme (2)** are supporting the existing R&D potential and developing research in general interests areas and orientations or considered of strategic importance for the economy and society. It comprises 20 research-development orientations grouped on thematic, synergetic fields with the Framework Programmes.

The amount of the Horizon 2000 Program of the budget used by the Ministry of Education, Research and Youth for financing of the national programmes for R&D and innovation is currently of about 40%.

General objectives of **The Programme of Grants for Scientific Research (3)** are: expanding the existing scientific patrimony; stimulation of the formation of performance research groups; creating and developing scientific careers and human potential in the research field. The grants programme for scientific research currently represents an amount of about 5% of the budget used by the Ministry of Education, Research and Youth for financing the national programmes for R&D and innovation.

The grant programme for scientific research coordinated by the Ministry of Education, Research and Youth is designated to the research teams and individual researchers from the research units and universities. Programme targets are promoting the efficient research groups from universities and institutes, developing the scientific research carried out in universities, in correlation with the Reform Program of the High Education and University Scientific Research financed by a World Bank grant. The grants programme of the Ministry of Education, Research and Youth has a special role in the formation of human resources for research, throughout correlation of the research programmes with those of university and post-university training involving the young graduates and students in the final years in the research activity.

The programme covers over 10 specialised fields, representatives for the high education profiles and the Romanian research potential. The main fields classified by the participation degree are the technical sciences, fundamental sciences, and biological sciences.

Box 27: ROMANIAN INNOVATION WITH GLOBAL USE IN THE INFORMATION TECHNOLOGY INDUSTRY

Microsoft, the leading global soft producer, acquired in June 2003 the Romanian owned private company GeCad – a firm started from the scratch in early 90's by a group of students. The main product of the Romanian company was a locally developed antivirus programme named RAV. Following this acquisition, Microsoft announced plans to use the RAV application on its products. A local rival of Gecad, Softwin, also sells its software products abroad. Another IT company with local company, benefiting from continuous product innovation, is Flamingo – it has became by now a multinational company de facto, with affiliates in seven EU member states and candidate countries.

Softwin is a private Romanian company that provides software solutions and services and a leading provider of data security solutions and services. Founded in 1990, Softwin was the first Romanian software company, set up entirely with Romanian capital, to be certified ISO 9001In 2002 Softwin's antivirus software, BitDefender™, won first prize (in a competition organised by Euro-CASE with the support and sponsorship of the European Commission´s Information Society Technologies (IST) Research Programme). This was the very first time (since the competition started) that one of the awards went to an East European company. In August 2003, RAE Internet, provider of antivirus, antispam and Linux Groupware products was appointed through a distribution agreement, as the US distributor of BitDefender Antivirus Solutions.

Source: Corina PASCU and Liviu VOINEA

The research programmes coordinated by the Romanian Academy

The major national projects coordinated by the Romanian Academy are complex projects approaching important issues of Romania from a multidisciplinary point of view and involving in their design the research institutes and centress as well as the most competent persons both in the humanistic field and exact sciences within and outside the Romanian Academy system (including from the Diaspora).

A few significant example projects referring to the Romanian cultural patrimony are as following; **Thesaurus Dictionary of the Romanian Language; General Dictionary of the Romanian Literature; Romanians History Treaty**.

In order to integrate Romania within the current global political, social, economic and cultural context the following projects are running within the Romanian Academy: **Romania 2020** and **Informational society – society of knowledge**. The "**Informational society – Society of knowledge**" project involved more than 40 specialists (including 7 members of the Romanian Academy) and 10 institutes of the Romanian Academy from 4 departments (Economic, Social and Legal Sciences, Information Techniques, Philosophy, Psychology, and Genomics).

Towards the Development of the Knowledge Based Economy in Romania

The set of policy measures and actions[79] is concentrated on the following three main objectives: increase of public investment for R&D and innovation activities; stimulation of R&D investment in enterprises, and attracting and training more human resources for R&D and innovation activities.

Box 28: Implementation instruments towards 3% of GDP target for R&D in Romania

The gradual increase of state budget funds for R&D up to 1% of GDP until 2007:

Specific actions: increasing the impact and efficiency of R&D activities in support of economic competitiveness, through: the development of new products, technologies and services achieved in enterprises; more diverse and intensified processes of technology transfer and valorisation of R&D results; promotion of collaborative R&D project; the correlation of thematic priorities in national RTD programmes with those of the EU Framework Programmes; the promotion of scientific and technical excellence (promotion and support for the development of centers of excellence), the expansion of the national research space towards ERA; the development of R&D infrastructure; the development of the National Computer Network;

[79] Position paper of Romanian Ministry of Research on 3% of GDP Target for R&D in Romania (2003)

The stimulation of the diffusion and transfer of S&T knowledge and R&D results and "spinning-off" from R&D institutes and universities:

***Specific actions**:* the development of technology transfer and innovation infrastructures at regional level, development of the "market" for R&D results, assurance of special IPR regime and free transfer of R&D results, the creation of S/T parks.

Direct support for the creation and development of innovative SMEs:

Attracting and maintaining in the R&D activity young graduates with high professional performances, the stimulation of the formation and development of the scientific careers, aiming the formation of the research personnel at European level, stimulation of the setting and strengthening of the high performance research teams; ensuring an adequate wage level for the research personnel; promotion of the researchers' international collaboration and mobility.

Specific tools: the Programme of grants for scientific research, the provisions promoted by the Government Ordinance 57/ 2002, the CORINT programme from the National Plan for R&D and Innovation.

Source: Position paper of Romanian Ministry of Research on 3% of GDP Target for R&D in Romania (2003)

Box 29: RELEVANT INFORMATION SOURCES IN ROMANIA

Romanian Ministry of Education, Research and Youth: www.mct.ro (Sep. 2003)
Romanian Chamber of Commerce and Industry, http://www.euro-info.ccir.ro/index-eng.htm (Sep. 2003)
FEMIRC http://femirc.imm.ro (Sep. 2003)
Romanian Academic Society: www.sar.org.ro (Sep. 2003)
Romanian Center for Economic Policies: www.cerope.ro (Sep. 2003)
Romanian Center for Economic Modeling: www.ipe.ro (Sep. 2003)
Romanian Institute for Economic Prognosis: www.ier.ro (Sep. 2003)
European Institute of Romania: www.ier.ro (Sep. 2003)
Romanian Institute of World Economy: www.iem.ro (Sep. 2003)

CHAPTER 11: The SLOVAK Republic

COUNTRY PROFILE[80]

Population (2001):	5.402 million people
Area:	49,035 km²
GDP/capita (PPS; 2001):	11,060 Euros
GDP growth (1995-2000):	3.78 %
Unemployment rate (2000):	19.1%
GERD as a % of GDP (1999):	0.66 %

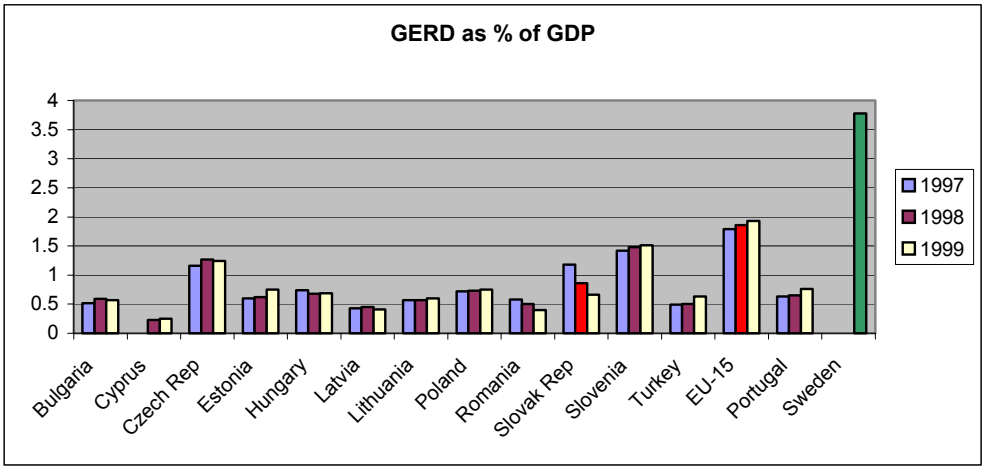
Source: EUROSTAT, European Commission DG Research-Key Figures 2002

I. BASIC INDICATORS OF INVESTMENT AND PERFORMANCE FOR THE KNOWLEDGE BASED ECONOMY in the SLOVAK REPUBLIC

A. R&D INVESTMENT AND HUMAN RESOURCES IN S&T

In 1999 the gross domestic expenditure on R&D (GERD) was 0.66% of GDP. At the end of nineties Slovak Republic was faced with a large decrease in expenditure on R&D. Nevertheless the GERD financed by the business sector is close to the EU average and was in 1999 49.9%

Figure 38: GERD as a % of GDP in the EU Candidate Countries – the Slovak Republic (1997, 1998, 1999)



Source: EUROSTAT, European Commission DG Research – Key Figures 2002

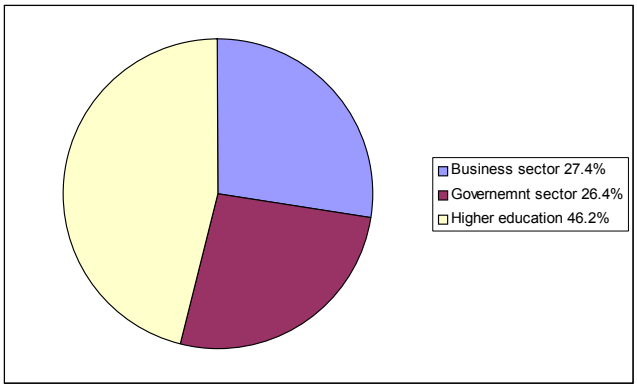
Table 29: GERD in the Slovak Republic (2001)

GERD as % of GDP (2001):	0.66%	1.93 (EU 15 / 1999)
GERD financed by business:	56.1%	56.3% (EU 15 / 1999)

Sources: Ministry of Education of the Slovak Republic

[80] The author would like to thank Mr. Dusan VALACHOVIC, Director General of the Science and Technology Division at the Ministry of Education of the Slovak Republic for his contribution and comments. Nevertheless the author takes full responsibility for the content of this country analysis.

Figure 39: Researchers by sector (%) in the Slovak Republic (1999)



Source: EUROSTAT, European Commission DG Research – Key Figures 2002

Total R&D[81] personnel in Slovak Republic were 14,849 people in 1999, which represented 0.58% of the labour force in Slovak Republic. According to the Slovak Ideal-ist project node[82] the number of R&D staff dropped to one third during the last 10 years. Human resources in S&T enables capacity to produce and absorb scientific and technological knowledge. In Slovak Republic the capacity to produce and absorb knowledge is the highest in the Higher education sector which employs 46.2% of researchers. The business sector employs 27.4% of researchers, which is higher than the EU Candidate Countries average but still less than the EU average of 50% of researchers employed in the business sector. Regarding the gender balance Slovak Republic, as other EU Candidate countries, performs better than the EU (30%) average with 38% of female researchers.

Table 30: Human Resources in S&T in the Slovak Republic (1999)

Type of researchers	Number of researchers	EU total number or EU average in %	Type of researchers as % of labour force
Total number of R&D personnel	**14,849**	**1,689,490**	**0.58%**
Number of female R&D Personnel	6,691	-	0.26%
Full-time equivalent (FTE) Total	9,204	919.796	0.36%
Full-time equivalent (FTE) Female	3,517	30%	0.13%
Business sector	**2,522**	**50%**	0.09%
Government sector	2,430	14.2%	0.09%
Higher education Sector	4,252	34.3%	0.16%

Source: EUROSTAT, EC DG Research, EC DG Employment and IPTS additional calculation[83]

[81] According to the Ministry of Education the total number of university teachers is 9707 (each of them involved in research in capacity from 500 to 1200 hours per year) out of that number there is 1064 professors and 2365 associated professors. There are 1242 full-time researchers at the universities.

[82] Information Society Technologies Programme in the Slovak Republic; Information Broshure prepared for the ERA Conference in Brussels, November 2002

[83] Labour force in Slovak Republic (1999): 2,523,330 – European Commission DG Employment
EU-15 (1999): 5.63 researchers (FTE) per 1000 in the labour force (head count).

B. S&T and ECONOMIC PERFORMANCE for THE KNOWLEDGE BASED ECONOMY in the SLOVAK Republic

Figure 40: Scientific Performance (publications per million population (1999))

Slovak Republic	EU -15	Sweden	Portugal
293	755	1657	333

Sources: European Commission DG Research- Key Figures 2002

In producing the scientific knowledge Slovak Republic is behind the EU average. Nevertheless there is a great potential of human resources for the future development of the S&T performance in the Slovak Republic. The low level of the applications submitted to the European Patent Office is compounded by the lack of institutional capacity to deal with the Intellectual Property Rights regime. According to the **European Trend Chart on Innovation 2002**[84] the relative weaknesses of the Slovak Republic are in the fields of public expenditure on R&D, in the trend of the level of internet access of population and in the field of current tertiary education[85]. On the other hand major strengths in innovation are in the fields of current medium/hi-tech manufacturing employment, business expenditure on R&D and trend for inward FDI.

Box 30: Attractiveness of the Science in Europe and in the Slovak Republic

In the Slovak Republic the particular problem is the future career of PhD graduates in sciences. Attractiveness of science is decreasing which is a common problem not only in the Slovak Republic but also in Europe in general. The Slovak Government would like to address this issue and look for future improvements. Compared with the EU countries there is still remarkable ''brain-drain'' both internal (towards business sector) as well as external, which puts the Slovak Government in more difficult position than developed EU Member States[86].

