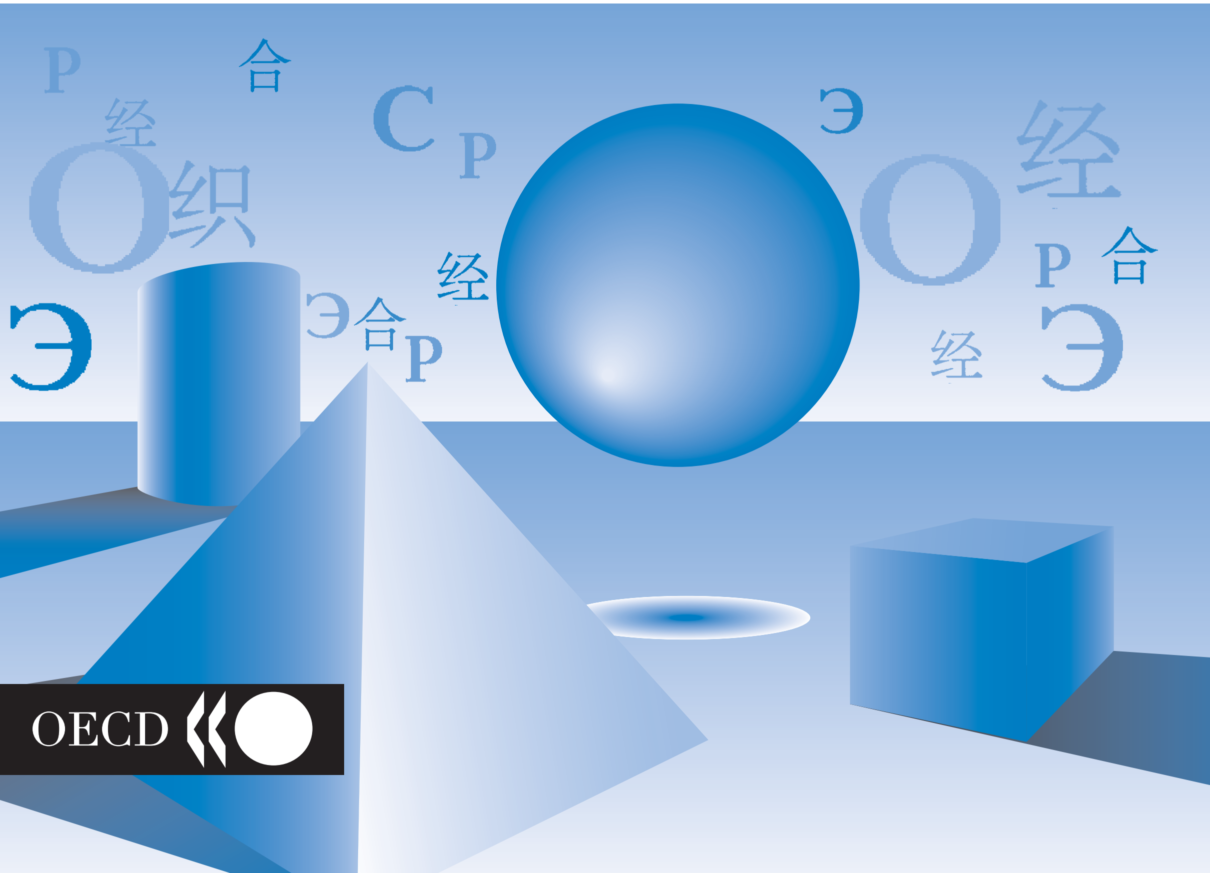
Reviews of National Policies for Education

Bulgaria

SCIENCE, RESEARCH AND TECHNOLOGY



Reviews of National Policies for Education

Bulgaria

SCIENCE, RESEARCH AND TECHNOLOGY

OECD

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

– to achieve the highest sustainable economic growth and employment and a rising standard of living in member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
– to contribute to sound economic expansion in member as well as non-member countries in the process of economic development; and
– to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996), Korea (12th December 1996) and the Slovak Republic (14th December 2000). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

Publié en français sous le titre :

BULGARIE

SCIENCE, RECHERCHE ET TECHNOLOGIE

FOREWORD

The transition of Bulgaria towards a pluralistic democracy and market economy has been marked by economic social and political changes of extraordinary breadth and depth. However, challenges remain as Bulgaria attempts to stabilise its economy, address severe social problems and maintain momentum in its privatisation efforts. The science and technology sector (S&T) reflects the general condition of the country.

The problems undermining the ability of the S&T sector to contribute to Bulgaria's development can be broadly categorised into three areas: legal, institutional and administrative. The absence of a solid legislative framework means there is a lack of a coherent, long term S&T policy. For a country with the economic capacity of Bulgaria it is necessary to ensure that limited resources are focussed in areas closely linked to the economic and social development of the country. Bulgaria lacks an efficient budgeting mechanism to maximise scarce resources and guarantee the accountability of research institutions. Furthermore, these limited resources for basic research are dispersed through two parallel structures with little interaction between them: universities and the network of institutes of the Bulgarian Academy of Science (BAS).

This review provides a comprehensive examination of S&T policy in Bulgaria examining its strengths and weaknesses while providing a series of recommendations. The review emphasises the need to inject accountability into the budgetary process by moving it to a project-based and effectiveness-oriented pattern of funding closely aligned to policy setting. Specific topics covered include, funding, legislation, research structure, innovation systems, international and regional policies, brain drain, public-private partnerships and education priorities. General and specific recommendations in the final chapter provide guidance for policymakers to address weaknesses and fully exploit Bulgaria's traditional strengths of science, research and innovation.

The review team carried out site visits, interviews and an examination of primary materials from 10 to 17 April 2003 in co-operation with Bulgarian authorities. The members of the team were: Johanna Crighton (Rapporteur), Jüri

Engelbrecht (Estonia), Maria Slowey (Ireland), and Tom McCarthy (Ireland). Overall co-ordination and substantive support were provided by Ian Whitman of the OECD Secretariat. The Review was undertaken within the context of the OECD's Regional Programme for South-Eastern Europe.

This volume is published on the responsibility of the Secretary-General of the OECD.

Eric Burgeat
Director
Centre for Co-operation with Non-Members

TABLE OF CONTENTS

Chapter 1

CONTEXT

This chapter provides the salient facts of Bulgaria's transition to a market economy and its current economic situation. Relevant economic and demographic statistics are provided. The chapter ends with a series of questions that need to be addressed to develop a sound and comprehensive S&T strategy in any country.

Geographic and historical context

Geography

Bulgaria (110 912 sq. km) lies on the west coast of the Black Sea and is surrounded by Turkey, Greece, the Former Yugoslav Republic of Macedonia (FYRoM), Serbia and Montenegro and Romania. The coastal length is 378 km. The landscape is varied, with the north being predominantly the Danube plain and the south consisting of more mountainous regions.

Recent history

After the Second World War, Bulgaria fell within the Soviet sphere of influence and became a People's Republic in 1946. Communist domination ended in November 1989 when Todor Zhivkov's government resigned. The first free elections were held in 1990; a democratic Constitution was adopted in 1991. Today, reforms and democratisation are aimed at eventual integration into the EU and Bulgaria has become a NATO member in April 2004. The government is a parliamentary democracy with 28 administrative divisions. The legislative branch consists of a uni-cameral National Assembly with 240 seats; members serve 4-year terms. Bulgaria's transitional recession was deeper and longer than that of most other former communist economies. Despite an initial bold reform programme, subsequent political instability and erratic macro-economic and fiscal policies led to high inflation and dramatic exchange rate depreciations. Output fell for 5 consecutive years following the collapse of the communist regime; GDP declined by 30% over the 1990-94 period, and was accompanied by a sharp rise in unemployment.

In 1994-95, the economy registered some growth, but the then-government was unable to contain fiscal deficits and tackle structural problems in enterprise and banking, and another downward spiral reached its lowest point in early 1997. By January of that year, the economic crisis turned into a political one which further aggravated the economic situation. The BGN (Bulgarian Leva) depreciated to 3 000 per USD; inflation reached 242% for the month of February alone. The impact on Bulgarian households was disastrous. Even with a doubling of nominal wages in February and another 60% raise in March, the average wage fell to USD 20/month – not enough to buy the most basic food for a family of three. Pensioners and others on fixed State incomes saw their benefits drop to USD 10/month. Popular and political protests brought down the government, and a more reform-oriented government was elected in April 1997.

Its foremost achievement has been the rapid restoration of macro-economic stability, *e.g.* by appointing a national currency board, pegging the BGN to the Deutschmark (now to the Euro) and bringing down the rate of inflation. The challenge now is to maintain stability and resist inflationary pressures without further eroding social protection or spending on health and education.

Poverty, inequality and unemployment are major social issues. A majority of households receive some sort of income benefit, regardless of household income, often from multiple sources. Efforts are now being made to target available resources more sharply, benefiting those most in need rather than spreading them thinly to so many. A new Act on Unemployment Security serves as the first social framework policy document for Bulgaria; it supports active labour market programmes for young people (with nearly 40% unemployment), ethnic minorities and long-term unemployed.

The Government of Bulgaria has laid out its development strategy until 2005 in the National Economic Development Plan (NEDP), with accession to the EU as its main objective.

Demography

According to the March 2001 census, the population was 7 973 673, with a population density of 71.9 per sq.km. The previous census (1992) gave the population as 8 948 649; the decline is mostly due to emigration. The 1992 figures have, however, been contested on methodological and political grounds, and are considered unreliable. There are 13 cities with a population over 100 000; the urban to rural ratio is 69 to 31%. There is considerable urban drift:

only 45 of the 262 municipalities are considered rural (*i.e.*, with less than 50% urban population). The gender ratio is 48.8:51.2 male:female.[1]

Trends

The population has been steadily declining for the last few years in all areas, at an average rate of -1.16% per year, and as much as -9% in some rural areas. Life expectancy in 2002 was 68.5 years for men and 75.4 years for women. Bulgaria has one of the “oldest” age structures in Europe, with those over working age (54 for women, 59 for men) accounting for 24.7% of the population. Only 21.8% are under 19. Birth rates have dropped steeply; estimates indicate that the primary school population will drop by 31% in the 2006/07 school year (in the March 2001 census, the under-10 age group represented only 8.8% of the total population, compared with 14% in 1985 and 12% in 1992).

Brain drain

In most “new democracies”, but also in the West, two main types of brain drain occur: “internal” brain drain, where young qualified people choose not to work in their specialist field but look for better-paid jobs within their own city or country, and “external” brain drain where they emigrate, temporarily or permanently, to another country. Bulgaria suffers from both. A typical example of internal brain drain is that many qualified teachers, especially in some fields such as ICT or foreign languages, look for better-paid jobs in the commercial sector; a typical example of external brain drain is the pulling power of prestigious universities and research laboratories in richer countries.

Many of Bulgaria's young scientists are looking to the West – and particularly to the United States – for better employment and career prospects. One estimate by the Bulgarian Union of Scientists states that 65% of all university graduates (approx. 300 000 persons) left the country during the 1990s.[2] This constitutes a major threat to the future of S&T “human capital” in Bulgaria, especially because at present (2004) 73% of professors are over 60

---

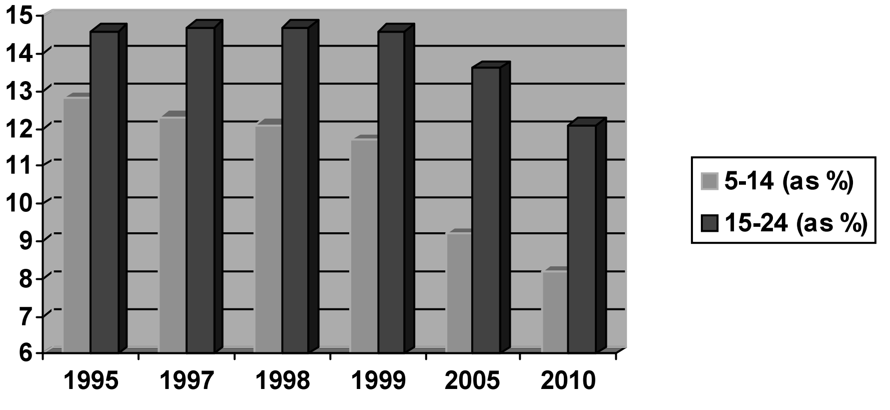
1 Source: National Statistics Institute, March 2001 census. Interestingly, among the under-10 population there are more boys (360 084) than girls (340 984).

2 Quoted in A. Marga, "Brain Drain and Professional Development", *Attracting Young Scientists.* 2002. P. 29. This estimate may not be accurate; in any case, the majority of university graduates are not young, and most are still in the country.

years old, and 47% are over 65. There is a critical need to look at incentives to attract talented young people into S&T, to analyse the support mechanisms for PhD students and to take a critical look at promotion and career structures for young scientists.

However, it is also becoming clear that migration has become a 21st century social phenomenon that requires far more systematic analysis, looking not only at the living conditions of scientists and their changing aspirations for freedom and opportunity, but also at the economic, research and political systems in which they work and at the social pressures to which they are exposed.

Fig. 1.1. **Percentage of population aged 5-14 and 15-24, from 1995 to 2010.**



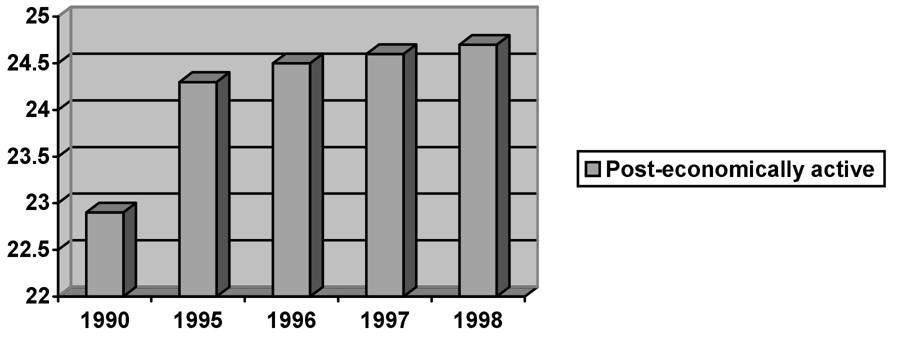
Source: National Institute of Statistics, Bulgaria.

Economy and employment

The GDP of Bulgaria for 2000 stood at 69.6% of its 1989 base; this represents an increase in real GDP growth of 5.8% over the 1999 figure.[3] Inflation has been well controlled after the hyperinflation of 1996-7 and the consequent revaluation, with inflation for the year December 2001-December 2002 at 5.8%. Annual growth rate (2002) was 4.3%.

3 See Table 1.1.

Fig. 1.2. **Proportion of population of post-economically active age, 1990-1998**



Source: National Institute of Statistics, via National Observatory Report 1999.

The registered unemployment rate for 2002 stood at 17.8%, slightly down from its 2001 level (19.2%), and the trend is downwards (2003 was 13.6% and 12.0% for the first term of 2004). Employment patterns have changed considerably since 1996, with a sharp decrease in employment in primary and secondary industries, especially agriculture, forestry and fishing (which collapsed from 800 200 employed in 1996 to 250 600 in November 1999),[4] and an increase in service-based industries. Manufacturing is still the largest employer with 25.0% of employees, followed by "trade and repairing activities" at 15.0% and agriculture, forestry and fishing at 9.2%.[5] The number involved in education has decreased from 255 800 in 1996 to 212 400 in November 1999, a decrease of 17%. The following Table presents an overview of Bulgaria's macro-economic development since 1992.

Small-country issues in science, technology and research policy

The key challenge for a country like Bulgaria, with a relatively small population and limited human and material resources, is to strike a balance between national priorities and the need to keep pace with international developments and rapid innovation on a global scale. Even large and wealthy countries cannot afford to support all possible scientific research in every field or discipline; priorities have to be set, and reflected in national policy.

---

4 Source: Labour Force Survey, National Statistics Institute, 2004.

5 Source: Labour Force Survey, National Statistics Institute, 2004.

Table 1.1. **Macro-economic developments 1992-2002**

Year	Consumer Price Index inflation (% change)	Budget balance as % of GDP	Real GDP growth (% change)	Unemployment rate (%)	Privatization revenue (as % of GDP)
1992	79.2	-2.9	-7.3	15.3	n/a
1993	63.9	-8.7	-1.5	16.4	0.4
1994	121.9	-3.9	1.8	12.8	1.5
1995	32.9	-6.3	2.1	11.1	0.9
1996	310.8	-12.7	-10.1	12.5	2.9
1997	578.6	-2.5	-7.0	13.7	5.6
1998	1.0	1.5	3.5	12.2	5.3
1999	6.2	-1.0	2.4	15.9	n/a
2000	**11.4**	**-1.5**	**5.8**	**17.9**	**n/a**
2001	**7.4**	**-2**	**4**	**17.3**	**n/a**
2002	**5.8**	**-0.7**	**4.3**	**16.3**	**n/a**

Source: European Bank for Reconstruction and Development, *Transition Report*, various years; Bulgarian National Bank, *Annual Report*, various years; Database incorporating national statistics.

In developing an S&T strategy for Bulgaria that satisfies both national and “global” needs, some basic questions need to be addressed. These questions are common to all countries, but are more acute for smaller and less affluent ones.[6]

- Should state funding give priority to fostering a strong and broad undergraduate background in *all* disciplines or to supporting excellent post-graduate training in *a few selected* fields? If the latter, by whom and on what basis are these few fields selected?

- Should the State apply hard [“only the best”] funding principles or soft [“everybody has a chance”] ones? In other words, should priority be given to substantial funding for a few projects in “top” institutions, or is it better to spread available funding more widely, through small projects for a larger number of institutions?

- Should researchers be encouraged to collaborate with colleagues in other countries, or should they focus their talents on strengthening national programmes?

- Should State funding be used for developing commercial applications and technology transfer?

6 Based on M. Bullock, "Big Science for Small Countries: What are the Issues and What are the Priorities?". In: *National Strategies for Research in Smaller European Countries.* 2002. ALLEA and Estonian Academy of Sciences, pp. 29-33.

- Should State funding be awarded on the sole basis of scientific excellence, or should other criteria (national need, future financial or industrial potential, etc.) be considered?

- What is the appropriate balance between “big science” – requiring multiple activities and/or expensive infrastructure – and “normal” science on a more modest scale?

- What are the relative merits of research-intensive organisations (such as Centres of Excellence) and institutions that combine research with teaching (such as universities or – at present in Bulgaria – the Bulgarian Academy of Sciences (BAS)?

- How can knowledge exchange and cross-border collaboration be encouraged without increasing the risk of “brain drain”?

Each of these policy questions has been answered in different ways in different countries. Generally speaking, for historical and cultural reasons, S&T in former communist countries remains more heavily dependent on state funding and state allocation of roles and priorities, although this is beginning to change. But for the foreseeable future, in Bulgaria the S&T strategy will need to be based on a “mixed economy” of State and non-State objectives and funding, but with a longer-term view towards greater liberalisation, competition and enterprise.

Chapter 2

SCIENCE AND TECHNOLOGY IN BULGARIA: STRUCTURE AND ISSUES

This chapter discusses the institutional framework of research in Bulgaria. The main research institutions are described as well as their financing arrangements and the challenges they face. The chapter outlines the existing governing legislation and introduces the proposed new Law for Promotion of Research Activities. Information is provided on both basic and applied research in higher education institutions.

Science, technology and research in higher education and in the academy of sciences

Science, technology and research before 1990

During the 1950s and 1960s, the Bulgarian Academy of Sciences (BAS) evolved as a large system of research institutes. By 1989 BAS had more than 100 institutes, centres and other units with a staff of over 15 000, half of whom were researchers. The mission of BAS was focussed on advances in basic research in almost all fields of knowledge. The Academy of Agricultural Sciences (AAS) had also been created and comprised over 70 research institutes and units around the country (This is now known as the National Centre for Agricultural Sciences [NCAS]).

The creation of two parallel networks for basic research – the universities and the institutes of BAS – has been quite costly for a country of the size and resources of Bulgaria. It should also be underlined that during the communist period a much greater proportion of the funding for research was provided to the institutes of the Academy of Sciences. Under these conditions, funding for the research infrastructure and programmes in the universities was given a lower priority. University researchers were forced to seek alternative ways of funding. Many HEIs, especially the technical universities, established strong links with particular industries. These mechanisms of co-operation were successful, though they could not compensate fully for the continuing lack of state funding.

A third part of the Science and Technology (S&T) sector has been the network of applied research institutes and development units belonging to branch ministries or bigger enterprises. Some of these institutes attracted the best researchers in particular technical fields. A good example was the well-known Central Institute for Computer Technology (CICT), which had a staff of over 2 000. Over the years CICT developed some of the most sophisticated computer systems exported throughout Eastern Europe and the Soviet Union; before 1990, Bulgaria was probably the biggest producer of computers in the region. After 1990 CICT was dissolved and the majority of its highly qualified staff is no longer engaged in research activities. Some have emigrated to the United States.

By 1990, the S&T system in Bulgaria was quite large in size, though rather ineffective. The funding per researcher compared to the OECD countries was low. The dispersion of resources between the universities and the Academy of Sciences did not contribute to either a high level of research output or high quality of education. There was a lack of co-ordinated research policy in line with modern requirements.

Science and technology during the period of transition

The S&T sector reflects many of the problems experienced by Bulgaria during its transition to a free market economy and a civil society. The transition has been marked by political and economic upheavals, including the financial collapse that marked the end of the socialist government early in 1997. Since then, the stabilisation programme has been quite successful, but it did not focus on the development of S&T. At the time of the team's visit (2003) only 0.34% of gross domestic product (GDP) was invested in publicly funded research. The overall number of researchers in the country has been sharply reduced over the past 12 years; although the reduction was inevitable since many institutes had been over-staffed. Nevertheless, "brain drain" and lack of opportunity and motivation for young people to enter the S&T field have been important factors, especially in engineering and natural sciences. (The 2002 ratio of researchers per 1 000 population in Bulgaria was only 2.11.)

Table 2.1. **Number of researchers in Bulgaria 1990-98**

1990	1991	1992	1993	1994	1995	1996	1997	1998	2002
31 704	29 060	26 598	26 284	25 616	25 557	25 853	25 871	25 192	16 671

Source: K. Simeonova (Editor), *Analysis of the State and Development of Scientific Research in the Bulgarian Academy of Sciences and the Country 1988-1998,* Centre for Science Studies and Science History, Bulgarian Academy of Sciences, Sofia, 1999. NOTE: The 2002 data were supplied by the National Statistics Institute (NSI) and show a steep decline.

Legislative framework for S&T and research activities

Several laws govern these activities in Bulgaria:

- Higher Education Act (1995, as amended in 1999), esp. Chapter 8;
- Law for the Bulgarian Academy of Science (1991);
- Law for Scientific Titles and Degrees (1973);
- Patent Law (1991).

Other laws that have a bearing on S&T in Bulgaria include: the Law on Encouraging Scientific Research; new amendments to the Law on Higher Education (2004); and a set of new and amended legislative acts in the field of intellectual property (1998).

Articles 61 and 62 of the Higher Education Act state that the research objectives of HEIs shall be “new scientific knowledge, the development of new applied research products, as well as the development of education” and that (Art. 62) research is a key responsibility of HEIs: “Higher education institutions shall encourage research and projects in high priority areas.” Article 63 states: “The pursuance of research activities shall be an integral part of the academic staff’s activities.” The Act further states (Art. 91 (3), amended 1999) that resources for “research and artistic activities” of the HEIs should not be less than 10% of the cost of the teaching and learning process. Such provisions are indicative of a governmental concern that research should form an integral part of the work of HEIs, albeit the implementation of such a policy still leaves a good deal to be desired. As noted above, the Law for the Bulgarian Academy of Sciences defines the principal mission of the Academy and regulates its activities. It provides for autonomy of the BAS from state institutions.

The new proposed Law for Promotion of Research Activities defines different mechanisms that would facilitate R&D activities in high technology, the commercialisation of research products, the establishment of techno-parks and other measures. It also provides for state funding in priority research fields.

The existing legislation does not stipulate clear mechanisms for the establishment of a national strategy and priorities in the R&D sector. For a country with the economic capacity of Bulgaria it is necessary to develop procedures for the adoption of coherent and well designed R&D policies so that the limited resources are focussed in areas closely linked to the economic and social development of the country.

It is noteworthy how little attention was given to research policy in the MES's 1999 *Strategy for the Development of Higher Education in Bulgaria*. Research was not listed as one of the "problems". It is to be hoped that the new *Strategy* now being prepared (2004) will rectify this.

The current situation

The OECD review team was told in nearly every meeting that the present situation – where universities mainly provide education and training, and the Bulgarian Academy of Sciences (BAS) mainly looks after scientific research – is not satisfactory, and that [government] action needs to be taken. The main problem, it was said, is that the already insufficient funds provided by the State are not used effectively. On the one hand there is not enough money for the BAS's many institutes to function properly; and on the other, supporting the BAS in its present form means that universities are struggling to maintain the quality of their teaching, libraries and laboratories. In the end, no one wins.

Universities

In 2002 there were 41 higher education institutions (HEI) in Bulgaria[7] including 8 public universities, 4 private universities and 29 specialised higher education institutions. Academic staff in higher education number about 23 300 (in 2000/01) including *circa* 15 600 full-time and *circa* 7 700 part-time teaching staff. This includes also the researchers – 277 full-time and 235 part-time.

---

7 P. Georgieva, *Higher Education in Bulgaria*. UNESCO, CEPES, Bucharest, 2002.

The total number of students was 247 000 (in 2000/01), appearing more or less stable at this level. The general situation in education is analysed in detail in the 2002 OECD Report on education policy in Bulgaria.[8]

There has been a strong rise in student numbers since 1990, as shown below:

Table 2.2. **Changes in student numbers since 1990**

Year	1990/1	1991/2	1992/3	1994/5	1995/6	1997/8	1998/9	1999/0	2000/1
Students	188 479	185 914	195 447	223 030	250 336	260 487	270 077	261 321	247 006

Source: "Attracting Young Scientists", Conference Proceedings, 2002, p. 4.

During the same period, the number of teaching staff in Bulgarian universities has remained stable (23 663 in 1990/91 and 23 888 in 2001/2), although fewer staff members are full-time and more are part-time. Since most of the part-time teachers also have another (often full-time) appointment in another university or in the Bulgarian Academy of Sciences, the total number of HEI teaching staff has probably declined while student numbers have risen sharply.

The Bulgarian Academy of Sciences

The Bulgarian Academy of Sciences (BAS) is a network of research institutes. Although the structure of BAS resembles the previous structure of Soviet-block countries, it has undergone essential changes. Actually, such academic research networks exist in many countries outside the CEE/SEE region – for example the Max Planck Society and Fraunhofer Society in Germany, the CNRS in France, the CSIC in Spain, etc.

However, a characteristic feature – and still a major obstacle – in former Soviet-block countries is the existence of a "Berlin Wall" between academic research institutes and universities. Breaking down this wall is no easy task, because it requires not only institutional restructuring but a change in long-standing habits and attitudes in both communities.