Source: Mr Dusan VALACHOVIC

Table 31: S&T and Economic Performance of the Slovak Republic

GDP per capita in Euros (PPS; 2001):	**11,060**	**23,200 (EU15)**
GDP average annual growth (1995-2000):	**3.78%**	**2.63% (EU15)**
Patents per million (1999):	**1**	**126 (EU15)**
Publications per million (1999):	**293**	**755 (EU15)**
High-tech exports, as % of total exp. (1999):	**4.1%**	**19.7% (EU15)**

Source: EUROSTAT, European Commission DG Research – Key Figures 2002

[84] European Commission DG Enterprise: 2002 European Innovation Scoreboard: Technical Paper No 2 - Candidate Countries, see annex Data Definitions and Sources and annex European Innovation Scoreboard 2002 – Trends (Candidate Countries) (www.cordis.lu/trendchart)

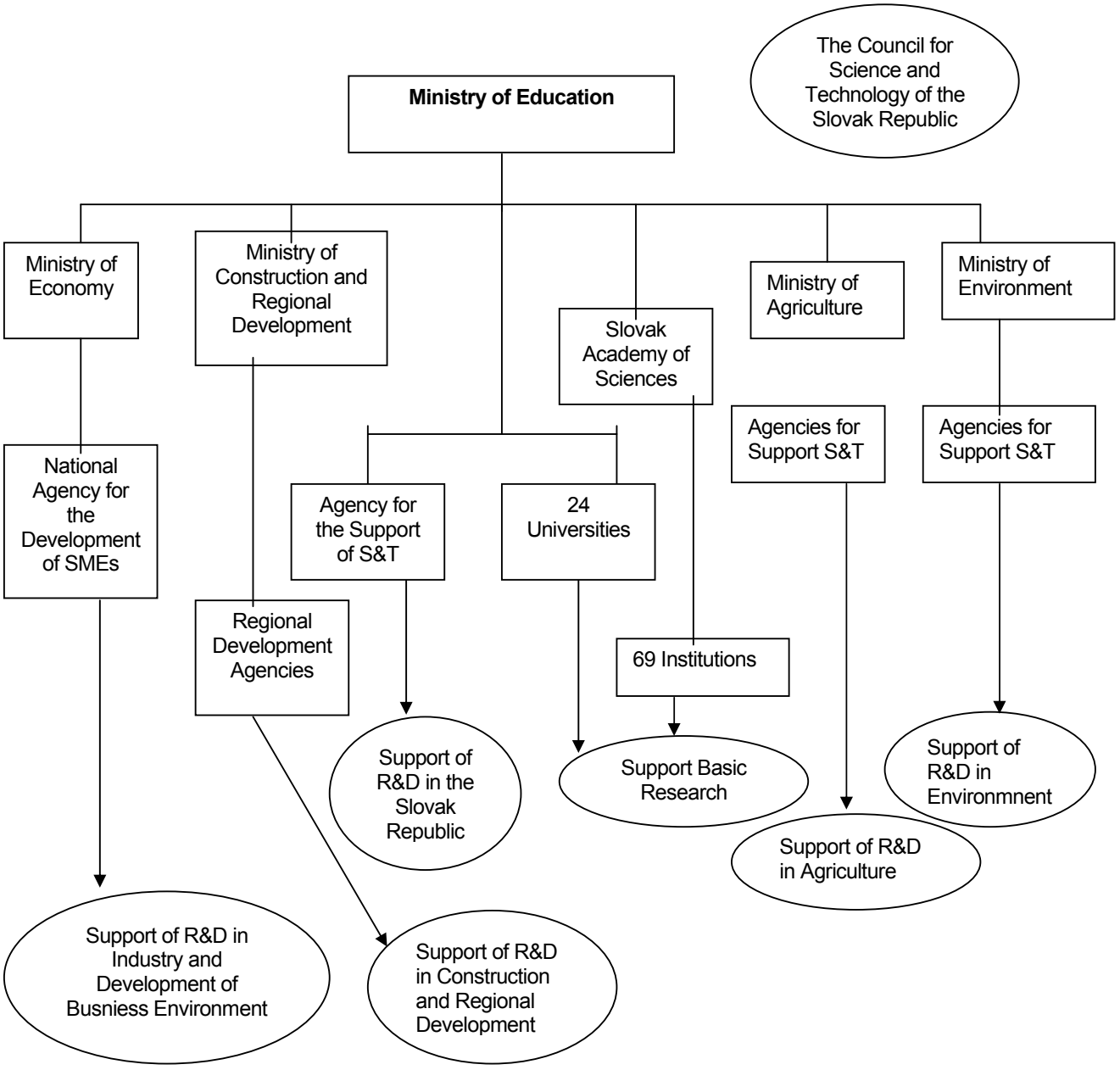
[85] According to Mr. Valachovic criteria for the evaluation of the tertiary education are not easy to be fulfilled (quality of education and research). If a department fails to comply with pre-set standards, it cannot teach a particular subject and there is a corresponding cut in the financial resources it receives from the state budget.

[86] Technology transfer and cooperation between R&D and industry: In the Slovak Republic problems are mostly coming out of former (and still pertaining) structure of the Slovak industry, which is very much labour-intensive, based upon imports of huge quantities of raw material and on capital investments (heavy industry). To re-orient this base needs further capital. Innovation is the leading idea, but it has to be seen within broader frame of changes in general (tax policy, support of SME's and private sector as a whole, change of pension and social and health care systems, education, etc..). According to Mr. Valachovic what shows up as a difficulty in Slovak Republic is insufficient capital – both from the state budget, as well as from the potential partners (research institutions and producers), very prudent behavior of banks and missing ''risky capital''. One of the reason for the above mentioned difficulties is the ''lack of marketing of S&T '' in public, media, investors and between policy-makers

II. INSTITUTIONAL CAPACITY for S&T POLICY MAKING in the SLOVAK REPUBLIC

The Ministry of Education is responsible for co-ordination of R&D activities. At the same time it also co-ordinates national participation in the EU Framework programmes. The Ministry of Education is the central authority in the area of S&T in the Slovak Republic. The Research and Development base in the Slovak Republic is mainly concentrated around the 23 universities and the 69 institutes of the Slovak Academy of Science.

Figure 41: Institutional Capacity for S&T Policy Making in the Slovak Republic



Source: Ministry of Education of the Slovak Republic and authors' own compilation

The Government of the Slovak Republic has its advisory body – **Council for Science and Technology**. The Council has a right and duty to discuss any document of substantial relevance to

S&T (R&D) and express its opinion before the document is submitted to the Government. The Council[87] comprises more than 30 experts from all sectors, nominated by representative authorities of the sectors and associations such us universities, Slovak Academy of Sciences, public and private research institutes, private companies and ministries.

The **Ministry of Education** is preparing S&T budget proposal in a close cooperation with other branch ministries and with the Ministry of Finance. Once the resources are on an account of the particular ministry, there is only a limited power of the Ministry of Education to influence its use within the respective other ministry. According to the EC Regular Report[88] the **Agency for the Support of Science and Technology** continued to work effectively when in most of the EU candidate Countries, such Agencies are in the process of being established.

The **Ministry of Economy** coordinates technology transfer and innovation. Most of the industrial R&D institutes are already privatised. R&D activities of SMEs have been growing significantly during the last period and many of R&D teams are involve in research and development in the area of information and communication technologies. The **Ministry of Economy** was partially reorganised in 2002, and departments for business environment and for support programmes were set up. The total number of institutions conducting R&D, under the auspices of the Ministry of Economy is 38, with more than 3000 employees. The Ministry of Economy runs a **National Agency for the Development of SMEs** which is partly financed by PHARE. The financing of the projects is mostly related to the support of new advanced production that is based on knowledge and modern technologies.

The **Slovak Academy of Sciences** carries out basic and strategic applied research. The Academy of Sciences supports scientific disciplines which have attained the international level of quality and which are necessary for the advancement of the Slovak Republic. The Slovak Academy of Sciences is subdivided into three scientific sections encompassing 56 scientific institutes and 13 auxiliary organisations, which conduct supporting activities. The Academy promotes the professional development and training of young researchers and co-operation with establishments of higher education. The Slovak Academy of Sciences publishes 52 scientific journals and almost 100 monographs annually.

Besides the Ministry of Education, the Ministry of Economy, the Slovak Academy of Sciences and the universities, there are also other important sectors with high research activities (**agriculture, environment, health, transport and communications**). Those important sectors for the R&D use quite substantial financial sources from the state budget.

There are altogether **24 universities in** Slovak Republic (23 state-funded, 1 private). According to the Ministry of Education 4 ''state'' universities are run by a particular Ministry or part of the government: Police Academy, Air Force Academy, Defence Academy, and University of Medicine. In the year of 2002 there were altogether 137,000 students on the first and second level (baccalaureate, master) and 8415 on third level (PhD). Enrolment reached over 3% of the population of the actual year.

The important supplier of continuing professional education is also the **Association of Slovak Scientific and Technological Societies (ZSVTZ**). This association is co-funded by the Government and by private organisations. ZSVTZ has created 4 **Houses of Technology** in

[87] According to Mr. Valachovic conclusions of the Council are of a very strong importance to the Government (including Ministry of Education).
[88] EC Regular Report 2002 on Slovak Republic

Bratislava, Banska Bystrica, Zilina and Kosice. The main objective of the Houses of Technology project is[89] the promotion of technology transfer towards highly qualified persons.

III. POLICIES & STRATEGIES FOR THE KNOWLEDGE BASED ECONOMY IN THE SLOVAK REPUBLIC

The Ministry of Education started to work on **Science and Technology policy** reform after the elections in 1998. The reform has the following three important stages:

- Drafting and adoption of policy materials
- Drafting and adoption of a new legislative framework
- Implementing the new legislative and financial framework

As a first part of the reform the Ministry of Education submitted to the government or to the National Council the following documents: **The Principles of State Science and Technology Policy (1999), A New Model of Science and Technology Financing (2000) and The Concept of State Science and Technology Policy (2000).**

According to the SGI National Report on S&T Policy[90], the **Concept of Slovak Republic State Science and Technology Policy by 2005** consists of the following principal goals:

- To make a consistent co-ordination of state science and technology policy and departmental policies in the areas of industry, power engineering, agriculture, transport, telecommunications, interior and exterior security of the state, defence, education, health care, and social, cultural, environmental, foreign and other policies.
- To create conditions for the approximation of the Slovak science and technology to the standards of comparable countries of the European Union by 2005.
- To create conditions for broadening and improving international scientific co-operation.
- To increase the performance and efficiency of the R&D in Slovak Republic.
- To increase the level of interconnection between the state sector, higher education institutions and business sector with regard to R&D institutions and departments with the focus on developing production and non-production branches.
- To speed up the transfer of R&D results as part of the development and restructuring process in the economy and society.

The S&T policy goals define two challenges for the policy makers in the Slovak Republic: first, to contribute to the **creation of the European Research Area**, and, second, to bring about **a new model of Science and technology financing**.

[89] Innovation policy in 7 candidate countries: The challenges (vol); European Commission DG Enterprise and www.zsvts.sk

[90] National Report on Science and Technology Policy, Slovak Governance Institute, editor Mr. Miroslav Beblavy, Bratislava, November 2002

Box 31: Policy objectives derived from S&T policy documents related to the creation of the European Research Area in the Slovak Republic

Partial goals resulting from attempts to create ERA focuses on following:

- To network the existing centres of excellence in Europe and creating virtual centres of excellence by means of new and interactive communication instruments
- To have a common approach to the needs and resources for financing large research facilities in Europe
- To provide a more coherent implementation of national and European research activities and closer relations between various R&D organisations in Europe
- To make better use of instruments and resources to stimulate investments in research and innovation: such us indirect-aid systems (within the EC rules on state subsidies), patents, and venture capital
- To create a common system for the assessment of implementation of science and technology policies
- To create more support for human resources with higher mobility
- To create a greater European cohesion in research based on the best experience of transferring knowledge at the regional and local level and in the role of regions in European scientific efforts
- To join research communities, companies, and research workers from Western and Eastern Europe
- To make Europe more attractive for research workers from other countries of the world
- To create and support common social and ethical values in science and technology matters

Source: SGI – Slovak Governance Institute, National Report on S&T Policy

Box 32: Policy objectives derived from S&T policy documents related to the new model of science and technology financing in the Slovak Republic

A new model of science and technology financing focuses on following:

- To prioritise financing for state R&D programmes and government R&D contracts
- To prioritise support for complex solutions to the development of science and technology requiring the co-operation of several R&D sectors (Higher education-Business – Government)
- To have a new approach to institutional R&D financing, which would ensure that state budget funds are more efficiently utilised and R&D workers are more directly involved in the results of their solutions
- To support and create of conditions to implement the results of industrial and applied research, which can have a gradual or immediate economic effect
- To follow the principles of cumulating budgetary and extra-budgetary funds in order to provide targeted support through the Science and Technology Support Agency
- To create conditions for more efficient diversification of resources to ensure direct support for science and technology

Source: SGI – Slovak Governance Institute, National Report on S&T Policy

The next stage of the reform was underpinned by the introduction of a new S&T legal framework in 2002. The Parliament of the Slovak Republic adopted the new **Act on Science and Technology**, the new **Act on Slovak Academy of Science** and the new **Act on Higher Education**.

According to the SGI Report the greatest compromises were made and longest debates took place in connection with the **Science and Technology Act**. The most significant new introductions were related to the following areas: adoption of criteria for membership of the boards of state programmes; **Change in the position of decision-making bodies (boards of programmes);**

Share of government contracts as a percentage of state programmes; Definition of criteria for the system of periodical assessment (allocation of institutional funds); and Introduction of thematic state programmes.

In addition to the development of the above mentioned areas according to the SGI Report some modifications of the S&T in Slovak Republic can be noticed. A code of ethics, regulating the conduct of all bodies was introduced. A better definition of science and technology services was introduced, which would prevent inappropriate use of public funds for science and technology. The parts of the law governing individual R&D sectors with representative or statistical functions were reduced. With selection of tasks within state programmes, public procurement will not be used to allow for a broader range of applicants and higher involvement of specialised bodies.