8 OECD Report – Review of National Policies for Education – Bulgaria. Paris: 2004. See also P. Georgieva, *op.cit.,*2002.

Financing of research in Bulgaria

Overall State funding for HEIs and the BAS since the early 1990s has remained relatively stable but at a low level, as shown below in Table 2.3:

Table 2.3. **Percentage of state budget for HEIs and BAS, combined**

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
%	2.8	2.8	2.35	2.6	2.05	2.6	3	2.8	2.6	2.95

Source: "Attracting Young Scientists", Conference Proceedings, 2002, p.10.

Inevitably, most of this will be absorbed by non-research activities in HEIs, leaving only a relatively small proportion for research in HEIs and the BAS.

Funding for research (see more detailed discussion in Chapter 4) has, since the early 1990s, come from two main sources: (1) a proportion of the State subsidies for higher education, and (2) competitive funding (in the form of grants or contracts) for fundamental and applied research.[9]

- The Law requires that "not less than 10% of the cost of the [university] teaching and learning process" will be provided under the State budget, for "research and artistic activities of higher education institutions".[10] This has not been entirely satisfactory, partly because the funding for teaching is itself inadequate, and partly because there is no reliable mechanism for establishing what is, and is not, included in "the cost of the teaching and learning process". Nor are there any indicators to evaluate the output and quality of publicly funded research.

- Moreover, the OECD review team found no hard evidence that this (10%) research money actually reaches the institutions for which it is intended. Indeed, the team heard considerable anecdotal evidence to the contrary. It was not possible, during the team's visit, to make an in-depth inquiry into the financial data of the institutions visited, but it would be useful to conduct such an inquiry, if only to dispel the

9 The Higher Education Act, Chapter 8, Art. 64 states that "Research shall be funded by subsidies from the state budget, and by additional funds raised in compliance with financial rules designated by Art. 90-91."

10 Higher Education Act, as amended through 1999, Chapter 11, Art. 91, as amended.

perception that unofficial arrangements are made that favour some HEIs over others. *Public transparency* in research funding and expenditures needs to be far greater than it now is.

- Nearly all competitive funding is channelled through two Funds established in the 1990s – the Bulgarian Science Foundation ("National Scientific Research Fund", for fundamental research), and the Bulgarian Technology Foundation ("Structural and Technology Policy Fund", for applied research). Until 1999 these two funds were placed within the Ministry structure (*e.g.*, the National Council for Scientific Research (NCSR) for basic research, established in 1990), but since 1999 they have become separate administrative units ("Foundations"), functioning as a liaison between the universities and the research community.

Until 1995, the majority of grants awarded through these two Funds went to the BAS and its institutes. Since 1995, some equalisation has taken place, and in 1996 and 1997 about 60% of grants went to the BAS and 40% to HEIs, primarily to technical, medical and agricultural faculties, and to the older and more prestigious universities. Most HEIs in Bulgaria now have structural sub-units devoted exclusively to research.[11] Meanwhile, the position of the BAS and its institutes in science, technology and research has shifted to a more internationally competitive and innovative role, while at the same time seeking greater co-operation with and integration into the work of Bulgaria's university system.

The procedures for funding through open competition are well established. During the past several years, however, and especially as a result of the financial collapse in the country at the end of 1996, the level of funding decreased about five-fold. Currently, NSRF, through its 10 subject panels, distributes the equivalent of approximately USD 500 000 per year for all subject fields. The policy is to finance only a limited number of projects at the level of about USD 10 000 per project. Currently, about 50 research projects are being supported. Some sub-commissions, however, award more grants but with only nominal funding. The competition is open to both Academy of Science personnel as well as to staff in the HEIs. In recent years there has been a decline in interest by researchers in the competition, probably due to the limited resources available.

11 P. Georgieva, *op.cit.,* p. 105.

Basic research in the HEIs

The academic staff of the HEIs now represents about 61% of the human capital in the S&T sector in Bulgaria. The higher education institutions in the country traditionally focus their research activities on basic studies. Under a very limited budget, researchers have great difficulty in keeping up with the latest developments in their fields. The supply of scientific journals and books for university libraries has been highly restricted: the budget does not contain specific provisions in this respect. HEIs are forced to seek alternative ways for funding subscriptions, for only a fraction of what is needed. The possibilities for investments are limited, since the earned incomes of the state HEIs have plummeted since the abolition of paid education by recent amendments in the Higher Education Act (1999).[12]

The infrastructure for research in HEIs has not been renewed in most fields, except in laboratories that took part in international research and education projects. The problem is particularly serious for the technical HEIs, as well as for the natural sciences departments in classical universities. An exception in this respect is the gradual development of a national ICT academic network. These developments have been facilitated through a number of international and national initiatives, co-ordinated by the MES.

Applied research in the HEIs

The Bulgarian HEIs have been quite successful in research directed towards development of new products and technologies. Until recently much of the research of the numerous technical universities had been focussed on the development of projects financed by enterprises or technology funds in universities. The decline of the Bulgarian manufacturing industry during the past decade resulted in substantial reduction of these activities. Most of the new private enterprises are still not in the position to seriously finance technological developments. On the other hand, foreign investors entering the local economy rely, in most cases, on products and technologies developed in the parent companies abroad. Nevertheless, the traditional links of technical HEIs and the respective industries still continue. Some institutions have established their own manufacturing or consulting small and medium-size enterprises (SMEs). The Technical University in Sofia has effectively established a big technopark of SMEs that use the developed infrastructure for applied research.

---

12 According to the MES, the fact that *all* students now pay (some) fees compensates for this loss of income, but evidence from the HEIs themselves shows that this is not the case and that losses are considerable.

Another development in the applied research field is the establishment of co-operative links of university researchers with big international companies. In the absence of funding from the national economy, co-operation with foreign companies has emerged as an important resource for keeping research alive in many laboratories. For example, in the chemistry departments of HEIs much of the current synthetic work is funded through contracts with foreign chemical or pharmaceutical companies.

The Patent Law of 1991 has stimulated the commercialisation of research products. Under the new legislation the interests of the different stakeholders – HEIs, individual researchers and external companies – can be well represented and balanced.

Chapter 3

BULGARIAN SCIENCE AND TECHNOLOGY IN AN INTERNATIONAL CONTEXT: ISSUES OF QUALITY AND PURPOSE

This chapter examines the linkages between Bulgaria's research and development activities and national and international trends and imperatives, with particular emphasis on the European Union. Topics covered include strategic priorities, funding, institutional arrangements of research, educational priorities and challenges, and the impact of brain drain. S&T best practices from across Europe are highlighted.

Introduction

Science and technology (S&T) are of vital importance to every country, large or small. The World Conference on Science (Budapest, 1999) clearly stated:

> "The inherent function of the scientific endeavour is to carry out a comprehensive and thorough enquiry into nature and society leading to new knowledge. This new knowledge provides educational, cultural and intellectual enrichment and leads to technological advances and economic benefits. Promoting fundamental and problem-oriented research is essential for achieving endogenous development and progress. Governments, through national science policies and in acting as catalysts to facilitate interaction and communication between stakeholders, should give recognition to the key role of scientific research in the acquisition of knowledge, in the training of scientists, and in the education of the public."[13]

Although this statement may sound rather general, it does reflect the current international understanding about the role of S&T in the contemporary world. However, different countries face different challenges due to their economic, political and social trends and needs. Bulgaria has experienced the

[13] World Conference on Science, UNESCO, Paris, 2000: Declaration on Science and the Use of Scientific Knowledge, 462-467, parts 29, 30.

collapse of its centralised economy and industry and is still working to create a market economy under the difficult conditions of the Balkans since 1990. The restructuring of the S&T institutions, together with other vital elements of civic society, also bears the marks of this general situation, made more complex by changes in the political system.

Recent history: research and teaching in Bulgaria

As has been set out in Chapter 2, until 1989 research and higher education were institutionally – and to a large extent methodologically – separated, following the "Soviet model" used in most Eastern Block countries. By state policy, science and research were predominantly the responsibility of the Bulgarian Academy of Sciences (BAS) and universities concentrated on teaching. After the adoption of new legislation,[14] universities were also given the right and obligation to do research; also, an increasing number of BAS scientists began teaching in the universities, especially when BAS took the initiative to reorganise or even close down some of its institutes.

Thus the previous division between research and teaching was starting to break down. While in general this was a positive development, it happened in the context of severe shortages of funding, outdated facilities, brain drain and the pressures of a rapidly increasing number of students wishing to enter university; research was no longer a priority. The state essentially withdrew from its role as the main liaison between research and industry. Funding for research dropped to 0.45% of GDP by 1992 and the number of research scientists dropped from 6.9% of all HE academic staff in 1991 to 0.5% in 1998.[15]

Financing of research in Bulgaria

Returning briefly to the more detailed discussion in Chapter 2, funding for research has, since the early 1990s, come from two main sources: (1) a proportion ("not less than 10% of the cost of university teaching and learning") of the State subsidies for higher education, and (2) competitive funding for fundamental and applied research, almost all of this channelled through the Bulgarian Scientific Research Foundation or the Bulgarian Structural and Technology Policy Foundation.

---

14 Academic Autonomy Act, 1991, and Higher Education Act (1995).

15 P. Georgieva, *Higher Education in Bulgaria,* 2002, pp. 102-105.

Since 1995, about 60% of grants have gone to the BAS and 40% to HEIs. Most HEIs in Bulgaria now have structural sub-units devoted exclusively to research.[16]

International context

As has been set out in Chapter 1 of this review, a number of common S&T issues and processes are under discussion world-wide:

- Fostering research: whose role is it, who should fund it, who sets priorities?
- Links among research, development and innovation (or government /academia/society);
- Educating future researchers together with high-quality specialists for society;
- Evaluating research and measuring the results.

Clearly the *quality* of research and education is the corner-stone of S&T in any country, influencing the competitiveness of scientific innovations directly.

In this Chapter, the Bulgarian S&T situation is analysed in its international context.

General trends

In recent years, the EU and the governments of the Member as well as Candidate States have consistently stressed the role of S&T in developing the knowledge-based economy. In 2000, the Lisbon Council set the goal to make Europe "the most competitive and dynamic knowledge-based economy in the world" by 2010.[17] The European Research Area (ERA) is a strategic process, and the present situation is still characterised by the existence of various

16 P. Georgieva, *op.cit.,* p. 105.

17 The general ideas for achieving this goal are presented in the EU document "Towards a European Research Area" [ERA]. Brussels, 2000.

national research policies.[18] Bulgaria's Position Paper on the ERA initiative is attached to this review as Annex 1.

The list of questions science policy makers must address is long.[19] They relate to research, to training, and to links among research, training and application/innovation.

Research:

- What mechanisms best promote quality research and application (university based, institute based, topical, project-based centres); What is the appropriate balance between "big science" (science activities requiring multiple parallel activities or expensive infrastructure) and "normal science" activities?

- How can researchers participate in "big science" projects – exchange; niche development; data analysis from shared large-scale data bases?

- What is the appropriate balance in providing research and development incentives to business and industry as both the producers and consumers of scientific knowledge?

- How can participation in larger-scale collaboration or scientific "virtual" communities be fostered? Is this an appropriate model both for fostering scientific progress and covering national science needs?

Training:

- What is the appropriate balance between breadth (broad comprehensive training so that students are prepared to enter any science field) and depth (comprehensive post-graduate training leading to high levels of expertise). For example, what proportion of resources should be allocated to ensuring that students can receive high quality, research-based training at the undergraduate level across

---

18 An overview of these policies in Member States is given in an EU policy document "Benchmarking National Research Policies" (2002), while the "Key Figures 2002" (2002) present the statistical data. The European Federation of National Academies of Sciences and Humanities has summarised its findings in the Report "National Strategies of Research in Smaller European Countries" (2002). See References.

19 See M. Bullock, ALLEA 2000.

all science fields, and what proportion should be allocated to building up graduate training or providing funds for graduate training abroad?

- What is the importance of having all levels of training available "in country"? Given limited human resources (*e.g.*, trained researcher scientists) it may not be possible for students to receive training in specialty or cutting edge research fields at home. What programs are effective in ensuring that students who travel abroad for training and research will return to teach and work at home?

- What are the benefits and risks of leveraging resources and creating "virtual universities" and fostering academic exchange?

- How can future leaders be identified and nurtured?

Links between research, training and applications:

- What models of academic / research / innovation interactions have proven most productive?

- Centres of excellence: does this resource-intensive investment yield high quality research output? What mechanisms will promote a sufficiently large critical mass to facilitate research-based application and innovation?

- Research-intensive *vs.* integrated with training: what are the relative merits of promoting research-intensive organisations versus integrating research and training activities?

- How can knowledge exchange and researcher mobility across national borders and between universities and industry/government be encouraged?

Getting answers to these questions is not enough. All the activities should be supported by public and private investments, and the public should understand *why* all this is needed.

Some of these questions are especially important for smaller countries including Bulgaria. A crucial point is finding a suitable balance between needs and opportunities. Much is to be learned from the experience of other countries. "Best practice" models used by smaller countries, as well as their disadvantages and weak points, include the following, with special emphasis on points 9 and 12:[20]

1. The success of S&T in leading countries is based on science policies that encourage long-sighted programmes, fluid boundaries between academia and industry, and international co-operation. Government programmes that stimulate such activities indirectly (through the establishment of co-operation mechanisms and incentives) and directly (through investment in research centres and science parks, and through funding of international ventures) should be scrutinised. A typical research strategy includes the following key words: governmental aims and initiatives, research for prosperity and welfare, quality to be promoted and rewarded, international research, co-operation, education and research, freedom and responsibility in research, structures and systems, funding targets and monitoring, evaluation.[21] The role of the Government as an investor, a catalyst, and a regulator should be clearly defined.