Towards the Development of the Knowledge Based Economy in the Slovak Republic

According to the EC Regular Report 2002 the framework for co-operation in the field of science and technology is well established, including the National Contact Points. Nevertheless the Slovak Republic should further increase the financial support and improve its administrative capacity. To ensure that the Slovak Republic can fully integrate into the European Research Area, it is important to increase gross domestic expenditure on research and technological development. The private sector should also be encouraged in order to participate more actively in research and technological development in the Slovak Republic. (Source: EC Regular Report October 2002)

Box 33: RELEVANT INFORMATION SOURCES IN THE SLOVAK REPUBLIC

Ministry of Education of the Slovak Republic: www.education.gov.sk (Sep. 2003)
Ministry of Economy of the Slovak Republic: www.economy.gov.sk (Sep. 2003)
Slovak Academy of Sciences: www.sav.sk (Sep. 2003)
Technical University of Kosice: www.tuke.sk/ist (Sep. 2003)
Slovak University of Technology: www.fei.stuba.sk (Sep. 2003)
Slovak Governance Institute: www.governance.sk (Sep. 2003)
Association of Slovak Scientific and Technological Societies (ZSVTS): www.zsvts.sk (Sep. 2003)

CHAPTER 12: Republic of SLOVENIA

COUNTRY PROFILE[91]

Area:	**20,273 km^2**
Population (2001):	**1,990,272 people**
GDP/capita (PPS; 2001):	**15,970 Euros**
GDP growth (1995-2000):	**4.3%**
Unemployment rate (2001):	**11.8%**
GERD as a % of GDP (2000):	**1.51%**

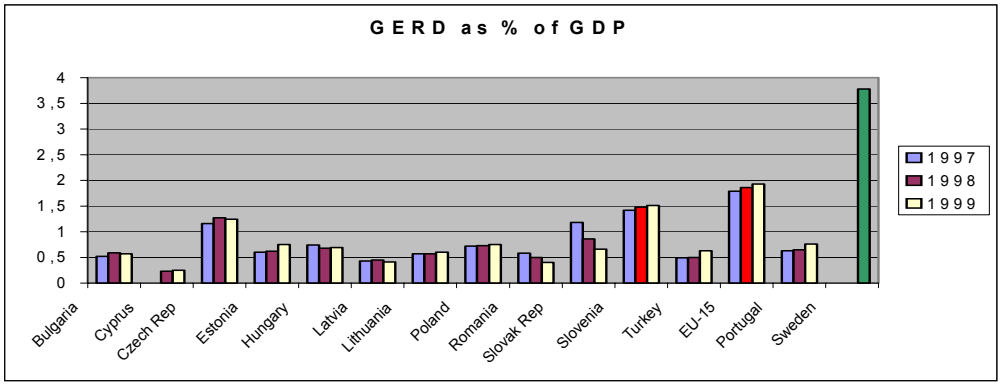
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

I. BASIC INDICATORS OF INVESTMENT AND PERFORMANCE FOR THE KNOWLEDGE BASED ECONOMY in SLOVENIA

A. R&D INVESTMENT AND HUMAN RESOURCES in S&T

In 2000, Slovenian gross domestic expenditure on R&D (GERD) was 1.51% of GDP. As in the previous years, the biggest share of GERD, namely 56.9%, was financed by the business sector[92], which was followed by the government sector, with 26% of GERD spent there.

Figure 42: GERD as a % of GDP in the EU Candidate Countries – Slovenia (1997, 1998, 1999)



Source: EUROSTAT, European Commission DG Research – Key Figures 2002

Slovenia has managed to maintain a relatively high financing for R&D comparable (GERD/GDP) to Austria, Italy, Ireland, etc. However in the 1990's spending was streamlined especially for basic research, while applied research and experimental development lacked funding. In recent years the share of applied research projects substantially increased, especially in the field of engineering and agricultural sciences.

Table 32: GERD in Slovenia (1999)

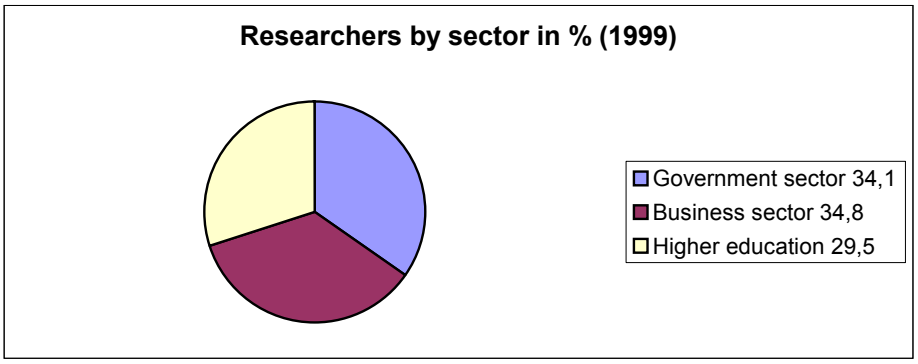
GERD as % of GDP (1999):	**1.51%**	1.93 (EU 15)
GERD financed by business:	**56.9%**	56.3% (EU 15)

Sources: European Commission DG Research, Key Figures 2002

[91] The author would like to thank Mr. Miloš KOMAC State Undersecretary at the Ministry of Education, Science and Sport for his contribution and comments. Nevertheless the author takes full responsibility for the content of this country analysis.

[92] Manufacturing is a dominant part of the Slovenian business enterprise sector. In 2000, the biggest R&D investments were recorded in the manufacture of pharmaceuticals and the manufacture of TV, radio and communication equipment.

Figure 43: Researchers in % by sector in Slovenia (1999)



Source: European Commission DG Research – Key Figures 2002

Total R&D personnel in Slovenia were 8,495 people in 1999, which represented 0.91% of the labour force in Slovenia. Human resources for R&D are important potential capacity to produce S&T knowledge. In 2000, Slovenian research and development organisations employed 12,220 people, 6,652 of which were researchers. The programme ''Young Researchers'' presents a good example of an initiative to strengthen the Slovenian human resources for R&D. The share of the business sector (34.8%) is lower than the EU average (50%) but still higher then Greece (15.6%), Portugal (12.7%) or Spain (24.7%). Regarding the gender balance, Slovenia is above the EU (30%) average with 33 % of female researchers (FTE). The private non-profit sector employs 3% of the total number of researchers.

Table 33: Human Resources in S&T in Slovenia (1999)

Type of researchers	Number of researchers	EU total number or EU average in %	Type of researchers as % of labour force
Total number of R&D personnel	**8,495**	**1,689,490**	**0.91%**
Number of female R&D Personnel	3,184	-	0.34%
Full-time equivalent (FTE) Total	4,427	919,796	0.47%
Full-time equivalent (FTE) Female	1,487	30%	0.15%
Business sector	**1,541**	**50%**	**0.16%**
Government sector	1,510	14.2%	0.16%
Higher education Sector	1,306	34.3%	0.14%
Private non-profit sector93	170		

Source: EUROSTAT, EC DG Research, EC DG Employment and IPTS additional calculation[94]

[93] In Slovenia there is 3% or 170 of researchers (FTE) that work in a private non-profit sector.

[94] Labour force in Slovenia (1999): 932,406 – European Commission DG Employment
EU-15 (1999): 5.63 researchers (FTE) per 1000 in the labour force (head count).

B. S&T and ECONOMIC PERFORMANCE for THE KNOWLEDGE BASED ECONOMY in SLOVENIA

Figure 44: Scientific performance (publications per million population (1999))

Slovenia	EU - 15	Sweden	Portugal
577	755	1657	333

Source: European Commission DG Research – Key Figures 2002, Statistical Office of Slovenia

In producing the scientific knowledge Slovenia is close to the EU average. Slovenia performs relatively good compared to the EU Candidate countries with 577 publications per million of the population and it is also high in terms of patents per million of the population. The implementation of Intellectual Property Rights regime is advanced compared to the other EU Candidate countries and some of the EU Member States. Nevertheless Slovenia still underperforms in the share of high-tech exports in total exports.

According to the **European Trend Chart on Innovation** 2002[95] the perceived weaknesses of Slovenia are in the fields of current life-long learning and inward FDI. There is also a weakness in the trend for inward FDI. On the other hand relative major strengths in innovation are in the fields of current S&T graduates, business expenditure on R&D, patents applied at the European Patent Office and the level of internet access of the population.

Table 34: S&T and Economic Performance of Slovenia

GDP per capita in Euros (PPS; 2001):	15,970	23,200 (EU15)
GDP average annual growth (1995-2000):	4.3%	2.63% (EU15)
Patents per million inhabitants (1999):	22	126 (EU15)
Publications per million inhabitants (1999):	577	755 (EU15)
High-tech exports, as % of total exp.(1999):	3.7%	19.7% (EU15)

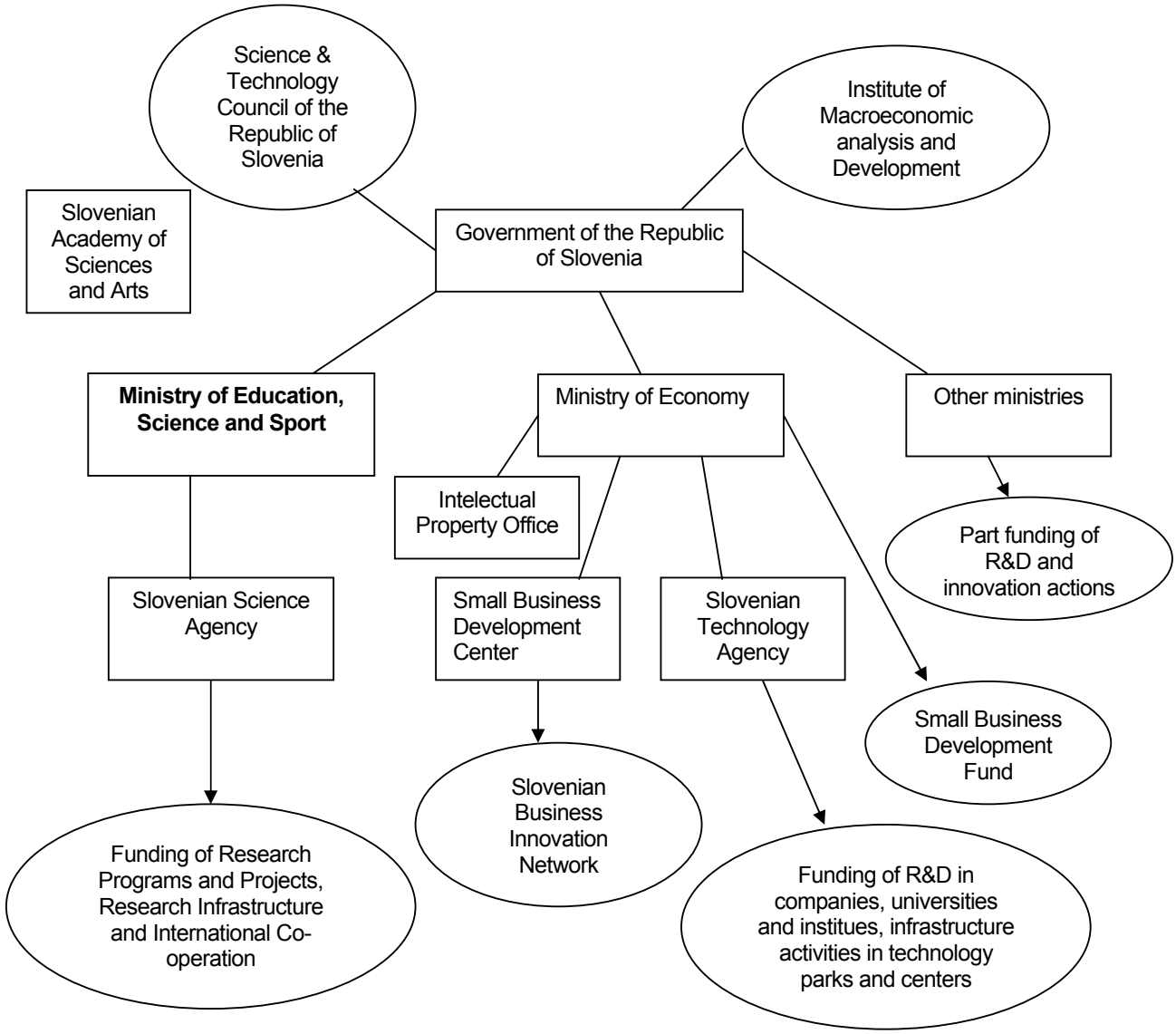
Source: EUROSTAT, European Commission DG Research Key Figures 2002, Statistical Office of Slovenia

[95] European Commission DG Enterprise: 2002 European Innovation Scoreboard: Technical Paper No 2 - Candidate Countries, see annex Data Definitions and Sources and annex European Innovation Scoreboard 2002 – Trends (Candidate Countries) (www.cordis.lu/trendchart)

II. INSTITUTIONAL CAPACITY for S&T POLICY MAKING in SLOVENIA

After the merger of former Ministry of Science and Technology and Ministry of Education and Sport in January 2001, the new **Ministry of Education, Science and Sport** is the main governmental body responsible for science policy in Slovenia as well as for research and development activities on a national level. At the executive level the **Ministry of Economy** determines the priorities for technological development and innovation policy. Innovation related issues were transferred to an expanded Ministry of Economy, which also gained responsibility for enterprise policy. The Ministry of Economy is the coordinator of theSlovenian Technology Foresight Programme.

Figure 45: Institutional Capacity for S&T Policy Making in Slovenia



Source: Ministry of Education, Science and Sport of the Republic of Slovenia and authors' own compilation

An important institutional player in the S&T policymaking structure is the **Science and Technology Council of the Republic of Slovenia.** The Parliamentary Committee for S&T is responsible for the political evaluation of every law and act related to S&T and innovation policy that needs to pass the

parliamentary procedure. Figure 4 illustrates the main players in the field of S&T or innovation policy formulation and implementation in Slovenia.

The **Slovenian Government** applies various instruments for the promotion of scientific research and technological development and for the transfer of research and development results to the economy and other segments of society. Two agencies will be established according to the new Research and Development Activities Act which entered into force in November 2002 i.e. the Slovenian Science Agency and the Slovenian Technology Agency. Two state funds/agencies are supporting innovative behaviour in Slovenian business enterprises – the **Small Business Development Centre** and the **Small Business Development Fund.**

The **Slovenian Intellectual Property Office (SIPO)** provides a range of information services, such us standard data about Slovenian and foreign patents, marks and industrial designs and selective dissemination of information concerning patent activities in different technical fields and companies. SIPO also provides written opinions about the novelty of inventions, and searches for identical and similar marks.

The **Slovenian Academy of Sciences and Arts (SASA)** is the supreme national institution of sciences and arts uniting scientists and artists who were elected in this institution for their particular achievement in the area of science and art. The SASA cultivates, encourages and promotes sciences and arts and, through its activities, contributes to the development of scientific thought and creativity in the arts. In the field of scientific research it does this by addressing basic issues of science; participating in the establishment of policies of research activities; giving proposals, appraisals and opinions on the position, development and promotion of sciences; organising research work particularly in the fields which are important for the understanding of the natural and cultural heritage of Slovenia; promoting international scientific cooperation. At present there are 71 full and 18 associate members of SASA, as well as 80 corresponding members from scientific organisations abroad.

The **Institute of Macroeconomic Analysis and Development** is a part of the Government of the Republic of Slovenia. The basic activities of the Institute are in line with the needs of the Government and its Ministries. The Institute's activities are: the elaboration of macroeconomic analyses of economic, social and regional development, the elaboration of the Strategy for Economic Development of Slovenia and the general provision of advice on economic, social and regional development.

There are **five types of research organisations in Slovenia**: the universities (Ljubljana, Maribor and Koper (established in 2003)), national research institutes and other institutes in the public sector, private non-profit institutes, and research units in the business sector. According to the data of the Ministry of Education, Science and Sport, there are 808 research teams within Slovenian research establishments and there are important research centres at the universities. At the University of Ljubljana there are 255 such teams, whilst at the University of Maribor there are 86. More than half of the participating organisations are active in the field of engineering sciences. There are 61 non-university research establishments, 18 of which have a status of national research institutes. In addition to research work at the universities, national and other research institutes, there are 204 commercial companies with R&D teams, particularly in industry.

The **Slovenian Science Foundation** is in general involved in the promotion of Science through co-operation between the Government and research organisations, scientists and the general public.

Coordination of Research Institutes (CORIS) is an important non-governmental association of key Slovenian research institutes that influence the governmental policy making process and monitor the implementation of S&T policies.

Among the other stakeholders, the most influential in public is the **Chamber of Commerce**, which participates in the debate on innovation policy framework, stressing the need for more development oriented economic policy.

III. POLICIES & STRATEGIES FOR THE KNOWLEDGE BASED ECONOMY in SLOVENIA

For the S&T policy making in Slovenia the **Coalition agreement** between political parties that form the Government is also important. There is a part of the Coalition agreement related to S&T and knowledge based economy. This part of the political document (agreement) defines long term political priorities of the Republic of Slovenia. The main elements of the Knowledge Based Economy are embedded in two main strategic documents of the Republic of Slovenia:

The Strategy for the Economic Development of Slovenia 2001-2006, *Slovenia in the New Decade: Sustainability, Competitiveness, Membership in the EU*; (Institute of Macroeconomic Analysis and Development, adopted by the Government on 26 July 2001)

The National Development Plan 2001-2006[96]; "**Knowledge for Development"**

The **''Knowledge for Development''** programme is coordinated by the Ministry of Education, Science and Sport and is one of the key programmes of the National Development Plan. This programme will be carried out by means of activities within the following four measures: **Creation and use of knowledge, International co-operation in research and development activities, Knowledge-Based Society and R&D networking programmes supporting the development of Slovenia – ''NDP 2001-2006''.**

Creation and use of knowledge (goals):

- Promoting investments in R&D activities and changing the structure of investment (more corporate investment and increasing staff in the business sector)
- Supporting the setting-up of institutions employing public funding and private capital – venture capital funds – that will help establish high technology companies
- Allocating more budgetary funds to priority research areas (national, regional and sectoral R&D priorities defined also by means of '' technological foresight'')
- Ensuring more a stimulating environment for R&D by modernising R&D infrastructure and providing network activities
- Promoting a faster transfer of knowledge from the public research sector to companies involving Slovenian scientific and research potential from all over the world

According to the Strategy the national priorities related to research and technological development will be established within the measure ''Creation and Use of Knowledge'' in 2004.

[96] The National Development Plan is the Strategy's implementing document and is currently under preparation. The National Research Program which is subject to a legislative procedure has the same status.

International co-operation in research and development (goals):

- Strengthening international cooperation in R&D into international and European research (ERA) spheres
- Increasing the international mobility of researchers in both directions
- Developing a stimulating environment for top R&D in cooperation with first-rate international R&D organisations (establishment of centers and networks of excellence)
- Increasing quality and applicability of R&D in Slovenia

Knowledge-Based Society (goals):

- Disseminating (scientific community, media, public) modern understanding of science and the role of knowledge in social and economic development.
- Bringing science closer to society (in the line of ERA objective)
- Bringing up young people in the spirit of creativity, curiosity and appreciation of knowledge

R&D networking programmes supporting the development of Slovenia – ''NDP 2001-2006'' (goals):

Allocate more budgetary funds to R&D priorities defined under the ''NDP'' (problem-oriented, interdisciplinary, inter-ministerial co-operation)

The main instruments of the **scientific policy** financed by the Ministry of Education, Science and Sport are; projects and programmes of basic and applied research, institutional funding of public research institutes, international co-operation, training and development of scientific staff (''**Young Researchers'' Program**), modernisation and operation of research infrastructure and **Targeted Research Programs - TRP** (inter-ministerial cooperation).

Box 34: Example of "Young Researchers" Program and Targeted Research Programs - TRP

The **Young Researchers Program** is a key programme aimed at improving human research potential by financing the doctoral study and postdoctoral projects of young researchers. The number and level of quality of young researchers increased. The programme also contributed to lowering the average age of researchers by 5 years.

A new programme entitled **Young Researchers for Business Enterprises** was launched in 2001 with the aim to promote post-graduate education and training of graduates by providing them with knowledge and skills needed for managing R&D in business companies, especially industry.

R&D activities supporting the development objectives of the Republic of Slovenia have so far been carried out through the mechanism of **Targeted Research Projects** (TRP), which have been a quite successful form of inter-ministerial cooperation. It is planned that the scope of TRP will be given to research studies serving as scientific bases for defining strategic orientations.

Source: Ministry of Education, Science and Sport of the Republic of Slovenia

For the implementation of **technology policy,** the emphasis has been put on the promotion of vocational education and training, adult education, protection of intellectual and industrial property and strengthening of innovative potential in companies.

Box 35: Example of funding support in Slovenia

Due to the economic transformation, in particular the loss of former Yugoslavian markets, a number of R&D units in the industry were downsized and many researchers moved to other sectors or set up their own companies. The support by the state to basic research in the years of transition has preserved the strong research traditions. Some research institutes have excellent relations with industry, but generally their co-operation with universities is weak. In Slovenia funding priorities include ICTs, biotechnology, advanced materials, complexity and systems, knowledge and science and technologies for sustainability. A specific focus is related to the national cultural and natural heritage and contemporary social challenges.

Source: Enlargement Futures Report on Technology, Knowledge and Learning, EC/JRC/IPTS-2001

The **Act on Support of Companies Developing New Technologies and Setting up and Managing their Development Units in the Period from the Year 2000 – 2003** is also a valuable effort to stimulate the business expenditure on research.

The **Program for Stimulation of Technological Development** by the end of 2003 determines as a priority to stimulate: co-operation between enterprises and research institutions and/or universities on joint research projects; faster knowledge transfer from research sphere to enterprises; strategic alliances among Slovenian enterprises as well as among Slovenian and foreign enterprises in the fields of development and marketing; and technological development in connection with investments in environmental protection.

Towards the Development of the Knowledge Based Economy in Slovenia

The framework of co-operation in Slovenia is established via the National Contact Point (NCP) system and the inter-ministerial working group set up in January 2000. According to the EC Regular Report Slovenia should focus further efforts on encouraging research that supplies relevant technology to SMEs and on strengthening the link between the private sector and science and research, in particular through transfer of know-how. *(Source: EC Regular Report – October 2002).*

Box 36: RELEVANT INFORMATION SOURCES IN SLOVENIA

Slovenian Government: www.sigov.si (Sep. 2003)
Slovenian Ministry of Education, Science and Sport: www.mszs.si (Sep. 2003)
Slovenian Public information portal: http://evropa.gov.si (Sep. 2003)
Slovenian Ministry of economy: www.gov.si/mg/ (Sep. 2003)
Slovenian Government Office for European Affairs: www.gov.si/svez/ (Sep. 2003)
FEMIRC (Josef Stefan Institute): www.ijs.si (Sep. 2003)
Chamber of Commerce and Industry of Slovenia: www.gzs.si/eng/index.htm (Sep. 2003)
Research on Internet in Slovenia, http://www.ris.org/providers.html (Sep. 2003)
ICT indicators, http://www.ris.org/ict.html (Sep. 2003)
Slovenian Intellectual Property Office, http://www.uil-sipo.si (Sep. 2003)
Slovenian Institute of Macroeconomic Analysis and Development, www.sigov.si/zmar (Sep. 2003)

CHAPTER 13: Republic of TURKEY

COUNTRY PROFILE[97]

Population (2000):	67,803,927 people
Area:	779,452 km²
GDP/capita (PPS; 2001):	5,210 Euros
GDP growth (1995-2000):	3.95%
Unemployment rate (2001):	8.5%
GERD as a % of GDP (2000):	0.64%

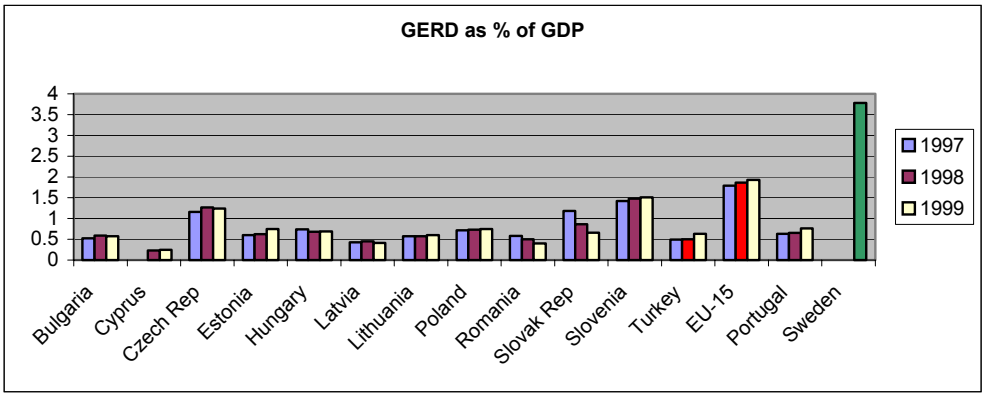
Source: EUROSTAT, EC DG Research - Key Figures 2002, State Institute of Statistics, Turkey

I. BASIC INDICATORS OF INVESTMENT AND PERFORMANCE FOR THE KNOWLEDGE BASED ECONOMY in TURKEY

A. R&D INVESTMENT AND HUMAN RESOURCES IN S&T

In 1999 the gross domestic expenditure (GERD) on R&D in Turkey was 0.63% of GDP. It increased from a level of 0.53% in 1991, but is still lagging behind the average for the other Candidate Countries. The percentage of GERD financed by industry increased from 28.5% in 1991 to 43.3% in 1999, whereas the part financed by the government decreased from 70.1% to 47.7% in the same period.

Figure 46: GERD as % of GDP in the EU Candidate Countries - Turkey (1997, 1998, 1999)



Source: EUROSTAT, European Commission DG Research

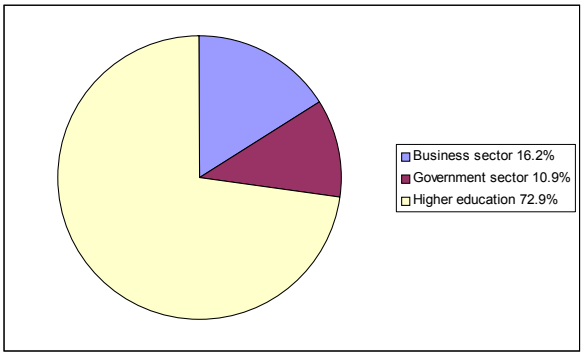
Table 35: GERD in Turkey (1999)

GERD as % of GDP(1999):	0.63%	1.93 (EU 15)	0.64% (2000)[98]
GERD fin. by business:	43.3%	56.3% (EU 15)	42.9% (2000)

Sources: European Commission DG Research – Key Figures 2002

[97] The author would like to thank Mr. Turgut TUMER, Deputy Vice – President of TUBITAK and Mr. Erol TAYMAZ from TUBITAK – Turkey for their contributions and comments. Nevertheless the author takes full responsibility for the content of this country analysis.
[98] Source: TUBITAK and State Institute of Statistics - Turkey

Figure 47: Researchers by sector (%) in Turkey (1999)



Source: EUROSTAT, European Commission DG Research –Key Figures 2002

In 1999, the total number of R&D personnel was 62,000 people; of which 52,000 were employed in higher education sector, 6,000 in business enterprises and 4,000 in thr government sector. The total number of R&D personnel represents 0.25% of the labour force in Turkey. Regarding the gender balance in the higher education sector, the ratio of women among the teaching staff rose from 31.9% in 1991 to 35% in 1999, and reached 36.7% in 2001.

Table 36: Human Resources in S&T in Turkey (1999)

Type of researchers	Number of researchers	EU total number or EU average in %	Type of researchers as % of labour force
Total number of R&D personnel	**66,330**	**1,689,490**	**0.28%**
Number of female R&D Personnel	21,061	-	0.08%
Full-time equivalent (FTE) Total	24,267	919,796	0.10%
Full-time equivalent (FTE) Female	7,434	30%	0.03%
Business sector	**9,576**	**50%**	**0.04%**
Government sector	6,116	14.2%	0.03%
Higher education Sector	50,638	34.3%	0.22%

Source: EC DG Employment, TUBITAK, State Institute of Statistics - Turkey and IPTS additional calculation[99]

[99] Labour force in Turkey (1999): 24.267.000 – European Commission DG Research
EU-15 (1999): 5.63 researchers (FTE) per 1000 in the labour force (head count).

B. S&T and ECONOMIC PERFORMANCE for THE KNOWLEDGE BASED ECONOMY in TURKEY

Figure 48: Scientific Performance (publications per million population (1999))

Turkey	EU -15	Sweden	Portugal
69 140*	755	1657	333

Sources: EUROSTAT, European Commission DG Research-Key Figures 2002
* Source: TUBITAK and State Institute of Statistics - Turkey

In the field of S&T and Economic performance for the Knowledge Based Economy Turkey is lagging behind the average level of the EU Candidate Countries. According to TUBITAK[100] sources Turkey published relatively high in the international periodicals. The contribution of Turkey to World science increased from 0.18% in 1991 to 0.5% in 1999, and reached 0.6% in 2001. Over the period 1991-1998, Turkey rose from 39th to 25th position in terms of the number of publications appearing in the Science Citation Index journals. In 2002 scientific performance measured by publications per million reached 140 publications[101].

According to the **European Trend Chart on Innovation 2002**[102] the relative weaknesses of Turkey are in the fields of current medium/hi-tech manufacturing employment, level of internet access of population and inward FDI. On the other hand major strengths in innovation are in the fields of current public expenditure on R&D and trend for R&D expenditure.