2. Well-organised administration of S&T requires setting targets and priorities, establishing mechanisms for strategic allocation of funds, establishing evaluation procedures and engaging in long-range planning.

3. Flexible funding with multiple sources (governmental, private, third sector) is essential to meet the needs of society, guarantee stability of research and foster innovation. Currently, international funding of S&T in small countries is relatively small, as is funding from non-public funds. Mechanisms for increasing these need to be explored.

4. Government initiatives in setting long-term targets (both aims and funding) considerably improve the outcomes of S&T, by creating special funds for targeted research, looking for tax incentives and levies on certain branches of industry, etc. (*cf.* Norway, Sweden).

---

[20] J. Engelbrecht, ALLEA, 2002.

[21] For details see Research Strategies of different countries.

5. High-quality research is a result of long-term continuous evaluation exercises and critical (peer)-review of all results and applications (*cf.* experience in Sweden, Finland, the Netherlands, the United Kingdom and Estonia). A national evaluation system works successfully in many countries and needs to be encouraged.

6. The main weak points of S&T in many smaller countries, especially those in transition economies, are the existence of old-fashioned science structures, rigid funding schemes, weak administration and a shortage of qualified (young) scientific workers. These problems can be ameliorated through a strategic system of priority setting and regional and international co-operation.

7. High-quality research merits special additional support and is characterised by intensive international co-operation (*cf.* Finland). There is a desire in many countries to create Centres of Excellence in Research.

8. National Programmes of Research help to focus on some priority areas, and can also help to overcome funding shortages.

9. S&T is not a static situation but a *process* that needs to pay special attention to young researchers: graduate schools, PhD scholarships, mobility, post-doctoral positions, etc.

10. In many Central and Eastern European countries, the scientific infrastructure – including equipment – is in a poor state. Special programmes could help to improve the situation (*cf.* Portugal).

11. Technological innovation is directed mostly to the *existing* traditional technologies and not to new, prospective areas. Investments are small, especially in Central and Eastern European countries, and the role of foreign investors is small.

12. Success of S&T depends on the level of *trust* among all actors: academia-government- industry.

13. Several specific initiatives are worth highlighting here:

- Funds for the realisation of government priorities (Norway) or for innovation (Finland, Ireland);

- Government initiatives to provide tax incentives (Norway, Ireland);

- S&T levy on certain industries (Norway);

- Technology assessment by special boards or institutes (Norway, Austria, Hungary, Slovakia, Czech Republic);

- Centres of Excellence in Research (Finland, Sweden, Austria, Israel);

- National initiatives/programmes (Portugal);

- Incentives for young scientists (Sweden, Finland, Austria, Slovakia, Estonia, Ireland);

- Programmes for material infrastructure (Portugal, Israel, Sweden);

- Funding provided for public awareness (Ireland).

This list is a good starting point for comparison and for ideas. Nevertheless, nothing should be automatically "transplanted": – much depends upon local conditions and the readiness of the society.

International trends in S&T funding

The crucial factor for the success in S&T and research and development (S&T) is funding. The recent benchmarking process (Benchmarking 2002) has analysed how to increase public and private investments in S&T that strongly depend on the governmental policy. Direct funding of S&T from public sources needs clear and successive (*cf.* Finland) S&T strategies approved by legal authorities. Even where the major player in funding is the private sector, the government should also elaborate instruments to encourage the private sector to increase its S&T activity. This could be done through (1) *direct support*, (2) *indirect support*, and (3) *improving framework conditions.*[22]

(1) Direct support instruments take the form of either grants – which effectively share the cost of research projects between the government and the company – or subsidised loans (soft loans) at reduced interest rates, which reduces the cost of the research and development to the company. The use of structural funds, in those countries that have a substantial number of them, becomes an important element in this approach. Another form of direct public support comes from public funding of venture capital (VC), either through

---

22 European Commission, *Benchmarking: National Research Policies.* Brussels: 2002.

support of private VC funds or through the establishment of specific government VC funds.

(*2) Indirect supports* are generally fiscal incentives, which use the taxation system of the country to provide the motivation to invest in S&T. If the policy aim is to boost the nation's rate of commercialisation of new products, processes, or services, then a tax incentive like an S&T tax credit, has some advantages over direct funding. Success in commercialisation hinges on a sound understanding of the market, and tax incentives have the advantage of leaving the decision on which projects to fund in the hands of private firms rather than government agencies.

(3) Improvement of framework conditions constitutes the third area of intervention in which public policy can influence investment in S&T. By providing a wide range of regulatory and infrastructural arrangements, private involvement in S&T can be supported and stimulated. Recent analyses suggest that an increase of S&T investment from business enterprises depends as much on framework conditions (entrepreneurship culture, social capital and routine, public-private partnership possibilities, intellectual property rights/patents, regulatory conditions for efficient capital market, competition rules, etc.) and availability of human resources (recruitment conditions, availability of the right qualifications, etc.) as on measures such as direct funding, fiscal measures, guarantee mechanisms or VC funding.

Important recent ideas in the international context

First, the European Research Advisory Board (EURAB), which is composed of academies and industrialists on an equal basis, recommends the following:[23]

- The European Commission should insist that candidate countries include S&T and innovation in their national development programmes and increase national spending on S&T and innovation, so that a *European average level of 3.0% of GDP can be reached by 2010*;

- The Commission should encourage the governments in the candidate countries to form advisory and co-ordinating bodies in S&T from competent representatives of relevant actors in society, which would advise the government on the development and co-ordination of

[23] EURAB 02.052, 22.01.2003 – Enlargement and ERA.

national science and technology policy. The Commission should also encourage the governments in candidate countries to establish a research funding system which distributes funds on a competitive basis, with the use of international peer reviews;

- The Commission should specifically encourage governments of candidate countries to use structural funds attributed to them to build research infrastructures, to strengthen creative innovation environments and to improve co-operation between industry, SMEs and research institutions.

The *second important document* is the Policy Briefing on Science Communication in Europe, issued by the European Science Foundation (ESF).[24] This is motivated by understanding that all European Research Area goals will be reached *only if* they have substantial public support, and *only if* they also attract and stimulate the interest of young people. On the national level, the ESF recommends defining a communication strategy as part of all activities foreseen by science policies. The ESF suggests that 1% of all free research money should be spent on communication and on setting up professional communication units.

Statistical data

Statistical data reflect integral input-output figures of investment in and performance of S&T in various countries. In the following tables, only some indicators are given, mostly those of middle-sized European countries with a population similar to that of Bulgaria (about 7.9 million).

Table 3.1 shows the level of S&T activity as % of GDP (Gross domestic Expenditure on R&D - GERD). Clearly, the Bulgarian S&T “intensity” is one of lowest in Europe, reflecting the present transition stage in state policy. The main feature characterising S&T in Bulgaria is the need to “put out fires”, *i.e.* to solve current problems with little attention to future development. The situation becomes worse when the percentages of Table 3.1 are compared with GDP figures in Table 3.2. The low GDP in general means that S&T funding is also considerably lower in real terms.[25] This adversely affects the country's human

---

24 ESF Policy Briefing. Science Communication in Europe. March, 2003, No. 20.

25 The MES reported in 2002 that "The budget has gone below 0.30% of GDP for the last few years". See "Bulgaria Towards Regional and European Co-Operation", MES, 2002, p. 11.

capital, leading to brain drain and to a deteriorating infrastructure of universities and research institutes.

Typically for countries with low S&T intensity, the role of business (industry) in funding S&T is small, as can be seen in Table 3.3. This situation is not only characteristic of EU candidate countries – reflecting the currently weak investment by business in the knowledge economy – but it is also seen elsewhere in the world.

The number of researchers in Bulgaria is not very different from other European countries (see Table 3.4). The low funding is reflected, however, in the number of scientific publications, as is clearly seen in the last column in Table 3.4.

Table 3.1. **S&T intensity (GERD as % of GDP), latest available year**

Bulgaria (2002)	0.47
Czech Republic (2000)	1.33
Hungary (2000)	0.80
Slovenia (2000)	1.52
Estonia (2001)	0.79
Latvia (2000)	0.48
Lithuania (2000)	0.60
Austria (2002)	1.80
Belgium (2002)	1.96
Sweden (2002)	3.78
Portugal (2002)	0.76
Greece (2002)	0.68
EU- 15 (estimated)	1.93

Sources: EC Key Figures (2002); Eurostat, New Cronos (2000); Ministry of Education and Science, Bulgaria (2003); R&D, Statistical Office of Estonia (2001).

Table 3.2. **GDP, middle-size countries, latest available year**

	GDP in millons, Euros	Population in millions	GDP per capita, Euros
Bulgaria	15 144	7.9	1 919[1]
Austria	204 843	8.11	25 258
Belgium	248 338	10.24	24 252
Sweden	248 479	8.86	28 045
Portugal	115 262	10.24	11 256
Greece	122 986	10.54	11 668

1. *PPS (Purchasing Power Standard) 6 510 Euros, see Eurostat figures.*
Sources: EC Key Figures (2002); MES Bulgaria (2003).

Table 3.3. **S&T financing by source (percentages), latest available year**

	Government	Business	Other
Bulgaria	71.0	20.0	9.0
Austria	40.3	40.1	19.6
Belgium	23.2	66.2	10.6
Sweden	24.5	67.8	7.7
Portugal	69.7	21.3	9.0
Greece	48.7	24.2	27.1

Sources: EC Key Figures (2002); MES Bulgaria (2003).

Table 3.4. **Number of researchers and publications, latest available year**

	Number of researchers	Researchers per 1000 in labour force (Full Time Equivalent)	Number of scientific publication per 1 million pop.
Bulgaria	16 671	5.56	164 (?)
Austria	20 222	4.88	845
Belgium	30 219	6.95	864
Sweden	39 921	9.10	1 657
Portugal	15 752	3.31	333
Greece	14 828	3.30	501
Slovenia	…	8.9	577
Estonia	3 002	4.3	467

Sources: EC Key Figures (2002); MES Bulgaria (2003); Baltov 1999; Research and Development in Estonia 2000 – 2001.

Research in Bulgaria

Without any doubt, scientific research is an international activity. Nevertheless, there are always national needs for research reflecting the societal, economical and environmental problems in any country. Clearly even larger countries cannot afford research in all possible fields. The eternal question about the *balance* is more acute for small and middle-sized countries.

The legal framework and current status of research in Bulgaria are described in Chapters 2 and 3 of this review. Here, the focus is on how research in Bulgaria corresponds to national and international trends – and also to national and international needs. It is not only a question of competitiveness: *the question is whether research in Bulgaria is able to act as a moving force for the country on its way towards a knowledge-based society.*

An earlier report on science and technology in CEE countries[26] places Bulgaria – together with Moldova, Russia, Belarus and Ukraine – in a group of countries that are slow to modernise their S&T structures. The characteristic features of that classification are (i) an economy with GDP falling, restructuring and privatization still in initial phase; (ii) S&T politics – changes in institutional framework beginning but not yet actually realised; continuing decrease in S&T budget; (iii) S&T performing sectors – partial or incomplete changes in diversification, democratisation, evaluation and increasing competitive funding, restructuring former branch institutes. Recent years have brought several changes for the better (see below), but clearly the situation as a whole needs to improve further and faster.

The OECD Review team has visited altogether 13 universities/research institutes, and has seen many examples of excellent practice. However, the team also clearly witnessed the drawbacks and weaknesses in Bulgarian S&T. Unfortunately, the general situation is shaped by two major difficulties: (1) constant low funding, and (2) the absence of coherent, long-term S&T policy.

As noted earlier, *funding of research* is "institutional", and mostly on a *status quo* basis. After salaries have been covered, only very small amounts are left for research. Competitive funding is done through the two Foundations (NSRF and STPF, see Chapter 2), but their budgets are very low and the grants are too small to influence the research. There are programmes initiated by various other Ministries (Ministry of Agriculture, Ministry of Health) that are targeted on certain priorities. These activities are considered to be effective.

In 2001, the Council of Ministers approved National Scientific Programmes in five key areas:[27]

- Genomics;
- Information Society;
- Nano-technologies and New Materials;
- Bulgarian Society – Part of Europe;

[26] S. Radosevic. Restructuring and reintegration of science and technology systems in economies in transition. EC SOE1- CT95-1008, 1999.

[27] Council of Ministers Decision No 550, 6.07.2001. Unfortunately the calls for those programmes started only in 2003.

- Cosmic Research.

In particular, the Ministry of Education and Science and the Ministry of Economics feel the need for more concerted (joint) action in science policy. An important July 2002 Position Paper[28] identifies the following pressing issues:

- The need for a national strategy and a realistic implementation plan;
- The need for coherence in government policy;
- The need for upgrading and modernising Bulgaria's science and technology sector;
- The need for upgrading existing companies.

The review team agrees that these are key priorities. Given Bulgaria's economic constraints and political changes, the restructuring of S&T has been slow. Indeed, in comparison with other countries, Bulgaria has taken the road of passive and gradual restructuring. This is illustrated in Figure 3.1 below.

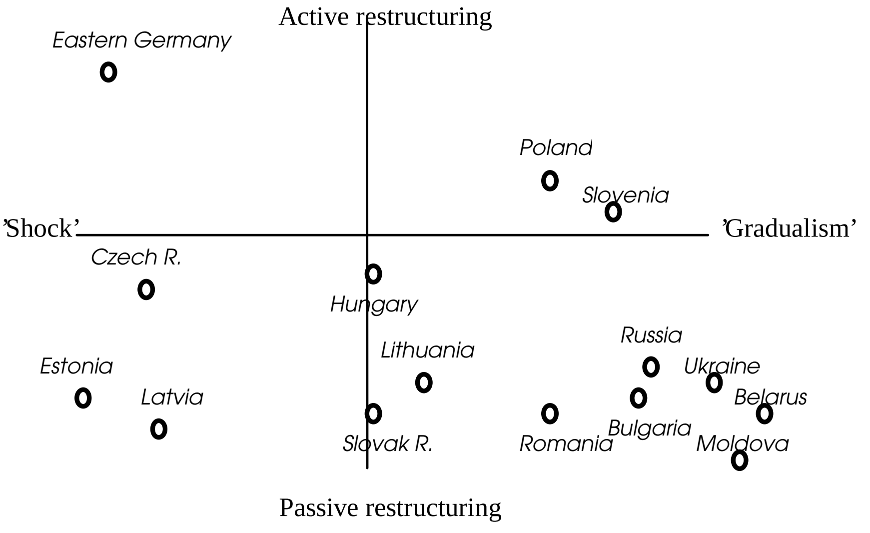
Therefore, S&T in Bulgaria needs strong political acts to build up an effective S&T and innovation system, together with continuing reforms in education. The human and scientific potential for this exists, although it is under the dual threats of ageing and brain drain.

Despite all the constraints in funding, fragmentation of research, ageing problems, etc, the Bulgarian Government and all the actors have stressed the importance of international co-operation on regional, European and world-wide levels. Bulgaria officially became a member of the 5th Framework Programme and COST in 1999; and the Bulgarian Academy of Sciences joined the European Science Foundation in 2001.

---

28 "Towards a Science, Technology, and Innovation Policy for Bulgaria", 15 July 2002. Prepared by the MES and the Ministry of Economics. This paper, as far as the team was able to discover, was never formally approved by contains important recommendations that should not be lost.

Figure 3.1: **National patterns of industrial R&D restructuring in countries of CEE**



Co-operation within TEMPUS, INCO-COPERNICUS, PECO and NSF-INF, among others should be stressed. Bulgaria is also actively involved in NATO Science for Peace projects (altogether Bulgaria has more than 280 NATO grants and 350 fellowships).[29] The regional co-operation in South-East Europe is developing and is supported by the governments.[30] [31] There are several excellent examples of co-operation, such as:

- Treatment of neurological diseases;
- Precision processing of materials using an original copper bromide laser;
- Non-destructive assessment of virtually peeled fruits and vegetables;
- Peanut processing technology;

---

29 NATO Newsletter, No 62, March, 2003.

30 Round Table of Ministers of Science on Rebuilding Scientific Co-operation in South East Europe, UNESCO, Paris, 24 Oct 2002.

31 A Brief History of SEE Regional Research Co-operation. Ministry of Education and Science. Sofia, 2002.

- Large-scale air pollution models, and many others.

Teaching and research in universities

The OECD team found that there are many obstacles hindering teaching and research in HEIs; these obstacles are well known to Bulgarian authorities (see, for example, P. Georgieva, *op.cit.*), but they are not easy to overcome.

To put it briefly:

- Teachers are overloaded and the staff is ageing;
- Infrastructure is out-dated;
- Research funding is very low;
- Research activities are primarily individual matters;
- The number of doctoral students has been decreasing although this is not the case in all universities: in some the numbers are now increasing significantly;
- The number of full-time researchers is small.

All these factors have direct consequences for scientific results.

Combining research and teaching is the main task of universities. According to Bulgarian legislation, the HEIs should be accredited institutionally. All HEIs have now (2004) been accredited without any problems (with one exception); in fact, there has been some criticism of the accreditation agency (NEAA) because it is seen by some as being unable to differentiate among institutions according to their actual academic quality rather than their reputation or influence.

Bulgaria in Europe: issues of convergence and diversity

The HEIs take part in many EU and EC programmes like COPERNICUS, TEMPUS, SOCRATES/ERASMUS, LEONARDO DA VINCI and others. This has greatly helped to maintain a good level of higher education despite the economic constraints in Bulgaria. Nevertheless, the OECD team formed an impression, from its various meetings and visits, that the universities are left on their own to solve their problems and that they do not feel that they receive support from the government. This has a deeply serious consequence – *the* *possible loss of motivation which in its turn is directly related to brain drain.* Again, counter-examples can also be given: universities are using their rights to autonomy to try their best to attract PhD students and are using their own funds to support research.

The European Research Area and the European Higher Education Area

In parallel to the efforts to create a European Research Area, the European Commission has been working assiduously towards a European Higher Education Area (EHEA), building on key agreements such as the Lisbon Recognition Convention (1997), the Bologna Declaration (1999) and more recently the Prague Communiqué (2001). These agreements are loosely referred to as belonging to the "Bologna Process", aimed principally at creating compatible (but not uniform) higher education systems across Europe. At present, the intention is to launch the EHEA by 2010 and the Berlin Ministerial Summit meeting of all ministers of education[32] in September 2003 marked the next milestone along this path.

Although the "Bologna Process" is mainly concerned with the first two cycles of higher education (Bachelor and Master degrees), inevitably the issue of Doctorate and other research degrees will need to be addressed. Obviously this raises structural issues in post-communist systems – including Bulgaria – where the relationship between teaching and research is not as close as in other European countries.

It is useful to see Bulgaria's efforts to improve its S&T policies in the light of wider European movements such as the EHEA and the ERA. For example, one worry frequently expressed to the OECD review team was the recognition of Bulgarian degrees and qualifications (also in non-university vocational and technical fields) outside Bulgaria. After the signing and ratification of the Lisbon Recognition Convention this has ceased to be an overriding worry for Bulgarian graduates and researchers; the "Bologna Process" and the convergence implicit in EHEA and ERA will remove further barriers in due course. A brief overview may be of help here.

Soon after the Prague Summit meeting of Ministers of Education in 2001, the European Universities Association (EUA) began to discuss major topics related to the "Bologna Process", and in the spring of 2003 it adopted a reply to

---

32 This includes not only the 15 countries of the present EU but also those of all accession countries as well as a number of other countries (*e.g.*, the Russian Federation) not participating in the "Bologna Process" at this time. Bulgaria was represented by the Deputy Minister for Science.

the European Commission's communiqué "The role of universities in the Europe of Knowledge". At the EUA's Convention in Graz in May 2003, about 600 university leaders, students and guests from governmental and international organisations from across Europe came together to work towards the creation of a *European Higher Education Area (EHEA*), the counterpart to the *European Research Area (ERA)*. One of the key themes discussed by Convention working groups was "Re-visiting the links between higher education and research", reflecting the clear need to set priorities and to formulate a long-term vision for universities and research institutions in Europe. This common vision, as expressed in Graz, is *"a Europe of knowledge, based on strong research and research-based education in universities across the continent"*:

> "With the growing differentiation of their mission, universities must ensure that their graduates at all levels have been exposed to a research environment and to research-based training. Higher education institutions accept the two-tier system and other goals of the Bologna process; they know well their particular liabilities in curricular reform, they jointly develop new contents and tools and share good practice, for example in credit transfer and accumulation. At the same time, however, [there is] a need to upgrade the Process towards a three-tier system. The Doctoral level should be conceived as the third cycle, and – together with post-doctoral study – seen as an *integral part of the European Higher Education Area, integrated with the European Research Area*."

The Bologna Process and south eastern Europe

Like Bulgaria, all countries of South Eastern Europe (SEE) and their higher education systems went through hard times in the 1990s, and they are now keen to participate in international co-operation and integration to foster *national* economic, social and cultural recovery. Universities can play an important role in these processes, offering knowledge and qualifications as well as democratic values. In August 2002, university rectors of all SEE countries met in Dubrovnik for the first time after a decade of conflicts in the region; they discussed international processes in higher education from a regional point of view, and agreed on two regional priorities: curriculum reform and mutual recognition of periods of study and diplomas within and outside the region.[33] However, the main "Bologna" follow-up event in the SEE region was a conference on "The External Dimension of the Bologna Process: South-East

---

33 Statement from the Dubrovnik Meeting of University Rectors of Southeast European Countries. Inter-University Centre in Dubrovnik, 23 August 2002.

European Higher Education and the European Higher Education Area in a Global World" organised jointly by UNESCO-CEPES and EUA and held in Bucharest on 6-8 March 2003. It relied on the Project "Regional University Network of Governance and Management of Higher Education in South East Europe", supported by the European Commission in the framework of the CARDS Programme. It focussed on challenges to academic values and to the organisation of academic work at a time of increasing globalisation; higher education as a public responsibility and a public good, and its regional significance; quality assurance, accreditation and recognition of qualifications as regulatory mechanisms in the EHEA.

Clearly, those responsible for higher education and research in SEE countries have already used the provisions of the *Bologna Declaration* and the *Prague Communiqué* as a reference framework for their own reform initiatives. Today, there is clear evidence of a strong commitment to achieving the Bologna Process objectives in the region, and a desire that new applicants from the SEE region be accepted as full members in the Bologna Process.

Throughout SEE, as in Bulgaria, *university autonomy* is now legally protected, and its practical implementation is improving. The values of academic freedom are highly regarded and embedded in everyday academic work. Nevertheless, in terms of *governance,* there are still many issues to be addressed. The current organisation of universities as mostly weak federations of legally autonomous faculties hinders the effective implementation of the objectives of the Bologna Process and the eventual creation of EHEA/ERA. *Quality assurance* has become a key challenge for national authorities and institutions across the region. Given the small size of the respective higher education systems, the introduction of more systematic and effective institutional quality assurance mechanisms – including a wider European dimension – becomes ever more important. Therefore, institutions have been encouraged to strengthen their European networking activities in this field.

Universities in the region are well aware that their main priority should now be curriculum reform. Structures remain traditional, curricula have not been restructured and the duration of studies at Bachelor level is longer than intended in the Bologna Process while the Master level tends to be simply an add-on to the previous one. Attention should be given to the importance of diversification, the need to develop alternative forms of provision and the need to promote lifelong learning. However, pilot projects are on the way and considerable efforts have been made in all countries to introduce the European Credit Transfer System (ECTS). Compared to the past, academic mobility has increased dramatically, despite obstacles encountered by both staff and students (visa requirements, financial resources). On the negative side, many of the best students and graduates do not return after their study abroad, thus contributing to brain drain from the region. There are still difficulties with the recognition of qualifications and periods of study, both internally between the countries in the region and in relation to other countries.

Joint doctoral programmes educating for research professions in Europe should be understood as a cornerstone for greater co-operation between EHEA and ERA. Synergy between the two areas is viewed as an essential prerequisite for the creation of a “Europe of Knowledge”. However, a need for *more structured Doctoral studies* in Europe is often expressed. Today, in half of the “Bologna” countries, doctoral students receive mainly individual supervision and tutoring, while in the remaining countries “taught” doctoral courses are offered in addition to individual (research) work. Growing international co-operation and attempts to develop joint degrees demand more attention to comparable Doctorate degrees, first of all to ensure quality standards. Doctoral studies will certainly be a crucial lever of the “knowledge society”, and form an important element of the attractiveness of the EHEA/ERA. Therefore, a *transparent, readable and comparable “third degree”* should be elaborated seriously in the next few years in anticipation of the EHEA launch in 2010.

One vital issue for EHEA/ERA relates to the fields of engineering sciences and technology, and also to the natural sciences. For example, in terms of the ERA objectives there is a shortage of some 700 000 specialists in Europe as a whole, especially engineers. Bulgaria's former education system, like others in the region, did produce such specialists, in much greater numbers than is now the case. The OECD review team is concerned about the decline in engineering and natural sciences studies and research in Bulgaria, not only in relation to the development of ERA but also in terms of Bulgaria's own future in S&T.

Next steps

The question now is how the particular goals of both the *Bologna Declaration* and the *Prague Communiqué* are reflected in discussions, policies and legal initiatives over the next few years. Two roughly drawn groups of issues (*structural* and *social*) need to be considered.

Structural dimensions

Important progress has been made regarding the introduction of study structures based on an undergraduate and a graduate tier. First of all, legal possibilities have been considerably improved and many governments have fixed deadlines for the transition to the new degree system. More than one-half of European higher education institutions report today that they are introducing the two-tier structure, and more than one-third of them are planning to do so.

Recently, much attention has been given to the *detailed structure of the two main cycles*. The terms of Bachelor and Master have been widely used to characterise both cycles; however, concerns have been expressed that these terms – in particular with reference to the EHEA – could provoke confusion both in countries that have traditionally used them and in those that have not. Tentative definitions of the internal composition of individual levels are being formulated; for example, "a Bachelor-level degree is a higher education qualification the extent of which is 180 to 240 credits (ECTS)".[34] Later discussions went more in depth, stressing that concerns for *learning outcomes* and qualification are even more important than *length of study*.

There is a growing trend towards Master level degrees that require the equivalent of 300 ECTS credits, although examples of slightly longer and slightly shorter courses can be found. The majority of countries and institutions seem to be inclined towards *90-120 ECTS Master programmes*. Medicine and related disciplines require a different scheme in most – but not all – countries, and expectations for an "integrated" Master degree have been noted also, in particular in environments with traditionally long one-cycle programmes. Some comments have been made at seminars and on other occasions that "particularities" should not be used as a pretext for "diversity", which should be respected. Similar comments have been expressed with regard to a tendency to see first-cycle degrees only as a stepping-stone or orientation platform for the second level degree and not as an end in itself, "relevant to the European labour market as an appropriate level of qualification". On the other hand, differentiation among "academic" and "professional" second-cycle degrees – which have been developed in some countries – does not seem to create problems, at least not in principle. It seems much more important to change approaches to *learning, e.g.* learning should not be expressed in traditional terms of "seat-time" but in terms of knowledge and competence attained. Various initiatives are underway that aim at defining learning outcomes, skills and competences both at the Bachelor and Master level (such as "common denominators for a Master degree in the EHEA"). This approach will allow capitalising on the richness of European higher education traditions and creating European profiles in various disciplines.