Table 37: S&T and Economic Performance of Turkey

GDP per capita in Euros (PPS; 2001):	**5,210**	**23,200 (EU15)**
GDP average annual growth (1995-2000):	**3.95%**	**2.63% (EU15)**
Patents per million (1999):	**1**	**126 (EU15)**
Publications per million (1999):	**69**	**755 (EU15)**
High-tech exports, as % of total exp. (1999):	**4.0%**	**19.7% (EU15)**

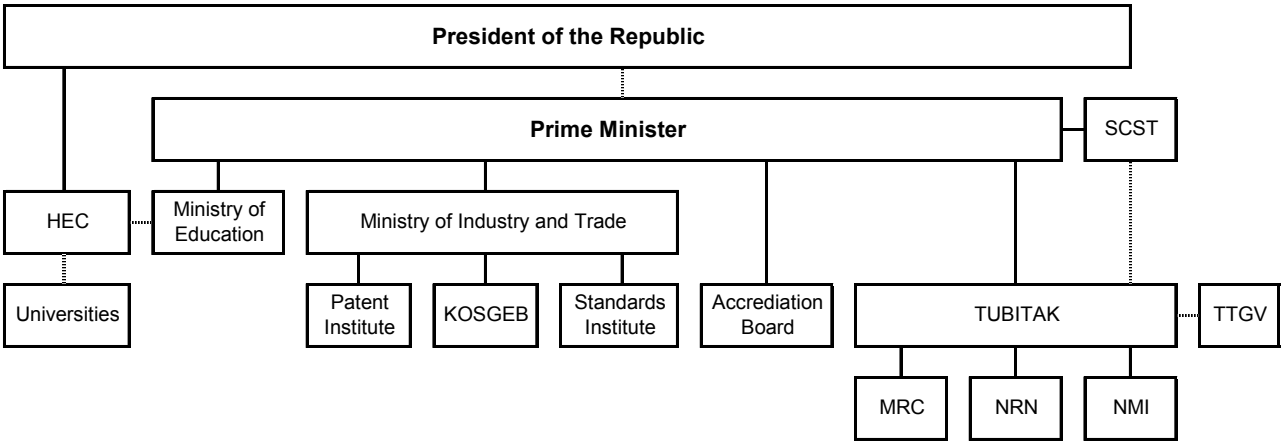
Source: EUROSTAT, European Commission DG Research – Key Figures 2002

[100] The identification of a real performance of Turkey, which has a significant human resources potential, might be misleading due to the lack of data needed to measure the S&T performance (TUBITAK – The Scientific and Technological Research Council of Turkey)
[101] TUBITAK and State Institute of Statistics - Turkey
[102] European Commission DG Enterprise: 2002 European Innovation Scoreboard: Technical Paper No 2 - Candidate Countries, see annex Data Definitions and Sources and annex European Innovation Scoreboard 2002 – Trends (Candidate Countries) (www.cordis.lu/trendchart)

II. INSTITUTIONAL CAPACITY for S&T POLICY MAKING IN TURKEY

The Science and Technology Supreme Council (STSC) is the highest science and technology policy making body in Turkey. It was established in 1983 following the recommendations of the first main science policy document, **"*The Turkish Science Policy 1983-2003*".** The STSC has laid the basis for science and technology policies in Turkey.

Figure 49: Institutional Capacity for S&T Policy Making in Turkey



SCST: Supreme Council for Science and Technology
HEC: Higher Education Council
TUBITAK: The Scientific and Technical Research Council of Turkey
KOSGEB: Small and Medium Sized Industry development Organisation
TTGV: Technology Development Foundation of Turkey
MRC: Marmara Research Centre
NRN: National Research Network
NMI: National Metrology Institute

Source: TUBITAK 2003

The **STSC** has decided to formulate a new S&T policy document for the period 2003 to 2023, and a new project, "***Vision 2023-Science and Technology Strategies***", was launched under the co-ordination of the Scientific and Technical Research Council of Turkey (TUBITAK).

The Scientific and Technical Research Council of Turkey (TUBITAK) is the main institution for the implementation of S&T policy in Turkey. TUBITAK was established in 1963 for the purpose of organising, co-ordinating and promoting basic and applied research. For some ten years, its chief function was confined to supporting basic research in universities through its grant scheme. Over the years, the mandate of TUBITAK has been gradually expanded from supporting basic research towards industrial technological activities, and contract research. **TUBITAK** is a central organisation in charge of promoting, organising, and co-ordinating R&D activities in various fields. It is provided with financial flexibility and administrative autonomy. TUBITAK reports directly to

the Prime Minister. It prepares the agenda, and formulates drafts resolutions for the STSC, and monitors the implementation of the STSC resolutions. TUBITAK also carries out R&D activities at its own research centres, aims to foster international S&T co-operation with a special emphasis on the 6th Framework Programme, provides facilities to assist industrial corporations in their R&D activities, publishes books and magazines to popularise science and technology, carries out a variety of programmemes dealing with scholarships, fellowships, travel support, science contests and Olympiads. TUBITAK is also the National Contact Organisation for the 6th Framework Programme.

The TUBITAK-Marmara Research Centre (MRC) is the main public research centre in Turkey. It was established in 1972, and now employs about 700 personnel, including 400 researchers. **TUBITAK-MRC** is consists of five institutes (Information Technologies Research Institute, Energy Systems and Environmental Research Institute, Materials and Chemical Technologies Research Institute, Food Science and Technology Research Institute, and Earth and Marine Sciences Research Institute). In addition, TUBITAK has six autonomous research centres in Istanbul, Gebze, Ankara, and Adana, specialised in ICT, defence technologies and cryptology, biotechnology and agricultural technologies.

The National Research Network (TUBITAK-ULAKNET) was set up in 1996 to establish the communication infrastructure for universities and research establishments. More than 1.5 million students, and about 80.000 academicians and researchers currently make use of the facility.

The Technology Development Foundation of Turkey (TTGV), a non-governmental and non-profit organisation, was founded in 1991, through a TUBITAK-led joint initiative by the public and private sectors. The initial budget was provided by the Undersecretariat of Treasury through a World Bank loan. The main mission of the TTGV is to provide loans to finance innovative activities in the economy, and to provide complementary innovation-supporting services.

The Small and Medium Industry Development Organisation (KOSGEB) was established by a special founding act in 1990, with the purpose of supporting innovation activities by SMEs and of encouraging entrepreneurship. It is a public body acting as both a consultancy service provider and a technology supplier for SMEs. To achieve these objectives KOSGEB has introduced several instruments, including Training Centres, Consulting and Quality Improvement Services, Common Facility Workshop and Labs and Technology Development Centres.

The Turkish Standards Institute (1960), the **Turkish Accreditation Agency** (1999), and the **Turkish Patent Institute** (1994) are main regulatory institutions that provide services for standardisation, accreditation, and protection of intellectual property rights. The **Ministry of Education** and the **Higher Education Council** are responsible for educational policies including various human resources development programmes.

III. POLICIES & STRATEGIES FOR THE KNOWLEDGE BASED ECONOMY IN TURKEY

During the last two decades, there has been substantial development in S&T policies in Turkey.[103] In line with this trend, the SCST has decided, on its Sixth Meeting held on December 13th 2000, that a new policy document should be prepared to formulate S&T policies for a twenty year period covering 2003 to 2023.[104] TUBITAK, then, has designed and co-ordinated a major project entitled

[103] Kemal Gürüz and Namik Kemal Pak, *The Turkish National Innovation System in the Making*, Conference Paper, Knowledge Economy Forum II, Helsinki, Finland, 25-28 March 2003 [http://www.helsinkikef.org].

[104] The Supreme Council has also decided in its sixth meeting to participate in principle in the Science and Technology Programs of the European Union namely the Sixth Framework Programme, Launch the National Biotechnology Research Programme in Agriculture, Upgrade

"Vision 2023: Science and Technology Strategies". This umbrella project consists of four sub-projects: National Technology Foresight Study; National Technology Inventory Project; Inventory of Turkish Researchers Project; and Inventory of R&D Infrastructure Project. The **Vision 2023** project is Turkey's first full scale attempt to design S&T policies by securing active participation of all stakeholders (academia, public institutions and private sector) in a technology foresight exercise. The project is intended to build a science and technology vision for Turkey, and to determine strategic technologies and priority areas of research and development, while involving a wide spectrum of stakeholders in the process, thus gaining their support, and creating public awareness on the importance of S&T for socio-economic development in order to create an innovative knowledge based economy and a welfare society in 2023, the centennial of the foundation of the Turkish Republic.

Box 37: Vision 2023 - Science and Technology Strategies and Technology Foresight of Turkey

The SCST has formed a Steering Committee (SC) which consists of 65 representatives (27 governmental institutions, 27 industrial organisations and NGOs, and 11 academic institutions). The foresight study has been carried out by the following 12 Technology Foresight panels: 1.) Education and Human Resources, 2.) Environment and Sustainable Development, 3.) Information and Communication, 4.) Energy and Natural Resources, 5.) Health and Pharmaceuticals, 6.) Defence, Aeronautics and Space, 7.) Agriculture and Food, 8.) Machinery and Materials, 9.) Transportation and Tourism, 10.) Textiles, 11.) Chemicals and 12.) Construction and Infrastructure.

Source: TUBITAK 2002

The final S&T policy document, incorporating the findings and recommendations of all four sub-projects, is to be released in the first quarter of 2004.

The document entitled **"*Turkish Science and Technology Policy: 1993-2003***" that was adopted at the 1993 meeting of the STSC suggested seven broadly defined priority areas of S&T. Together with the addition of earthquake related research after the 1999 disasters, these constitute the priority areas currently in force: Information and communication, Flexible manufacturing and automation, Transportation with particular interest in rail transport, Aeronautics, space and defence, Genetic engineering and biotechnology with particular emphasis on the agricultural applications in relation with the "South-Eastern Anatolian Project", Environment friendly technologies and renewable energy systems and Earthquake related problems and disaster management.

The **Eighth Five Year Development Plan (2001-2005)** considers scientific and technological activities as a vital ingredient for creating an information society. The Plan envisages the establishment of the technological infrastructure necessary for raising the level of scientific and technological research and targets increasing the GERD (Gross Domestic Expenditures on R&D) to 1.5% of GDP by the end of 2005 and the number of researchers to 20 per 10,000 of the working population.

Regarding the development of a **national system of innovation** and the diffusion of knowledge, and networking, **University-Industry Joint Research Centres** have been established by TUBITAK

the National Academic Network, Launch the National Technology Development and Research Priorities Programme on energy technologies, Coordinate Earthquake Research throughout the Country and to suggest inclusion of clauses in the draft bill concerning "Government Tenders Law" to create extra funds for R&D.

with the aim of initiating and fostering university-industry cooperation in specific industrial research areas. The centres are jointly funded by a consortium that includes TUBITAK and the private sector. The private sector side of the consortium has to involve at least three companies or an umbrella organisation (association, chambers of industry, etc.) collaborating with a university.

SMEs are expected to play the leading role in the knowledge based economy, thanks to their adaptability, dynamism, and entrepreneurship. Turkey considers **technoparks and incubators** as important tools for supporting knowledge intensive SMEs. Currently, there are two active technoparks in Turkey. The METUTECH was established at Middle East Technical University (METU) Campus, Ankara. There are 96 companies with almost 1000 employees working in METUTECH. The other one is TUBITAK-Technopark Complex (The Technology Development Zone, and the Technology Free Zone) at TUBITAK's Gebze Campus near Istanbul[105].

Turkey has adopted systematic **innovation finance programmes** since the early 1990s. The **Technology Development Foundation of Turkey** (TTGV) was established in 1991 and has provided loans for industrial RTD projects since 1992. TUBITAK initiated an R&D Grant Program in 1995 for industrial RTD projects, and established a special division, TIDEB, in charge of the programme. These two programmes together have been instrumental in doubling the share of the private sector in R&D activities in less than ten years, raising it to about 40 percent. There were 374 companies supported by TIDEB in 2002. The total budget of projects supported exceeded 700 million USD in the same year. Most of the projects supported by Technology Development Foundation so far are in the area of **telecommunications and electronics** that form the basis of the knowledge based economy. The share of SMEs in the group of companies supported by TTGV is 73 %. A similar trend is also observed in the projects supported by TUBITAK-TIDEB: 30 % of all projects supported since 1995 are in the area of information technologies and electronics, and SMEs' share is more than 50%. [106]

Turkey has developed **a contemporary intellectual property system** via a legislative reform package in 1994 and 1995107. The background of the massive legislative change is two-fold. Turkish industry's reaction to the new legislation was very prompt as reflected by the dramatic increase in the domestic patent applications since the establishment of the Patent Institute.

The **e-Turkey initiative** is an important step towards the creation of a Knowledge Based economy in Turkey. It has been implemented by the Turkish government within the framework of e-Europe+ Programme. Thirteen working groups have been formed in 2001. Perhaps the delay in implementing the **e-Turkey initiative** could indicate that e-Europe+ is not a policy priority for the Turkish government.[108] Uckan and Becani (2003) present the necessary steps or essential strategies for the transition of Turkey into the Knowledge Based Economy. The Turkish Government has a critical role in the following areas: to constitute necessary legislative infrastructure for information society

[105] There are presently 20 firms. After the enactment of the **Technology Development Zone** (TDZ) Act (which provides rather generous financial incentives to innovative industrial firms located in these zones) in 2001, these two technoparks were automatically granted the status of TDZ. Although incubators and technoparks provide a supporting environment for new technology based firms and young skilled entrepreneurs, these firms face with serious problems in marketing their products and financing their growth. In order to solve these problems, the creation of **venture capital** (VC) firms has received considerable attention in recent years.

[106] TUBITAK has launched a comprehensive evaluation study to assess these programmes in 1999, because evaluation of S&T programmes is considered to be an essential part of S&T policies and the policy learning process. The impact of R&D support programmes on R&D activities is analysed by using advanced panel data econometrics. The findings of the study support the claim that industrial firms underinvest in R&D activities, and the R&D support programmes help firms increase their R&D expenditures. Moreover, R&D intensive firms are more innovative, and innovative firms are more productive, more competitive in international markets, and generate more employment.

[107] Firstly, as a member of the WTO, Turkey had to align her legislation with the TRIP's Agreement. Secondly the Customs Union with the EU has obliged Turkey to accede to the Stockholm Act of the Paris Convention as well as to the Patent Cooperation Treaty.

[108] Ozgar Uckan and Yasin Becani: A Strategical Approach to Turkey's transition process into Knowledge Economy: The Evaluation of e-Turkey Initiative within the Framework of e-Europe+ Programme; Conference Paper Knowledge Economy Forum II, Helsinki Finland 25-28 March 2003

and knowledge economy; to constitute and sustain national science and technology policies; to constitute and sustain the National Innovation System; and to constitute and sustain the National Information Infrastructure.

Box 38: The concept of "Economical Catchments Area" in Turkey

During the Helsinki Forum on Knowledge Based Economy the concept of "**Economical Catchments Area"** was presented. The concept is used as an alternative management style in regional development plans in Turkey. The management concept takes its inspiration from the self-sufficient ecosystems of regional "*catchments"* areas, as a requirement of economical capability principle and presents an innovative regional administrative model. In this model, project management responsibility is distributed to the specific governance networks including all parties needed for the economic development. Besides international and national supporters, all of the local parties including local administration, municipalities, NGOs, business could contribute to the development and implementation of human, social and economical development targets. According to the authors opinion[109] in an "**Economical Catchments Area**", which is to be chosen as a pilot region according to the self-sufficiency principle, organic agriculture, environment, culture, tourism and other alternative economical activity fields can also be developed in addition to the Knowledge Based Economy institutions.