---

34 *Conclusions and Recommendations of the Seminar to the Prague Higher Education Summit*. The Bologna Process. Seminar on Bachelor-level Degrees. Helsinki, 16-17 February 2001.

Considerable attention at European level has been given to the question of *access*: in principle, the consensus is that entrance to second (and third) cycle degree programmes should be made possible without additional requirements, but actual admission should remain the responsibility of the institutions offering graduate degrees. While this is an admirable goal, the vital issue of funding, both in higher education and in research, cannot be ignored.

Such discussions have helped to broaden the scope from the two-tier structure alone to many detailed aspects of content, approach, methods, etc.: a simple statement that there should be two (or three, if Doctorates are included) successive cycles *is insufficient to make degrees comparable and compatible on a European level*. The length of degree programmes (in terms of credits earned) is not an issue that stands by itself, but is just one crucial factor in the entire process of convergence of higher education: including the content, nature and level of study programmes.

The objective of a "system of easily readable and comparable degrees" as a distinctive feature of the EHEA/ERA can only be achieved if over the next few years priority is given to elaborating *national qualification frameworks*, possibly in relation to an overarching "broad but common" *European qualification framework*. This idea is relevant not only to degrees and qualification structures, but also to lifelong learning.

Social dimensions

Student and teacher mobility has increased across Europe, but there are obvious differences with regard to particular countries, types of mobility, etc.: for example, there is a clear distinction between "importers" and "exporters" of Erasmus students. Public funding of mobility has increased in the majority of EU countries but only in a minority of accession countries. In addition, language issues in mobility seem to become more important everywhere.

On the positive side, an important tool to strengthen mobility – the European Credit Transfer System (ECTS) – is clearly emerging as the European credit system. ECTS, introduced in the late 1980s, has achieved this by developing a standard unit expressing workload – the "ECTS credit", 60 of which constitute an average workload for an academic year – as well as a standardised grading scheme. In recent years, it has become a legal requirement in many countries. Two thirds of HE institutions today use ECTS for *credit transfer* (and 15% use a different but compatible system).

The *conceptual basis* of ECTS is a student-centred system, based on the student workload required to achieve the objectives of a programme. These objectives are preferably specified in terms of learning outcomes. Therefore, a successful implantation of ECTS could not be done in a mechanical way (*e.g.* re-calculating traditional contact hours into credits), but it demands thorough curricular reform at the institution level

Another useful instrument is the *Diploma Supplement (DS),* developed jointly by the European Commission, the Council of Europe and UNESCO. In many countries, institutions are now obliged *by law* to issue it to their students once they earn their degrees. The Diploma Supplement, which is an addition to and not a substitute for the original diploma, contains information on the student, the institution and programme, the competences earned and the higher education system. It could be particularly valuable for students (learners) in the context of lifelong learning.

At first glance, ECTS, Diploma Supplement and similar tools appear to belong more to the "structural dimension" of European convergence of higher education and research, but their importance for mobility, transparency, employment, etc. also argues for classifying them as important elements of the "social dimension". Broad access to higher education has become a key topic of the last decades. On the one hand, it requires structural change; on the other, widened access raises serious questions about studying and living conditions, and about systemic removal of obstacles related to students' social and economic backgrounds. Introduction and maintenance of social support schemes for students and young researchers, including grants (portable as far as possible), loan schemes, health care and insurance, housing and academic and social counselling become *equally important issues for the successful establishment of the ERA/EHEA as changes in structures*.

Another frequent theme has been the emerging global market in education and research, stimulated by the radical new possibilities based on ICT. Global competition in higher education and research is a real challenge, especially to smaller countries with limited resources; the question is how to achieve a balance between competition and co-operation? In their discussions with Bulgarian colleagues, the OECD review team was often told that any necessary changes should be based on academic values, respect for diversity, and co-operation between different countries and regions of the world; but in an unequal environment this remains a difficult issue.

Centres of excellence in Bulgaria

That the human and scientific potential for an effective S&T system exists in Bulgaria is clearly demonstrated in *Centres of Excellence in Research* within the EU Programme for Central and Eastern European Countries. The review team visited the following:[35]

- The Central Laboratory for Parallel Processing (CLPP) of the Bulgarian Academy of Sciences;

- The Agrobio Institute (ABI) of the National Centre for Agricultural Science.

The team found that these centres are characterised by clear vision, modern equipment, excellent international co-operation, attractiveness for young researchers, and excellent leadership. They are much better funded than the average scientific establishments, due largely to their own active co-operation with foreign partners. As a rule, the centres are advised by international advisory boards (consultative councils). They have well-elaborated development plans, with (often rather ambitious) concepts and goals. They are nuclei for innovation in extremely important key areas, such as:

- Information technology;

- Plant biotechnology;

- Sustainable development.

There are other good examples as well. The Institute for Tinned Food Production in Plovdiv has been successful in several international projects in Europe and the US; the Medical University in Sofia runs several international projects (such as research on genetic diseases in the Danube region, joint research with US centres).

The Bulgarian Academy of Sciences

The Bulgarian Academy of Sciences (BAS) and its network of research institutes have undergone a series of essential changes, although some structural aspects still resemble the previous Soviet model. Nevertheless, the BAS continues to occupy an important place in Bulgarian research; and in fact, similar academic research networks exist in many countries outside the

---

35 The team was unable to visit a third centre, the Centre for Sustainable Development of the Black Sea Region, but received relevant information from counterparts.

CEE/SEE region – for example the Max Planck Society and Fraunhofer Society in Germany, the CNRS in France, the CSIC in Spain, etc.

However, a characteristic feature, and still a major obstacle, in former Soviet-block countries is the existence of a "Berlin Wall" between academic research institutes and universities. Breaking down this wall is no easy task, because it requires not only institutional restructuring but a change in long-standing habits and attitudes in both communities.

Being an independent organisation, BAS has taken restructuring extremely seriously, concentrating on two issues:

- Striving for excellence in research;

- Connecting education and research.

Excellence in research

The evaluation of research within BAS in 1992 – 1993 has resulted in the closure of 24 research units and restructuring of several others.[36] The number of staff has been reduced. Still, having a staff comprising about 15% of all researchers in Bulgaria, BAS produces about 55% of scientific publications.

Connecting education and research

Moreover, BAS has organised a Graduate School (Education Centre) for PhD studies (PhD Programmes for 2000, Education Centre of BAS), approved by the National Evaluation and Accreditation Agency. Such a Graduate School makes it possible for BAS to use the high potential of its research centres for educational purposes.

BAS priorities until 2005

The Bulgarian Academy of Sciences has formulated its functional priorities for the period 2001 – 2005, within the framework of three basic aims (policies):

- Scientific aid and counselling of the state and society;

- Development and integration of Bulgaria's research potential and infrastructure in the European Research Area (ERA);

---

36 Baltov, 1999.

- Supporting and sustaining national values and identity.

The programmes (10 in total) along these policy lines specify the activities in more detail.

At the same time, BAS is aware of the major problems it faces, such as the need for restructuring its existing campuses, issues of ageing and brain drain, etc. Striving for excellence in research and for close co-operation with universities, BAS plays a strong part in the high reputation and forward-looking spirit of Bulgaria's S&T system.

The way forward

As the July 2002 Position Paper suggests, a National Council for S&T and Innovation should be established as a matter of urgency, because it provides a mechanism to link all relevant Ministries in their attempts to solve complex problems across their separate areas of responsibility. Furthermore, the two existing Foundations – the Bulgarian Science Foundation and the Bulgarian Technology Foundation – remain important and need to be actively involved in the planning of reforms. The Position Paper's own strategic action plan includes (a) approving the competitive programme and project funding of research, and (b) strengthening the national innovation network (for example through High-Tech Parks, Business Incubators, etc.).

The need for implementing these actions is obvious, and well understood by the scientific community. The universities and research institutes visited by the review team expressed similar objectives:

- A long-term, coherent S&T policy for Bulgaria is urgently needed;
- Priorities should be identified and agreed;
- New legislation is needed to regulate the role of industry in using/supporting/funding S&T;
- New legislation is also needed to regulate the establishment of spin-off companies, and the use of revenues from privatisation in S&T.

In short, the scientists' message to the government is simple – "good intentions should now be realised". The team also heard that there are still discrepancies in existing laws and that the links between government and academia are weak; these issues also need to be addressed as part of a general effort towards creating a vibrant S&T sector in Bulgaria.

Clearly, the scientific community understands the problems – they are not just complaining about low funding and brain drain, but they are positive and confident they will be able to react fast to good incentives. Some universities already try to introduce measures to improve the situation themselves. For example, the Agricultural University in Plovdiv has started to support PhD students by redirecting funds within the University; the University of National and World Economy runs its own research programmes, etc.

Brain drain and other major challenges

The OECD team draws attention to the analysis of strategies against brain drain.[37] This is the voice of the Bulgarian scientific community, which cares about the future. Although they may sound harsh, the words of K. Vesselinov are worth repeating here: "The fact that the state bodies – the Parliament and the Government – remain indifferent and inactive as far as staff development in the sphere of higher education and science is concerned, is quite troublesome*…. What is needed, in fact, is not only views on relevant issues, but also political will… ".*[38]

The most important tool to mobilise scientific potential is fairly abstract – the *quality* of research should be rewarded. This means that funding decisions, promotions, accreditations, etc should be based explicitly on *quality* requirements. The definition of these requirements should be one of the main tasks of Bulgaria's scientific community, and should take account of international assessments of scientific research as well as on Bulgaria's own strengths and needs.

There are serious additional challenges to the government and the ministries as well:

- How to implement the Position Paper with all the important changes it proposes, such as competitive funding and state structures for innovation;

- How to avoid a crisis in human capital, which could happen in the near future unless counter-measures are taken (73% of professors are

---

37 *Attracting Young Scientists – Strategies Against Brain Drain.* Conference. Proceedings. Oct, 2002, Sofia, Bulgaria. MoES, DAAD, HRK, Sofia, 2002.

38 K. Vesselinov, "Brain Drain – Opportunities for Narrowing the Scope of this Phenomenon in Bulgaria". In: *Attracting Young Scientists – Strategies Against Brain Drain,* op.cit., pp. 93-98.

over 60 years old, 47% are over 65); this is closely related to the need to analyse the support mechanisms for PhD students, and a critical review of promotion and career structures for young scientists;

- How to improve the legislation in order to make S&T flexible and open;

- How to improve national networks- *including BAS and universities* – addressing also the differences between salaries, and reviewing the number of research centres;

- How to improve infrastructure, including access to scientific periodicals;

- How to improve the evaluation/accreditation system, which clearly needs to include international peer-reviews.

Last but not least – public awareness of S&T should be improved, for example through popularisation programmes, media campaigns, science fairs, etc. The government should take a leading role in this, to ensure that the public understands the importance of science, research and technology on the road to a prosperous, knowledge-based Bulgarian society.

A deep analysis is needed as a preliminary exercise in order to overcome the present fragmentation. Although it is difficult, the question about the *size* of the system of higher education and research should be addressed. This is closely related to the problem of funding all research fields in the same way – *there will never be enough funds for that*, and priorities need to be considered and agreed.

Recommendations

The OECD team does not wish to advocate specific changes but stresses the following threats:

- If legislation will not be improved and the science policy made definite;

- If S&T funding will not be increased and competitiveness (quality requirements) are not introduced into the funding systems;

- If strategies towards a knowledge-based society – supporting academia-industry links and fostering innovation – will not be formulated, then Bulgaria's road to a knowledge-based society will be long, and the danger of loss of competence and educated human capital will be great.

A summary of the OECD team's recommendations is found in Chapter 5.

Chapter 4

BUILDING THE RESEARCH SYSTEM FOR AN INNOVATION SOCIETY: ALIGNING STRONG INSTITUTIONS AND QUALITY RESEARCHERS.

This chapter analyses the challenges that Bulgaria must address in order to transform itself into a knowledge-based society to achieve long term economic competitiveness. The components of an innovation system needed to underpin this transformation are discussed and appropriate best practice models are noted.

The innovation society

The stages of modern economic development can be broadly classified according to the source of wealth creation. In its most basic form, it is determined by the availability of factors of *production*. Therefore a society that is relatively well endowed with labour and land may concentrate on primary goods production, where its wealth level will be determined by the extent to which it is internationally competitive and has ready access to export markets free of trade restrictions.

The next stage of development is driven by *investment*. This occurs most notably through foreign direct investment, where domestic labour and natural resources are combined with imported capital.

In current conditions of globalisation, the next stage – *innovation, is a key indicator of success.* Here, investment in human capital is fundamental to the creation and transfer of new knowledge which underlies the development of new technologies.

In simple terms, the path of development sees the transition of the export base from one dominated by *products* relying on basic unskilled labour to ones with a significant *human capital* concentration. It is also likely to be a transition from exporting potentially high quality labour ("brain drain") to one where technology migrates abroad. This latter transition can be of mixed benefit. If the migration of technology is largely in the form of un-exploited intellectual property, we have a variation on old-style "capital flight". In this case domestic investment in knowledge creation is dissipated, thus undermining the capacity to achieve a sustainable innovation system.