Source: Knowledge Economy Forum II, Helsinki -Finland 2003 (www.helsinkief.org)

Towards the Development of the Knowledge Based Economy in Turkey

In preparation for Turkey's participation in the VI Framework Programme, all S&T actors were consulted, according to TUBITAK report, including academia, industry and relevant state departments. Most of the principles of the ERA coincide with Turkish S&T policies. From the side of the Turkish government the long-term benefits are expected. Turkish industry, which was not interested in RTD until recently, realised the importance of research and innovation and its participation in the Framework programmes.

Box 39: RELEVANT INFORMATION SOURCES IN TURKEY

TUBITAK: www.tubitak.gov.tr (Sep. 2003)
Science and Technology Policies Department of Turkey: www.tubitak.gov.tr/btpd (Sep. 2003)
Industrial R&D Promotion of Turkey: www.tubitak.gov.tr/english/irdpa.html (Sep. 2003)
Small and Medium Sized Industry development Organisation (KOSGEB): www.kosgeb.gov.tr (Sep. 2003)
Technology Development Foundation of Turkey (TTGV): www.ttgv.org.tr (Sep. 2003)
Higher Education Council of Turkey (HEC): www.yok.gov.tr (Sep. 2003)
Information Technologies Research Institute of Turkey: www.btae.mam.gov.tr (Sep. 2003)
Istanbul Bilgi University: www.bilgi.edu.tr (Sep. 2003)
Internet and Law Platform – lvHP of Turkey: www.ivhp.org.tr (Sep. 2003)
Marmara Research Centre: www.mam.gov.tr (Sep. 2003)
National Academic Network & Doc Service of Turkey: www.ulakbim.gov.tr (Sep. 2003)

[109] Ozgar Uckan and Yasin Becani

CHAPTER 14: CONCLUDING REMARKS

The analysis of the 13 EU Acceding countries shows that the level of the state of the art in S&T varies and that there are also differences in S&T governance. S&T governance varies from country to country and is dependent on: the size of the country concerned; general economic development; the historical development of the S&T base and the cultural understanding of science; the institutional setting and the role of key S&T players: policy making experiences in each country; and the process of identification of domestic policy objectives with EU policy objectives *(Lisbon / Gothenburg / Barcelona process, Foresight and similar experiences).*

Bearing in mind that there is a need to further increase R&D financing in the EU Acceding Countries, the analysis of the 13 different countries demonstrates a lot of innovative approaches that can be used to strengthen various areas in the development of the Knowledge Based Economy and the pursuit of the 3% GDP target for R&D. In the field of promotion of S&T, the Cyprus Research Promotion Foundation is one example of the institutional setting and financing of various S&T programmes. The Cyprus foundation is a good example of a non-governmental organisation that has been entrusted with distributing the R&D funds allocated by the Government through open competitive procedures. An innovative approach of financing of R&D is also the "offset" system. In Poland, there is the example of the compensation of expenditure made by the country to purchase military equipment, which will, according to the Polish government, help to create a scientific think-thank to look for applications for inventions and innovations.

During the transition period in many of the EU Acceding Countries, the number of researchers, particularly in industry has decreased. Nevertheless, in the field of human resources development there is great capacity for the production and absorption of knowledge. With a total of almost 300,000 R&D personnel in 1999, the EU Acceding countries will add 18% to the current EU total of 1.7 million R&D personnel. Some countries were more and others less successful in the implementation of the proper policies to maintain or strengthen human resource potential in the past. The Slovenian ''Young Researchers'' programme or recent the ''Pupils in Research'' and Young ''Researchers'' programmes in Cyprus demonstrate the effectiveness of policies aimed at improving human research potential.

In the involvement of stakeholders in the determination of S&T priorities, the Polish Business Centre Club is a practical example of the private sector (principally SMEs) influencing the policy debate. Together with a range of think-thanks they influence and contribute to S&T policy debate in Poland. The Slovenian Chamber of Commerce is an important stakeholder that participates in designing S&T policy and stressing the need for more development oriented economic policies. In many of the EU Acceding Countries the most important S&T institutional players are the academies of sciences. Some of them have a historically important role, which they retain today, such as the Hungarian Academy of Sciences, the Romanian Academy, the Czech Academy of Sciences and recently the Slovak Academy of Sciences.

An interesting example of the practice of strengthening the links between the innovation system actors can be seen in Estonian university-industry relations. The Tallinn Technical University (TTU) has combined bottom-up and top-down approaches in extending its industry relations. Another practice example of regional level co-ordination and policymaking is the Turkish ''Economic Catchments Area'' project. The concept is used as an alternative management style in regional development plans in Turkey. The Lithuanian initiative "Window to the Future", shows how private initiative can influence the government policy making with the aims of minimising the digital divide in Lithuania and speeding up the growth of internet penetration in the country.

The recent Foresight exercises in the Czech Republic (Technology Foresight) and in Turkey (Vision 2023 S&T Strategies and Technology Foresight) are examples of long term planning and priority-setting that are needed for the identification of countries' or regions' priorities that further influence the S&T policy making. The EU Acceding governments' plans define as a priority S&T development over the next decade. Examples of strategic documents highlighting S&T are the "Program of the Government of the Republic of Lithuania for 2001-2004" and the "Hungarian National Development Plan" (with the Creative Hungary scenario). The analysis of recent government strategic plans shows that there is a desire amongst the EU Acceding countries to strengthen the policies related to the development of the Knowledge Based Economy.

Presentation of some of the indicators of the EU Acceding Countries and analysis of the S&T institutions and S&T policies show that the forthcoming members of the European Union will contribute to the development of the Knowledge Based Economy. This will not occur immediately with the finances invested either from public or private sources but with the innovative policy approaches and institution settings that enable further investment towards the 3% of GDP target for R&D by the year 2010.

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List of Acronyms and Abbreviations

BAS	Bularian Academy of Sciences
BZF	Bay Zoltan Foundation
CC	The 13 Candidate Countries in process of joining the European Union: Bulgaria, the Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, Turkey
CORIS	Coordination of Research Institutes in Slovenia
CISTI	Inter-Ministerial Council for Science, Technology and Innovation
DG	Directorate General
EC	European Commission
EBRD	European Bank for Reconstruction and Development
ERA	European Research Area
ERTDI	Higher Education Research activities, Technology Development and Implementation
EU	European Union
EU15	The 15 present member states of the European Union
FDI	Foreign direct investment
FP6	Framework Programme 6
FTE	Full-time equivalent
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
IT	Information and Communication Technology
IPSE	Institute for the Promotion of Small Enterprise
IPTS	Institute for Prospective Technological Studies
IRC	Innovation Relay Centre
ISO	International Organisation for Standardisation
ISSP	Institute of Solid State Physics
IT	Information Technologies
KBN	State Committee for Scientific Research - Poland (Komitet Badan Naukowych)
MCST	Malta Council for Science and Technology
MDC	Malta Development Corporation
METCO	Malta External Trade Corporation
MHD	Magneto Hydro Dynamic
NCP	National Contact Points
NCSRHE	National Council for Scientific Research of High Education
NDP	National Development Plan
NGO	Non-Governmental Organisation
NIS	National Innovation System
NPOR	National Programme of Oriented Research
OECD	Organisation for Economic Co-operation and Development
OMFB	National Committee for Technological Development

PPS	Purchasing Power Standards
RCEP	Romanian Centre for Economic Policies
RPF	Research Promotion Foundation
RTD	Research and Technology Development
R&D	Research and Development
SASA	The Slovenian Academy of Sciences and Arts
SGI	Slovak Governance Institute
SIPO	Slovenian Intellectual Property Office
SME	Small and Medium sized Enterprise
S&T	Science and Technology
TRP	Targeted Research Programs
TTGV	Technology Development Foundation of Turkey
TTU	Tallinn Technical University
TUBITAK	The Science and Technical Research Council of Turkey
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WEF	World Economic Forum
ZSVTZ	Association of Slovak Scientific and Technological Societies

LIST OF BOXES, TABLES AND FIGURES

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ANNEX 2:

E.U. Candidate Countries and the 3 % of GDP target for R&D - challenges and actions

Informal Seminar

Brussels, 5th March 2003

I. **Background Document – IPTS Staff Working Paper**

II. **Seminar Output – Main Points Arising**

Seminar held under the auspices of DG RTD K – Knowledge Based Economy and Society

Rapporteur: DG JRC IPTS Seville

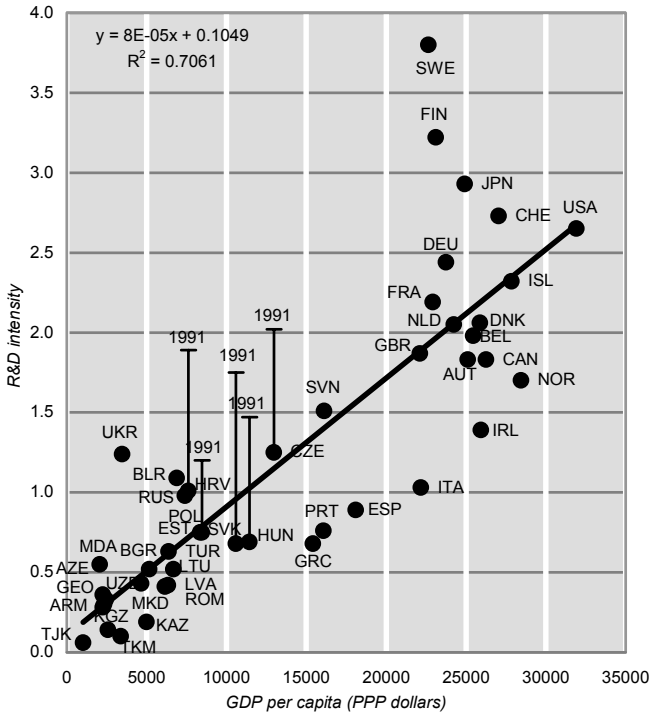
What specific challenges does the 3 % target raise for Candidate Countries, and what actions should be undertaken to address these challenges?

1. Background Document – IPTS Staff working paper

GDP and R&D / Introduction

Statistical data show that there is a positive correlation between most S&T and knowledge-related indicators (investments in education and training, patenting activity, R&D, …) and GDP per capita (UNECE, 2002). This is shown in the following graph for R&D intensity (GERD/GDP):

Research intensity and GDP per capita in the UNECE region, 1991 and 1999



Source: Economic Survey of Europe, 2002 No. 1 (released in May 2002) UNECE calculation, based on OECD, Main Science and Technology Indicators, Vol. 2001, Issue 2 (Paris), 2001 and UNECE Common Database.

On this basis, it is not surprising that CCs demonstrate lower levels of GERD when compared to other countries where the level of GDP/capita is much higher. Several CCs have also undergone declines in the level of R&D investment at least up to 2001 – e.g. according to the November 2002 European Innovation Scoreboard, the trend for public R&D expenditure was negative for RO (up to 1999) and SK (to 2000), and the BERD trend up to 2000 was negative for BG, LT, PO and SK.

Such low R&D investment plus the weak state of collaboration between public research and the business sector cannot be treated in isolation as problematic *per se*. It needs to be considered as symptomatic of, and in conjunction with, a series of structural issues and innovation system-wide deficiencies in CCs, all of which need to be tackled on a broad front:

111 IPTS Staff consulted: Andries Brandsma, , Constantin Ciupagea , Tibor Dory, Ken Ducatel , Gustavo Fahrenkrog , James Gavigan, Blaz Golob , Elissaveta Gurova , Anton Geyer , Jan Kozlowski , Corina Pascu

- Profound economic restructuring (in the case of CEECs)
- Limited availability of resources for long-term investment
- Low level competitive pressure (in some business sectors) for companies to innovate
- Higher risk of R&D activities than in the EU15
- Domination of (domestic) industry in CCs by low tech activities/products
- The low regard for and remuneration of R&D activities, etc…

New R&D in CCs is mostly linked to foreign investment, which brings with it the necessary financial instruments, and imitation strategies of local companies. Governments recognise that successful research applications are often brought about by the mobility of researchers, including the fresh turnout of the higher education system. R&D could be stimulated by measures to improve the standing of research. In the longer term national innovation capacities could be increased through the search for excellence in the education system and through intellectual property arrangements that allow innovators to benefit from their research effort.

However, it is also important to keep in mind the many constraints (in the form of budgetary limitations and other policy areas which command priority for public expenditure such as social policy) on the wish to increase public R&D expenditure. Innovation policy suffers in this respect from its 'horizontal' character (in CCs as in the EU). While policy-makers acknowledge the long-term potential of research and innovation for economic growth, they are faced in the short term with limited financial and human resources (EC 2002).

Policy action to increase BERD is obviously even more difficult. Here, the indirect influence of economic development strategy, setting market, regulatory and broad framework conditions, etc. are crucial, but investment decisions are ultimately taken by private firms.

Furthermore, several CCs (e.g. SL112, HU, …) see the aim of **increasing the efficiency and effectiveness of the current level of R&D investment** as a priority over further increasing the overall spend.

The meaning of the 3 % target

Com(2002)499113 states that approaching the **3 % target is an objective for the EU as a whole**, and that current and future Member States cannot all be expected to meet this target individually by 2010. But they should all contribute to the effort and co-ordinate their efforts to create a joint dynamic for the growth of R&D investments throughout the Union.

The fact that, in 2010, five countries alone (D, UK, F, I, E) will still account for 75 % of European GDP114 implies that these countries will have a correspondingly large influence on any number reflecting EU averages such as R&D intensity. **This should however not hinder all Member States from fully participating in the overall effort**. The same paper presents an interesting series of simple trend extrapolation scenario based on calculations in which estimates of how much additional R&D spending would be needed and how much more R&D human resources would be required on a country by country basis for EU Member States and CCs, both individually and as blocks of countries, in order to reach the 3 % target by 2010.

112 "*The current level of the state's investment is satisfactory compared to international figures; however, the state will increase its investment in research and development in line with the level of the corporate sector's investment in these areas*." from **Slovenia in the New Decade:** Sustainability, Competitiveness, Membership in the EU, The Strategy for the Economic Development of Slovenia 2001-2006, Institute of Macroeconomic Analysis and Development

113 More research for Europe. Towards 3% of GDP. European Commission COM(2002)499 final 11 Sept 2002, Brussels.

114 Schibany and Streicher (2003)

Role of R&D in CCs

R&D has played a minor role when compared to reform, capital, firm-based learning and technological accumulation, in driving growth in most Candidate Countries through the 1990s. Further continued growth and socio-economic progress towards a learning/ knowledge-based economy will require R&D – and especially private sector R&D - to play a more central role115.

Romania, for example, aims to achieve 1 % of GDP by 2007 and 3 % of GDP by 2010, and Estonia's R&D strategy *Knowledge –based Estonia* aims to reach GERD of 1.6 % by 2006. However, it is important to reconcile political rhetoric with practicality in terms of identifying what is really achievable in CCs (as indeed is also the case in much of the current EU) over the time period in question, given the starting point, the competing policy priorities, and the high mobility of private investment.

Action:

- Raise the awareness of policy makers in CCs to the need for increased competitiveness, and therefore, **of the importance of the Barcelona R&D target and the Lisbon objective**. This action will help to ensure that the countries will **switch from wish-lists in the area of R&D to real R&D public support measures** aimed at increasing competitiveness and flexibility in domestic markets.
- To define a **more precise set of evaluation criteria of the R&D effects within an economy**, as a base for future assessment of competitiveness. These evaluations will serve discussions with current and future EU Member States on the Barcelona targets.

National Innovation Capacities

CC economies tend to be highly polarised, with technologically advanced foreign-owned companies forming islands of innovation among the larger numbers of technologically weak domestic firms. In an overall analysis of the national innovation capacities of CEECs compared to the EU (particularly cohesion countries) in terms of four major components – *absorptive capacity*, *R&D supply*, *diffusion capacity* & *capacity to generate demand for innovation* – (Radosevic, 2002)116, the following was concluded:

- ***the most important distinguishing factor between CEECs and the EU15 is in the capacity to generate demand for innovation***, &
- ***the most important distinguishing factor between the advanced and less advanced CEECs is in terms of the innovation absorptive capacity and R&D capabilities***

These conclusions are largely borne out by the November 2002 European Innovation Scoreboard which covers all of the CCs.

Demand for R&D

The weakest aspect of the innovation capacity of CCs (CEECs) is the demand conditions for innovation – i.e. a weak demand for innovation from the business sector. For firms with limited cash, tough competition and limited access to long term finance, it is difficult to conduct R&D, and it is perceived more like a liability.

The capacity of an economy to generate demand for innovation depends on the financial system, the degree of competition and macro-economic stability, etc. Seven of the ten CEECs are behind EU cohesion countries on this count, with EE, HU and CZ slightly better than the others, mainly because of better developed stock market, banking system and high share of FDI. SL which has a high absorptive capacity and level of R&D supply comes at the low end of the demand capacity spectrum because of its underdeveloped financial system and low FDI (Radosevic, 2002).

115 Basanini and Scarpetta (2001) estimate that, at a minimum, a 0.1 % increase in business-sector R&D spending in GDP boosts the level of GDP *per capita* by 1.25 % in the long term.

116 see a summary of definitions/ indicators in the appendix

Action:

- To provide a set of guidelines for "How to increase the BERD in a country with low technological level or with few experience in innovation promotion and recognition?". This could touch problems such as: property rights legislation and implementation, global attractiveness of the business environment, consumer's culture and protection, educational programmes for enhancing specific skills, etc.

The level of R&D investment

In CCs, the level of investment lags EU - including cohesion countries - in terms of the recorded levels of public and business R&D expenditure and the share of R&D personnel in the labour force. However, CZ, HU and EE investment levels and patenting activity, places them in the range of less developed EU Member States, with SL even ranking ahead of them (Radosevic, 2002).

However, it is important to target the level of R&D in a given region and country to the sectoral structure of business – both its present composition and the future composition which the national economic development strategy aims to achieve. Clearly, a strategy which seeks to develop the most R&D intensive sectors (e.g. the most R&D intensive sectors OECD-wide in terms of percentage of output are pharmaceuticals 11 %, instrumentation 7 %, electrical & electronic equipment 5.6 %, transport equipment 4.5 %) will require a much higher increase of R&D investment than one which targets other less R&D intensive sectors.

Multinational companies account for **~ 80% of the total private sector R&D expenditures** worldwide. So it is worrying that, while the European Round Table of Industrialists (ERT) report that member companies expect to increase their level of **global R&D expenditure**, the risk is that the increase will **occur outside of Europe** because of the perceived unattractive framework conditions for investing in R&D in Europe, in terms of human resources and infrastructure, financial incentives and overall legislation and regulation (ERT, 2002).

While this needs to be tackled on an EU-wide basis, the fact that the **CCs represent a hugely underdeveloped (especially when compared to the EU15) market potential in almost all areas (consumer goods, all types of services, retail and trade, construction, etc.) should possibly drive policy actions to aggressively target FDI from foreign multinationals in order to attract R&D activities and provide a stimulus and 'market' for the further development and exploitation of indigenous R&D.** Through the 1990s, in some CCs, what was initially *market-seeking* type FDI became *resource-seeking* or *efficiency-seeking*, as foreign firms discovered valuable intangible assets in acquired companies leading to the location of part **of their strategic R&D**117. These tendencies could be intensified by the EU accession.

The specialisation patterns of Candidate Countries is very variable. Poland is specialised in traditional sectors, with a large share of market-seeking FDI118. The Czech Republic, Hungary and Slovenia are specialised in resource–intensive and technology-based scale-intensive sectors, with a large share of resource-seeking FDI. Accession to the EU will redraw the specialisation patterns of these countries. One expected trend will be the crystallisation of past specialisation patterns – viewed as a distribution of shares of industries with market-seeking or resource-seeking FDI.

Action:

- There is need for industrial policy to be developed in a way which, **in a first instance**, is tuned to the relative levels of development and underdevelopment of sectors of the economy, and **secondly** biased in favour of knowledge/ R&D -intensive production and service activity. The case of Hungary which raised its proportion of high-tech manufacturing from 13.3 % in 1994 to 26.4% (in 2000), underlines the high potential across the ensemble of CCs where the proportions of high-tech manufacturing and services are much lower than the EU average.

117 For example in Hungary a number of well-known trans-national companies have set up research facilities and the main corporate R&D facilities of the country are established or overtaken by multinational companies. Instances include General Electric, Ericsson, Nokia, Audi, Knorr-Bremse. See also the contribution of Andras Inotai to the Forum Bled Proceedings, Enlargement Futures Report Series 07, IPTS, who notes a third wave of FDI focusing on R&D-intensive activities.

118 On the Polish experience Jerzy Kleer argues in the Forum Bled Proceedings that in the long term the absence of and independent R&D sector and specialised research centres, in combination with imitation strategies, hurts the economy and leads to growing dependence on Western technology.

Example: Supporting corporate investments in high-tech R&D

The Hungarian government provides up to HUF 125 million (€ 0.5 million) and not exceeding 25 % of total investment costs, to establish a new research facility, either as an individual economic organisation, or a separate unit in an existing business organisation in order to develop and introduce modern technologies. The support is eligible for companies which invest over HUF 500 million (€ 2 million). The established research facility and the new (extra) R&D employees must be used and employed in accordance with the original purposes for at least five years.

Underestimation and statistical problems

There is a strong possibility that GERD and BERD are underestimated in the candidate countries. In the case of Poland, Jan Kozlowski (2002) estimates that the underestimation could be as high as 0.17 % of GERD.

Action:

- Standardise the actual R&D statistics in candidate countries. This action will refer first of all to the share of BERD in GERD. (example - Romania has now a reported percentage of 50.2 % of GERD financed by the business sector; in reality, the previous state-owned institutes of research were privatised, but in some of them the state still maintains a share).

One should not disregard the very important knowledge economy effects of the softer side of innovation and technology which is typified by organisational innovation, R&D related to software, logistics, design, and strategy and service related innovations in both industrial and service sectors, much of which is unaccounted for in traditional S&T statistics. As CCs catapult themselves into modern market economies, the development of services is one of the most dynamic segments, and a hive of uncounted innovation and para-research type activities.

Action:

- Develop ways to take account of para-research and innovation activities both to recognise their contribution to the economy, and permit actions to be taken to foster their further development. (EU and CCs). (The 2002 revision to the Frascati Manual – in particular Chapter 2 (2.3 & 2.4) dealing with software and services, provides a framework for bringing statistical data more in line with reality – if implemented correctly).

S&T Governance

An important structural problem which CCs face is an underdeveloped system of S&T governance – this refers to the mix of formal and informal institutions, mechanisms and procedures for managing S&T infrastructure, designing, delivering, selecting and evaluating S&T policy programmes, and the specification and implementation of technical standards.

The formulation and delivery of policy is hindered by a lack of appropriate procedures and institutions, through which to channel different interests and lobby positions, and balance all relevant inputs in the interest of the best possible policy decisions. In terms of the delivery of policy action, only Estonia has a dedicated agency for innovation and technology. Several countries have placed technology funds under the management of intermediaries. Funding for industrial R&D centres or centres of excellence is provided either by ministries for science and education or by those for industry (EC 2002).

Problems include:

- A frequent lack of integration between research agendas and economic policy
- Poor operational links between innovation system actors
- Lack of regional level co-ordination of R&I measures
- Poor integration of stakeholders in the determination of R&I priorities (especially SMEs)
- Imbalance between demand-side issues and supply side interests in setting research agendas
- Major gaps between political rhetoric and action/ effort/ outcomes/ resources available
- A deficit of think-tank and policy research, policy evaluation competence and tradition.
- A deficit of innovation management capacity, innovation-management oriented training and education (for policy and private sector purposes)

Action:

- Further encourage the use of participative processes for debating and identifying areas for priority action, not only at national level, but also regional, sectoral, and throughout the broad S&T&I stakeholder community. (Foresight is an example of a participative approach to S&T vision and network building which can help 'wire–up' the innovation system, and compensate for formal institutional deficits.)
- Take corrective action on the deficits in policy inputs (research, evaluation, …) and economy wide innovation management competence.

Human resources

Any attempt to increase the level of R&D investment is ultimately dependent on the availability of numbers and quality of human resources.

The research capacity that existed under the former regime went into particularly rapid decline during the early 1990s. There was also a substantial outflow of scientists from technological activity in virtually all of these countries, and this did not stabilise until the mid 1990s. The loss of R&D personnel mainly affected industrial research rather than higher education.

The poor conditions for state-of-the-art research (due to the outdated equipment) and the low level of salaries in the research sector discouraged many young people from choosing a career in R&D. In some sense these conditions reflect the low regard for what used to be a sheltered occupation in the past. The relatively low intake of young people contributed to a general ageing of the population of researchers. In response, significant policy attention has been paid to attracting young researchers, through targeted seminars, training and exchange programmes.

E.g. In order to ensure continuity of academic education and science, Estonia needs ca 80 new PhDs per year (following the corresponding ratio in Finland and Sweden, it would be even higher 200). In 1991–1998, on average, 38 students including external students have completed doctoral courses at Estonian universities and 5–10 students abroad.

A critical requirement in the development of the knowledge infrastructure is the attraction of young people into research careers.

Action:

- Target the education and training of the increased volume of students to the areas of the economy where the graduates will need to be absorbed. (This depends on the sectoral structure of industry as well as on the industrial development strategy)
- Target replacement and updating of the research equipment so that it is possible for researchers and university teachers to pursue a career in their home countries.
- Build/strengthen centres of excellence to reach the critical mass of research capacities – establish regional knowledge centres.
- Connect the research-training system within the 'e-Science' infrastructures that are emerging to link up to researchers not just in Europe but globally.
- Establish bridges between doctoral training and research careers for people to take the risk of embarking on the long process of becoming a qualified scientist.
- Increase circular flows of researchers also from West <=> East, in particular of students and young researchers
- Place high S&T qualified graduates in companies across all sectors to conduct R&D type of activity.

Industry - public research linkages

Public research institutions are relatively strong, they are only orienting themselves slowly to the needs of the new market economies. The **R&D and innovation activity** of most of the **small- and medium-sized enterprises** is very poor, there are just a few spin-off companies originating from knowledge centres (e.g.

universities, research institutes). The connection of individual companies with the network of R&D institutions is rather weak, thus the results of the research-development either can not reach the producing sphere or only with great delay. Partly it is due to the generally **low level of entrepreneurial co-operation**, partly due to the underdeveloped institutional background of knowledge and technology transfer (innovation centres, technological transfer centres, technological hothouses), and partly due to the lack of any connections between the innovation network, the entrepreneurial and scientific spheres.

Can international actions help to leapfrog the situation in CCs (FP VI) or at least catalyse this? The problem for linking institutions and organisations is to survive beyond their initial set up phase with the support of public/ international funds.

Action:

- SMEs from CCs should aim at fully grasping opportunities arising from co-operative research (former CRAFT) and collective research. This would allow R&D in indigenous SMEs to be fostered and linkages between SMEs within CCs and in EU15 to be built.
- Encourage the development of spin-offs from public/ academic research activities
- Support of the establishment of industry-academia joint co-operation research centres

Improve system efficiency

Lack of the co-ordination between agencies and instruments - almost all CCs show signs that funding mechanisms are not meeting targets or fail to provide the correct incentives for companies to innovate.
There are too many intermediaries (incubators, business parks, technology centres, development agencies, etc.) in comparison to the demand for their services: there is on average one intermediary for every innovative enterprise – the "bridging" system is not efficient, resources are divided and do not reach critical mass, a considerable share of the funding is only for functioning/surviving of the intermediaries, and therefore they heavily depend on existing financial resources.

Action:

- The key policy action would be to define priorities before funding the different institutions.
- Increase the combined leverage effects of direct public funding through tax incentives.

R&D driven entrepreneurship

R&D-driven entrepreneurship make a huge difference to economic competitiveness in the modern knowledge economy[119].

The creation of new enterprises, although rapid, does not seem to be giving rise to a strong dynamic of investment in high-growth, knowledge-based firms. The lack of reliable data on innovation performance of enterprises in CCs[120], means that policy measures are inspired by the EU negotiation requirements rather than either the needs of domestic enterprises or national and regional development priorities.

Analysis shows – see the following figure - that there is a positive relation between a regional economic performance (per capita GDP) and its innovative performance as measured by Revealed Regional Summary Innovation Index[121]. The very high per capita income levels for Hamburg and other regions, however, point out that other factors also generate high incomes. Conversely, as demonstrated by Noord-Brabant, a **strong innovation performance does not automatically result in higher per capita income** (EC 2002).