The depth of the *education system* at all levels plays a critical, indeed a determining role in achieving an innovation society. Research, teaching and learning create the knowledge base on which societal and cultural evolution occurs on the one hand and economic development on the other. More fundamentally, education inculcates those aspects of personal growth that are essential for binding economic and social development together.

This Chapter focuses on economic development. Bulgaria's long-term competitiveness in an expanding European trading area requires that it must aspire to becoming an innovation society. This in turn will require the evolution of an integrated innovation system, brought about by critical, informed choices made through Bulgaria's political system. Underlying a successful innovation system is a robust research system. A research system needs strong institutions and an environment that fosters the development of quality researchers. One can argue that robustness in a research system comes down to the challenge of aligning strong institutions and quality researchers.

In advancing these arguments one should place them in the context of evolving best practice and experience, and relate them to the current state of development in Bulgaria as was gleaned from the team's reading as well as first-hand site visits to research institutes and universities and extensive discussions with Ministry representatives.

The innovation system

The dimensions of the innovation system are summarised in Figure 4.1, which shows the confluence of people and knowledge with infrastructure.

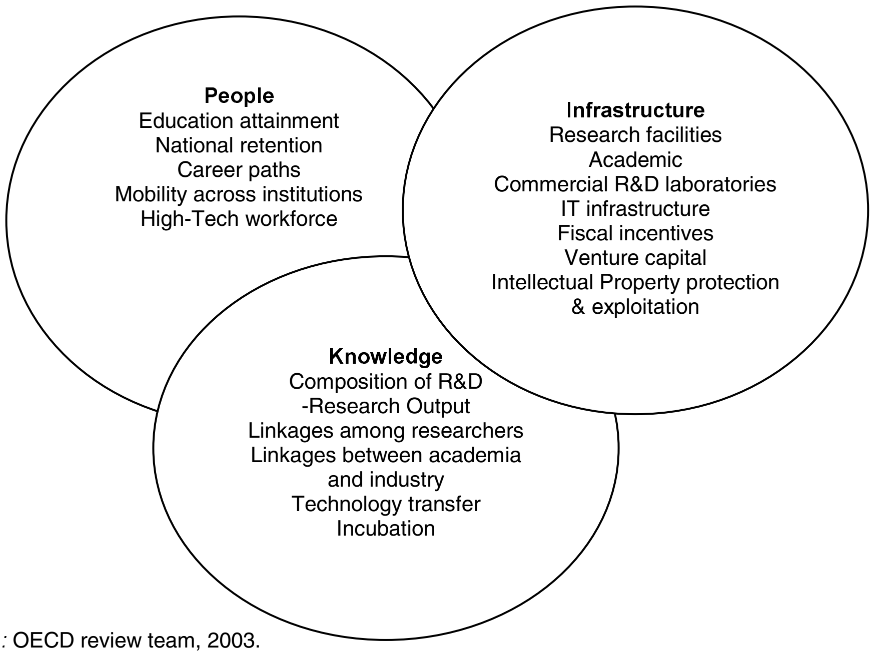
People. Balance in education and training attainment will be critical to commercial exploitation. The system must ensure an adequate flow of high-tech workers, just as it must train research scientists. "National retention" refers to a country's ability to retain people it has trained in areas that are internationally sought after. In the case of scientists, it is reasonable to expect international mobility as part of career development. The critical issues centre on the new flow of these assets into a country.

An innovation system must develop career paths for scientists that are attractive relative to other professions. Uncertainty in scientific career paths is a common characteristic of immaturity in an innovation system. When this uncertainty is combined with a relatively low salary structure, and when such high quality personnel will have greater choice of career, the consequence can be a drift to less risky professions and/or emigration to more developed systems.

Knowledge. The knowledge base comprises the composition of research and development in a country, the direct research outputs, the systems for technology transfer and incubation, and the linkages and consortia among academics.

Infrastructure. The infrastructure comprises the physical space, the information technology, the policy framework which provides incentives for this research, and the funding that facilitate exploitation of research findings.

Figure 4.1. **The dimensions of the innovation system**



Source: OECD review team, 2003.

The research system: principles and issues

Principles

Traditional distinctions between basic, applied and strategic research are becoming less and less relevant. These distinctions usually classified research along two lines: whether there was a quest for *fundamental* understanding, or whether considerations of *use* motivated the research project. Viewed from this perspective, one could argue that it was never the science but the science and technology *policy* that dictated structures which separated basic from applied.

Crow (2001) has argued that science and technology policy in the United States during the second half of the 20th century can be classified into three phases: military, commercial and comprehensive. In the first two of these phases (perhaps best seen as overlapping) we can distinguish both a narrow focus and a clear functional objective, whereas the third phase is more generally directed at sustained prosperity.

In the United States, the development of a publicly funded science and technology system saw the simultaneous evolution during the 1940s and 1950s of mechanisms for funding research in universities (the National Science Foundation, for example) and the creation of government controlled national laboratories (Los Alamos perhaps being the most famous). Considerations of national security were clearly behind the creation of these latter institutions.

In the comprehensive phase of science and technology policy, a research system built on strong lines of demarcation between basic and applied research is likely to be both inappropriate and wasteful. As noted in the Commission for Economic Development's analysis of the position of America's basic research, national laboratories – once the hotbed of scientific advance – now lag behind the research performance of the leading universities.

The evolution of science, and in particular the evolution of science and technology *policy*, means that institutions that conduct research must evolve. So also must the mechanisms for funding these institutions. They must do so in a way that fosters a critical mass of pure basic research capable of addressing strategic and functional missions. The strength and depth of the research system will depend on the extent to which these missions are aligned both within and across categories.

Broad strategic missions take into account the national imperative to achieve an innovation society on one end of the spectrum, and the researcher's personal desire to establish a reputation on the other. Governments, too, have functional missions with regard to science (for instance in the need to conduct research and set standards in relation to food safety and health promotion). One can, of course, also identify strategic and functional objectives that motivate industrial research and development. Efficient alignment of all these missions will increase the effectiveness of any given level of expenditure, and open up avenues for additional sources of revenue to fund research.

The fundamental building blocks of a research system are strong research institutions and quality researchers. In discussing an approach to building strong institutions and researchers, the review team will argue for the *importance of subsidiarity*[39] *as a core value. An alignment of missions without this principle is most probably illusory and unlikely to be sustainable.*

Sustainability will further depend on the research support system. Three aspects are critical:

- Open mobility, recognising both the emigration and immigration of researchers;
- A national framework for the protection and exploitation of intellectual property;
- A systematic approach to meeting the indirect or overhead costs associated with research projects.

Issues

Four broad issues need to be addressed as part of the design of an effective research system.

- The public funding levels (from debt or taxes) that society is willing to devote to research programmes;
- The extent of targeting of resources that the system is both willing to tolerate and require;
- The extent to which programme and project funding is allocated according to excellence criteria;
- The extent to which capital flows to where it can best be used.

These issues are taken up in detail in the sections below.

Public funding

Chapter 3 noted the relatively low productivity of Bulgarian science. In the cross section of countries in Table 3.4 – which constructs an index of researchers per 1 000 in the labour force and an index of scientific publications

39 Here, meaning devolution to the appropriate level/institution, based on peer review etc.

– productivity in scientific publication was roughly a quarter of the entire set and came only within 50% of the next least productive country.

Earlier reference was made to funding levels – GERD accounting for less than 0.5% of GDP. An examination of the allocation of MES funding will be shown (latest figures made available by the Ministry during the site visit). The budget division to higher education follows a broad allocation characteristic of the former Soviet approach involving a division between the research and teaching institutions. In the current year 48% of the Ministry of Education budget was allocated to the State Universities, 13% to the Bulgarian Academy of Sciences and less than 1% to the Science Budget.

The allocation to the publicly funded universities accounted for 60% of their total income with the remainder coming from tuition fees (25%) and projects and commercial revenue (15%). State university budgets have four broad elements. The first element is a grant per student. This grant is determined by the Higher Education Act and varies according to disciplinary area. In the current year grants vary as follows:

- Economics student BGN 600
- Medical student BGN 4 000
- Natural sciences student BGN 1 100
- Technology student BGN 1 500

Fees are set at approximately 10-15% of the student grant level.

The second element of the university budget is a student support grant. This includes an equal grant for food and accommodation, and a variable stipend. While the global fund for stipends is determined by the Ministry and the Council of Ministers sets bounds for the level of stipend, each institution is free to set – in co-operation with Student Councils – the exact grant level and the criteria of award. Such criteria can include academic performance and social status. About 15% of students get a stipend.

Capital expenditure forms the third element of the university budget. No explicit criteria exist to allocate such funding. In particular, there is no investment programme involving open competition with explicit allocation criteria. In such circumstances it is reasonable to conclude that “lobbying expertise” will be the determining factor in the allocation of capital funds.

The final element of the university budget is set by law at 10% and is to be allocated to scientific work. Much of this can be devoted to the cost of publishing textbooks.

The state budget allocation to the Bulgarian Academy of Sciences appears to be devoted almost entirely to meeting salary and standard operational costs. Project funding relies on winning funds from the relatively small Science Budget – in which Academy institutes have been particularly successful – and from non-national sources.

The significant point here is that *discretionary funding to research projects forms a very small percentage of the Ministry's budget allocation*. Considering that much of the science allocation from the university's budget will find its way to subsidising the production of textbooks, it is unlikely that more than 2% of the MES's budget is available for project and programme funding.

Targeting

Decision No. 15 of the Council of Ministers (6 January 2003) approved five national scientific programmes for research and technological development. These are in the areas of: genomics, information society, nanotechnologies and new materials, "Bulgarian Society – part of Europe" and cosmic research. While the MES has responsibility for co-ordinating these programmes, the funding contribution relies on co-operation from other ministries; in particular, it relies on the willingness of other Ministers to designate a portion of their budget for activities that have some functional association with their department. While the implementation of this decision was at an early stage during the visit of the OECD team, and while there was evidence of the willingness of other ministries to be supportive with advice and even funding in some limited circumstances, *the team finds it hard to accept that this formulation will generate scientific programmes across the priority areas, to the extent that they will have a focus of resources sufficient to be internationally competitive.*

The Science Budget – with an allocation of *circa* BGN 2.5 million in 2003 – is allocated according to competitive criteria but following the priorities set in the budget determination. Allocations have been made for project grants, schemes to foster young scientists and scientific publications. In the past there have been some very limited allocations for equipment.

As noted previously, institutes of the Bulgarian Academy of Sciences have enjoyed significant success in competitions for project funding under the Science Budget. This has given rise to a certain amount of disquiet among those who see this as a mechanism to foster research in the universities. Against this background, it is significant to see that the funding has been allocated according to *excellence* criteria.

Funding from the Science Budget is clearly of value to individuals in their particular research missions. There is little evidence, however, of its bringing about noticeable *institutional* reform.[40] In this respect, the Bulgarian Academy of Sciences has significant questions to answer.

The team was impressed by the commitment of researchers that it met at Academy institutes. However, it was struck by the proliferation of poor facilities. The team understands that the Academy has considerable autonomy in the sub-allocation of its budget. In particular it has the authority to re-allocate funds across institutes and to rationalise in terms of the spread and number of institutes and the scale of employment. The Academy, however, appears to have chosen not to concentrate its resources in a small set of centres of excellence, and instead has essentially maintained its existing structures.

There is no evidence of a concerted policy of targeting resources with the objective of achieving critical mass. The team's visit to AgrobioTechpark illustrated that it was possible to establish and grow a significant modern research facility in Bulgaria. However, this was a clear exception with other facilities significantly lacking the type of infrastructure necessary for achieving international status.

It must emphasised that the team's comments here are directed at infrastructure and institutional development issues. There is no doubt that Bulgaria, in common with other countries, has extraordinary scientists who function even in the most inhospitable circumstances. However, this is not a recipe for building a robust research system capable of growing a sustainable innovation system.

Quality

The issue of quality has been addressed in Chapter 3. Here, the team wishes to comment on some of the perception of quality matters as encountered during the site visits.

---

[40] Along similar lines, a Competitive Teaching and Management System (CTMS) – funded under the Government of Bulgaria/World Bank Education Modernisation Project – which solicits competitive grant proposals from the academic community, reports that only a very small number of proposals (approx. 2%) relate to institutional management reform.

There is a strong adherence to the principles of peer review among Bulgarian scientists as the basis for determining what gets published. This is an attitude that also prevails when it comes to allocations under the small science budget. However – and this is an attitude that is frequently encountered in evolving research systems – there is deep suspicion about basing core institutional funding decisions on such criteria. Scientists believe that existing institutions ought to be given adequate funding by virtue of their existence. There was resistance to the notion of letting market forces determine institutional allocations.

These attitudes are to be expected and indeed are reasonable when viewed from the perspective of individual researchers in particular institutions. They do not suggest an antipathy towards peer-based allocations but a concern for preserving the institutional *status quo*.

Capital allocations

In a vibrant scientific research community, capital investments – both in infrastructure and equipment – follow the best researchers, as identified through competitive, quality-based allocations. There is little evidence of such investment to date and there is no framework for achieving this outcome. Poor funding levels explain the under-investment. It will be vital to put an allocation framework in place before embarking on any significant investment programme.

The mechanism for supporting the indirect or overhead costs of research can provide a basis for investment decisions. Examples of overhead recovery systems – *e.g.*, in the United States, Ireland and other countries – are dealt with later in this chapter.

The research system: strong institutions

Bulgarian concerns with its science base and research system mirror those of other countries. A recent comparative study of 12 European countries[41] noted the increasing emphasis on the promotion of economic growth, innovation and technology transfer. It also noted a convergence in the approach taken to achieving these ends. Five major common trends were identified:

---

41 J. Senker et al., "European Comparison of Public Research Systems." University of Sussex TSER Project SOE1. Sussex: 1999, pp. 1 and 50; the case studies are useful.