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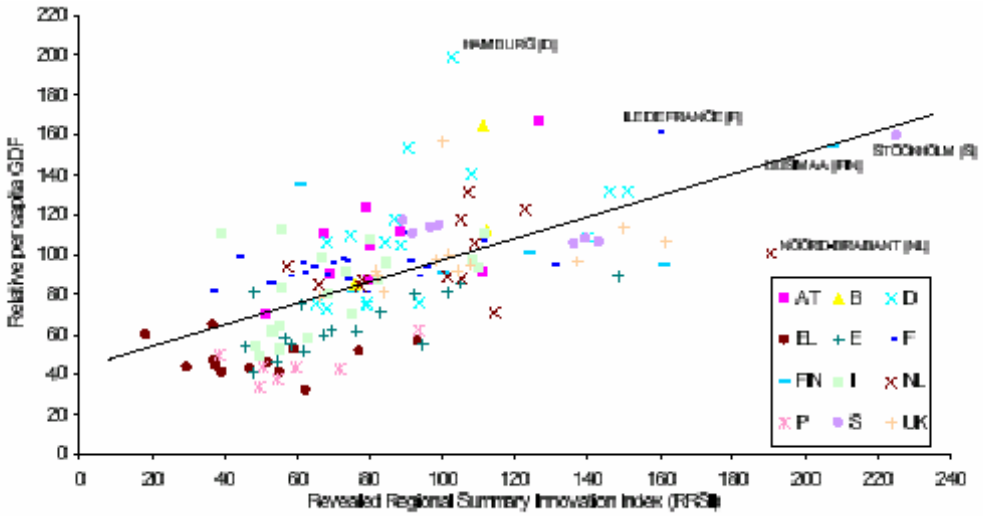
119 E.g. just five companies which have all been founded within the last 30 years or so – Microsoft ('75), Intel ('68), WorldCom ('87), Cisco ('84), Dell ('84) - have a total market capitalisation ($900 billion) equal to almost one tenth of the entire U.S. GDP (= $10.082 trillion 2001)

120 Most CCs do carry out innovation surveys. For CIS III, most of the CCs have already launched their questionnaire, Romania and Bulgaria is planning to launch the activities in 2003.

121 Revealed Regional Summary Innovation Index tries to take into account both the region's relative innovative performance to the EU mean as the region's relative performance within the country.

Innovative and economic performance on a regional level



Source: European Innovation Scoreboard 2002 – Technical Paper No 3: EU Regions

Using the example of Italian industrial clusters (i.e. spatial system of small-scale skilled production enterprises), it can be pointed out that Emilia-Romagna is one of the wealthiest regions in Europe with a GDP per capita € 27,975 (32 % above the EU15 average) but only records a level of formal R&D activity of 0.83 % GDP (0.40% public and 0.43% private funding). This exemplifies how highly innovative and sustainable knowledge-economy business, even in traditional sectors should not be neglected in the pursuit of raising formal R&D spend.

Action:

- Make an inventory of knowledge infrastructure and competitive assets including those that are latent, dormant, or former activities and areas of strength whose potential has been neglected or overlooked.
- Direct venture capital to such latent/ dormant competences and assets. (Heretofore, venture capital in Candidate Countries suffers the same problem of failure as national policies which lock-in to internationally set R&D priorities to the exclusion of more nationally relevant objectives. The tendency has been to favour the fashionable areas (ICTs, biotech, etc.) in the same way that national R&D priorities align to EU Framework priorities (e.g. rare earth metals and compounds in Estonia – an untapped asset))
- Develop strong R&D centres of excellence (e.g. laboratory equipment, in industrial field of competence. The developments should build upon traditions and experience These CoEs should participate in, and integrate into, international clusters.

Intellectual property rights and technology transfer systems

The process of setting-up of legal and administrative environments for innovation is still not finished in CCs. Although the governments have launched a range of initiatives to foster innovation and the importance of business networking has been recognised in many CCs, only a few have introduced real practical measures to encourage foreign investors to use domestic suppliers or have provided a favourable tax relief. Moreover, intellectual property rights (IPRs) are not yet recognised as a key constraint on innovation in CCs and few activities have been carried out to establish IPR support services in universities and to raise the awareness of innovative SMEs to protect know-how.

Regional disparities and the scarcity of funding allocated to S&T factors in regional development plans also cause major concern. The scope for local supply and demand for S&T and assessments of regional strengths

and weaknesses in R&D are mostly unknown, while technology transfer and innovation is to be encouraged. The R&D system mainly centres on capital cities, with weak and slow regional innovation performance.

Financial markets for the development of innovation-based business

Similarities/ differences with the EU15: Catching up fast.

Action:

- No particular direct government actions needed with respect to R&D. EVRD and EIB are already sponsoring risky, but promising, ventures including in SMEs.

Effectiveness of public support for business R&D (direct measures, fiscal incentives, guarantee mechanisms, public support for risk capital)

Guarantee mechanisms are one of the key areas of innovation funding, because new technology based firms cannot obtain funding easily, as they do not have a historical trading record, they lack the suitable collateral in the form of tangible assets and very often the entrepreneur or project applicant lacks experience or a good track record. Furthermore, high technology business trend not require a large initial outlay of investment in capital equipment in which value is retained and which remains in the business as a store of capital value against which bank loan charges can be made.

Action:

- A favourable climate for research activities needs to be created, involving a clear break with the past.

Example: Guarantee Scheme: KredEx (Estonia)
The Estonian Guarantee Scheme was built between 1997 and 2000 using information and models from Austria. KredEx is a state supported institution that seeks to identify suitable applicants from among innovative projects seeking funding and there arises the concomitant need to identify risk and provide guarantee cover. KredEx offer mentoring services for applicant SMEs to assist with processing documentation and briefing and provide risk cover through a guarantee before making a formal application to the bank.

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Appendix: National Innovation Capacity Framework

(taken from S. Radosevic, 2002)

The four elements of this framework are:

1. **Absorptive capacity:** the ability to absorb new knowledge and adapt imported technologies – essential for catching up economies to grow and innovate. The indicators for this included: expenditures in education as % of GDP; S&E graduates (% 20-29 population); population with third level education; participation in life-long learning; employment in high-tech manufacturing; and employment in high-tech services.
2. **R&D supply:** as the capability to generate new knowledge but also as a mechanism for absorbing it. Indicators for this are public and private R&D expenditure, R&D personnel per labour force, EPO high-tech patents, US Patent Office high-tech patents, resident-patents per capita.
3. **Diffusion:** being the key mechanism to reap economic benefits from own investments in R&D as well as to employ absorptive capacities. Indicators include: training enterprises as % of all enterprises; CVT (continuing vocational training) as % of labour costs of all enterprises, ISO9000 certificates per capita, internet users per 10,000 inhabitants, and ICT expenditures (% GDP).
4. **Demand:** for RD and innovation is the key economic mechanism which initiates wealth generation processes in R&D, absorption and diffusion activities. It is proxied by three groups of indicators: finance (share of stock market in GDP, share of domestic credit provided by banking sector), competition (shares of trade and FDI in GDP, plus index of patent rights) and macroeconomic stability (unemployment and consumer price index).

   See the full paper for a more detailed development and discussion.

2. Seminar Output – Main Points Arising

1. Candidate Countries are committed to taking part fully in policy actions and open co-ordination mechanisms which aim to achieve the 3 % of GDP target for overall R&D spend in the EU by 2010.

2. The topmost priority for Candidate Countries is to raise GDP and increase competitiveness. However, several CCs have recently adopted policies and programmes embedded in the National Development Plans which specifically target increases in R&D activity to contribute to reaching the EU's 3 % goal122. In recent years CCs have also gained substantial experience and knowledge of different types of R&D-orientated policy actions and approaches. This constitutes a good basis for further diffusion, sharing and exchange of 'good practices' and policy lessons123 – not just among CCs, but also with EU members. The process of open co-ordination can provide a forum to deepen and broaden the exchange that, heretofore, has taken place informally.

3. **The main problem in CCs regarding R&D and innovation is the very low level of demand for R&D and technology from indigenous businesses**. Actions to enhance local demand for R&D and technology need to be set within an explicit, and urgently needed, innovation policy addressing current and future needs of local firms. These should address in particular the objective to increase the business proportion of the overall level of R&D expenditure up to 2/3rds. In this regard, (re)building business R&D capacities is just as, or more, crucial than ameliorating R&D contracting/ co-operation between the private sector and public R&D institutions.

4. Domestic companies are hesitant to invest in innovation and R&D. They see innovation to be excessively risky given their insufficient financial resources. The reasons for this in the case of young innovative companies may be the low level of capitalisation, a lack of a track record and the shortage of equity finance. Therefore, actions are needed to make access to finance easier, especially for SMEs. Joint industry-university undertakings are a distinct opportunity likely to attract potential investors. Moreover, the general lack of R&D culture that can be observed in some CCs, lessens the likelihood that SMEs might consider R&D as an investment priority. Therefore, actions are needed to raise awareness amongst SMEs of opportunities offered and benefits produced from innovation and R&D activities.

5. More generally, the systemic nature of innovation makes the level of **R&D capability** and investment dependent not only on **business demand**, but also on **diffusion** and **absorptive capacities**. Actions aimed at contributing to the 3 % objective need to get the right balance in making progress on all four fronts –capability, demand, diffusion, absorption. The balance will be necessarily different from country to country.

6. The CC situation suggests that '3 %' policy actions, on the whole, need to emphasise relatively more absorption capacity-, demand-, and diffusion- factors which indirectly affect R&D capacity, rather than direct action. Different CC experiences already point to the fact that increasing R&D budgets alone may result in allocated money being under spent once the R&D system's capacity to absorb funds has been saturated. In the same sense, improvement of the efficiency and effectiveness of the investments already made in R&D and technology is also a priority target. A further obstacle to

122 While countries are not required to materially meet the 3 % target individually, raising R&D investments will, nonetheless, conflict with other urgent policy priorities (social, fiscal, macroeconomic stability, …)

123 Industrial clustering actions, public procurement, different types of tax incentives, different types of co-operative research, and research capacity generating actions, etc.

increased efficiency of R&D funds is that public agencies can lack (regional) administrative capacity to properly manage and widely deploy, more target-oriented R&D programmes.

7. Weak demand, diffusion and absorption is often accompanied by a lack of connectivity, synergy, reflexivity (the ability to reflect on one's actions and to make necessary corrections) in terms of both habits and capability. Therefore, policy actions geared at stimulating demand, diffusion and absorption in CCs, may need to be accompanied (or even preceded) by regional level actions to build the necessary trust and social capital among stakeholders.

8. R&D infrastructure and the human capital / skills profiles are potential major bottlenecks for CCs. Actions are needed to enhance and upgrade R&D infrastructure in CCs. Regarding human capital, actions are also needed to counter the net negative brain drain (both internal and external) which are more acute in CCs than in the EU, and assure more balanced and sustainable "brain circulation". It was pointed out, however, that brain drain is a 'result' of other factors which have to do with systemic deficiencies in the innovation system, and in particular, things like the unavailability/ lack of attractiveness of a research career – in terms of pay, progress possibilities, incentives, rewards for risk-taking, research facility/ equipment conditions, etc. Policies that directly affect brain drain will be of limited effects unless complemented by polices that address the demand for R&D and technology.

9. Increased R&D funding will not suffice. Support for R&D needs to be complemented by institutional reform in the public research and higher education systems to provide better framework conditions for the preservation and attraction of human capital into R&D. Actions are called for to create R&D/ innovation posts and functions within more firms and to promote mobility back and forth between the public and private sectors. At the core of these measures should be 'people mobility'.

10. The use of structural funds – which devotes a similar amount of money to R&D as the Framework Programme - was pointed to as a means for helping CCs make up some of the R&D infrastructure and capability deficits. While programming for the period 2004-2006 is more or less closed, it is important to start now preparing for the next programming period from 2007. In particular, preparatory work should focus on accentuating regional innovation potential and much more specific and targeted actions in the area of R&D which are tailored to the different national and sub-national specificities. In this regard, the plans for 2004-2006 show relatively little differentiation.

11. Governance deficits in CCs at regional level, and more generally in relation to broad S&T issues and priority setting, constrain the efficiency and effectiveness of R&D and innovation policy actions. New participative approaches to governance as well as new institutions and mechanisms for broader, inclusive debates, interest representation, etc. need to be fostered. The use of S&T foresight in many CCs is a positive development and could be deployed even further at sectoral, sub-national levels. In some instances, a supra-national interregional approach may be the most effective.

12. One of the positive developments in many CCs has been the influx of FDI bringing with it demands for a skilled workforce, sophisticated services and knowledge inputs including some R&D. **Actions could be directed at integrating and further biasing FDI towards knowledge type activities with co-operative R&D mechanisms and seeking to encourage spill over effects and innovation transfers into domestic firms**. Well targeted policy actions of this nature might be a more efficient use of public money than direct R&D spend.

13. Even after EU accession CCs will continue to be heavily dependent on FDI for industry upgrading, and competition between regions in attracting FDI may even increase further. The EU could exploit this competition by channelling it through **public FDI contests** as a mechanism for improving the business environment in the weakest regions. Such contests – primed by public/EU grants could stimulate innovative solutions to improve the investment climate at a sub-national levels: as an

incentive device for local government and domestic firms to engage in meaningful joint actions and reforms; as a *coordination device* to coordinate activities at national and EU level under the umbrella of private-public competitiveness projects; and as a *mechanism to share policy knowledge*.

14. Relating to this is the importance of integrating nationally-located, and nationally-orientated R&D, innovation and entrepreneurial capability into international networks and S&T communities – be these business-driven internationally distributed systems of production/ distribution/ consumption; Framework Programme instruments aimed at European excellence or rationalisation and attaining critical mass; or others such as those fostered under COST, Eureka, the ESF, the IMS (Intelligent Manufacturing Systems), etc. Integrating CCs into a wider European economy only through production networks will not ensure their participation in building the EU wide knowledge based economy. However, maximising the number of entry points (R&D, technology and innovation oriented actions and programmes) for CCs will increase the probability of full integration.

15. In keeping with the systemic nature of innovation, such actions need to be accompanied by an equally determined effort to implant and develop R&D and innovation into domestic firms. The best potential here may lie in firms which are operating successful and profitable businesses in traditional sectors or through technology-based pubic procurement where the introduction, or creative use of new leading-edge technology and an explicit innovation strategy could release significant growth potential.

Priority Generic Actions (tentative)

- ***Promote private investment and engagement in R&D in domestic firms by raising their awareness of opportunities, improving their access to capital and raising their profile for investors*** (via S&T audit-type actions to identify R&D needs and potential, placement schemes for R&D personnel, collective research, public-private research joint undertakings, industrial cluster initiatives, indirect support measures, etc.)

- ***Establish explicit systemic innovation policies*** in CCs which aim at balanced progress on R&D capability, demand, diffusion and absorption factors.

- ***Increase the knowledge and R&D bias of FDI***, taking determined action to accentuate spill over effects, innovation and capability transfer, linkages with local knowledge infrastructure, etc.

- ***Rebalance over time the distribution of large S&T facilities to the benefit of CCs,*** in order to offer domestic opportunities for CCs' R&D teams.