- Convergence between the roles of non-university research organisations and universities;

- Increasing co-ordination of public sector research policy;

- Convergence of management practices;

- Growing emphasis on industrial relevance;

- Concentration on fashionable areas of high technology, often to the neglect of local needs.

However, the study's national "case" studies showed that "political history has had a strong effect on the development of public research systems in each country, and current practices in the distribution of responsibilities for public sector research (between the regions and the state, or between Ministries) also determine the way in which the system in each country evolves, and its room for manoeuvre." The particular history of Bulgaria has left it with two parallel systems of research institutes concentrating on research, and universities with a teaching mission. The research institutes can be further subdivided between those coming under the aegis of the Bulgarian Academy of Sciences and the Agrarian Institutes. There is now a clear need to link all the elements of the existing research system into a whole. Whether that will involve restructuring, and to what extent, is to be decided by Bulgarian policy-makers. This is particularly so in light of the international convergence trends noted above, and the desire to create an innovation society.

The OECD team understands that there is a policy desire to re-establish the universities as research centres. This would require *fundamental re-organisation of the universities and research centres, including the Bulgarian Academy of Sciences and Agrarian Institutes,* to unlock additional funding such institutional reform would involve making hard policy choices which would result in losers as well as winners. Other countries have achieved change in association with an expansion of funding, essentially requiring reform as a pre-requisite for additional funding. The team understands that there is no real likelihood of growth in the Bulgarian Science Budget. Therefore, necessary funding will need to come from consolidation and targeting of budgets.

It should be noted, however, that change in this environment will require the sort of consistency and long-term political commitment to research that has not been evident to date in Bulgaria. This point is developed below. First it is necessary to look at the international climate discussed above and to identify the characteristics of a system that develops and supports strong research institutions.

Pitfalls in maintaining separate teaching and research institutions

It was not unique to the Soviet system to separate teaching and research into distinct institutions. The establishment of stand-alone research institutes has been justified for reasons of security – particularly when science budgets were driven by military needs – and by concerns over governance. This latter concern is often implicit in statements that question the capacity to carry through on long-term projects in universities.

Over time, the very attributes that distinguish specialised laboratories – stability and consistency – can be their undoing. A vibrant scientific institution must have the capacity to regenerate itself. Having access to the next generation of scientists and participating in their training and development accomplish this. In addition, the institutions must also maintain a competitive edge, so that there is always a danger that funding will be limited where good science does not emerge.

Research institutions that stand apart from universities often go through a life-cycle where the age-profile gets older. This is more likely the case where other options exist in research universities and abroad.

In some countries such as the United States these institutions obtain funding from the departments of government which have responsibility for their functional mission. The laboratories run by the Department of Energy in the United States are a case in point. This can lead in some cases to inadequate mechanisms for determining merit, leading the US Council for Economic Development to conclude "that if the national labs are to continue to play a productive role in basic research, that role must be justified on the basis of strong missions, outside peer-reviewed determinations of scientific merit and efficient management and oversight structures."

The future role of universities

Universities are dynamic institutions. Over the centuries they have survived because of their capacity to adapt and to be relevant to the age. The second half of the 20th century has been one of unprecedented change, according to Skilbeck (2001, p. 23), with "waves of critical self analysis and tireless efforts at renewal affecting institutions everywhere". The process of adaptation involves a creative tension which in many cases will mirror tensions that need to be worked out by society in general. Etzkowitz et al. (2000, p. 326) offer an interesting perspective on this adaptation:

> "The contemporary university is an amalgam of teaching and research, applied and basic, entrepreneurial and scholastic interests. These elements exist in a creative tension that periodically come into conflict. Conflict typically results in compromise and normative change in which different and even seemingly opposed ideological elements such as entrepreneurship and the extension of knowledge are reconciled."

The authors then conclude that a process of transformation is underway towards an entrepreneurial university, and that the role of this institution will be affected by two major trends, "the shift to ever greater dependence of the economy on knowledge production" and "the attempt to identify and guide future trends in knowledge production and their implications for society". In other words, universities act as a central institutional component of national technology foresight.

Finland is often cited as an example of an innovation society. It is therefore instructive to reflect on the process of structural developments that have occurred in the Finnish university system over the past two decades. In operational and structural terms, these developments have included (Husso et al. 2000, p. 51):

- The launch of the Centre of Excellence system;
- The creation of the graduate school system;
- The advancement of professional careers through the post-doctoral researcher system.

During the 1990s Finnish universities experienced a drop in core funding. Yet "performance statistics indicate a huge increase in the operation of universities: the number of Masters degrees went up by 35% from 1991 to 1998 and the number of doctorates by 88%. During the same period the number of new students rose by 13% and the total number of students by 27%" (Husso et al 2000. p. 61). This is an important example, because it demonstrates the capacity of a system to improve outcomes through institutional change.

Institutional funding for research in the universities

Most countries operate a two-track system of funding research in universities. This involves some form of core infrastructural funding to institutions alongside schemes for allocating grant aid to projects to meet the direct costs on these programmes. Project funding will be considered in the next section. Here, the focus will be on the institutional funding component.

Guena *et al.* (1999) identify three main approaches to the allocation of institutional research funding: performance-based, formula-based and negotiation-based. The first approach involves some form of research evaluation, be it linked to peer review as in the United Kingdom, or performance indicators as in Australia. In formula allocation, research funding is generally included with the overall teaching and learning grant to institutions and is determined by size factors such as student numbers. Variations of this approach are used in Germany, Italy and Scandinavia. The negotiation approach can involve a very broad set of considerations which may not include research evaluation, as in the case of Austria.

The Guena *et al.* study reviewed resource allocation systems for research across Europe, North America and the Asia-Pacific countries. While performance-based allocation mechanisms were relatively rare in the 1990s, they identified an almost universal trend towards using such an approach.

The move towards performance-based allocations is indicative of an approach that sees the research system as central to the knowledge-based economy which drives an innovation society. However, the common approach can give rise to a variety of models for aligning research organisation and performance. Benner and Sandstrom (2000) offer a three-way classification: the interventionist model, the autonomy model and the trans-institutional model. The first of these involves strong direction by a central agency whose focus is the knowledge needs of industry, while the autonomy model is best exemplified by traditional research councils which "reinforce collegial reputational control" and support networks that "are primarily academic" (p. 300).

The trans-institutional model is a hybrid of the other two and underpins the "triple helix" of academic-industry-government relationships. Its success will depend on the extent to which it generates "norms for knowledge production which evolve within a wide socio-economic network, involving academic and industrial interests in the regulation of research programmes" (p. 300).

Co-ordination may be better achieved in some countries than in others. In Finland, the Prime Minister chairs a Cabinet sub-committee with a specific remit for co-ordinating science policy. In Ireland, there has been a significant injection of public funding into research, with at least three government departments – Education and Science; Enterprise, Trade and Employment; and Health – having lead roles in the determination of some parts of this budget. Concerns with lack of co-ordination induced the Irish government to establish a Commission on a Framework for an Overarching National Policy for Research & Technological Development. A central recommendation of this Commission, which has not yet been taken up by the government, was the establishment of a Science and Technology Office headed by a Chief Scientific Advisor to the government.

Mechanisms for inducing institutions to develop strategic focus and co-operate

Ireland also provides an example of using a concerted policy to tie increased funding to institution building. This scheme, the Programme for Research in Third Level Institutions (PRTLI), was launched in 1998 and provides "integrated financial support for institutional research strategies, programmes and infrastructure" (Thornhill 2002). It operates through a competitive process where calls for submissions are issued to all publicly funded third level institutions. Each institution is entitled to submit a single integrated application that must include a statement on the institution's research strategy and a proposal which identifies institutional priorities. Evaluation is conducted by an international panel of experts who score applications on three broad criteria: strategic planning [including inter-institutional collaboration (40%)], research quality (35%), and the contribution of the research programme to improving the quality of teaching (25%).

The PRTLI initiative was motivated by a number of considerations (Thornhill, 2002):

- The need for prioritisation, based on institutional strengths, in the face of resource constraints;
- The need to build collaborative inter-institutional programmes to overcome problems of scale and rapidly rising research costs;
- The need to develop a number of centres of critical mass;
- The importance of encouraging trans-disciplinary and interdisciplinary basic research;

- The desirability of assisting research strategies in smaller research institutions through alliances and collaborative arrangements with larger institutions;

- The benefit of integrated funding packages providing support for personnel, infrastructure and recurrent programme costs.

To date the programme “has created new capacity and critical mass and has provided funding for the recruitment of over 700 new researchers. It is beginning to have a transforming effect on research in the third level system” (Thornhill, 2002), with unprecedented institutional structures such as the Dublin Molecular Medicine Centre emerging as a joint initiative between two of the largest universities.

The significant aspect of this structure is that it solves the “principal-agent” problem that is inherent in institutional funding in an efficient manner. This agency problem arises because the principal government wishes to fund an outcome – research which will ultimately support broad societal and economic objectives, particularly those contributing to wealth creation through industrial application – whose providers and researchers, differ in aptitude and whose effort and effectiveness are influenced by institutional considerations. The PRTLI solution is to use the principle of subsidiarity[42] in identifying talent and appropriate structures, and to reward collaboration (10 percentage points in the scoring were reserved for evidence of inter-institutional collaboration).

Transition challenges for the Bulgarian system

The team found significant examples of rigidity in the system. Much of this may be due to misunderstandings with respect to degrees of freedom of movement. Ministry officials were anxious to stress the autonomy enjoyed by research institutes with respect to their use of budgets. On the other hand, the team heard of difficulties with use of state assets for commercial purposes. Many countries have found that the direct return of an agreed proportion of “profits” from commercialisation to universities or research institutes can form an important additional source of revenue. This can then be used to support new research activity. Careful monitoring and auditing are essential to ensure that the returns on public investment are in fact channelled into further research to the broader social and economic well-being of the country as a whole.

---

42 See “subsidiarity”, footnote 39.

There are some clear examples of success from recent policy, such as the AgrobioTechpark. Here the essential characteristics centre on a strategic approach to research development and management. The budget is drawn from the Education and Agriculture ministries (for example, the Ministry of Agriculture funded laboratory reconstruction), private industrial support and international collaboration. The AgrobioTechpark structure is based on inter-institutional collaboration, and its training is based on a philosophy where each member of a research group is skilled in a broad set of techniques.

Many countries use additional targeted, or “earmarked”, funding as a means of unlocking historic rigidities. This approach is not always wise, especially if funding is not directly linked to reform. Bulgaria, however, is likely to have to rely on re-deploying existing funding. In addition to the necessary political will, this will require a strategy that recognises the inevitability of change. Here a variant of the Irish PRTLI scheme could be used to align the actions of research performers with each other and with the broad policy objectives of the funders. Success will require the establishment of a multi-annual fund, possibly through budget consolidation, and the creation of a co-ordination mechanism most likely centred in the office of the President or Prime Minister, rather than in a line ministry as envisaged in Decision No 15 of the Council of Ministers (January 2003).

The research system: quality researchers

In the autonomous research system discussed above, research councils determine organisational structures and network formation. Such councils continue to have a role within a trans-institutional system in that they provide a mechanism for bottom-up identification of scientific priorities.

The previous section discussed a framework aimed at achieving national and institutional missions. This framework will not be sustainable unless such missions are aligned with the capacity of researchers within institutions. There are two aspects to this. An institution may seek to specialise in nanotechnology and apply for institutional funding to support such a mission. One indicator of the institution’s potential would be the capacity of its researchers to produce useful work in areas allied to nanotechnology, and evidence of a desire by nanotechnology researchers to re-locate to this institution. However, these activities will themselves require funding assistance. Such funding decisions ought to be based on the very narrow missions characteristic of *peer-review* rather than the broader strategic considerations involved in deciding allocations for institutional funding.

Over time, research councils act as agents of continuing change and development. Given the narrow focus on peer-review, funding will flow in support of programmes and projects *only when* quality standards are maintained.

An autonomous system relying on research councils alone will not be powerful enough to align research programmes with national self-interest to gather the political support needed to ensure it receives priority in the budget. Nor will it be effective enough to "incentivise" institutional focus and collaboration. In short, the tasks of supporting research institutions and individuals need to be the task of *separate bodies whose activities are co-ordinated in a national mechanism.*

Research councils will need to prioritise their spending. However, in principle they should be prepared to support individual researchers regardless of area of expertise. The councils ought to be responsible for: funding doctoral students; setting up and monitoring schemes for career development and an integrated research career structure; collecting data on the employment and salary of science graduates; and promoting the place of science in society.

The OECD team believes that the current support structure for doctoral students in Bulgaria is too disjointed and sees a need to consolidate activity into a small set of research councils. For example, there could be two broad councils: one serving Science and Technology, and the other serving Humanities and Social Sciences.

The consolidation of activities into the work of broadly based research councils should also help Bulgaria's efforts to reduce brain drain.

The research system: an open market in researchers

A recent article in *Time* magazine ("How to plug Europe's brain drain", 19 January 2004) claimed that 400 000 European-born science graduates live in the United States. It would appear that the entire continent of Europe faces a challenge in retaining its researchers. In this respect, Europe is caught between a West-moving high-skill labour force and an East-migration of basic production to low-cost areas in Asia.

Bulgaria's history of brain drain must be viewed in this larger context. Making Bulgaria an attractive location in which to conduct research involves financial stability for the researcher and career flexibility. Too much focus on large salaries ignores the fact that researchers will ultimately be driven by a desire to get the job done. For this to happen, career progression must be attractive and timely, and institutions need to reform so that change can occur before it is too late. The structures now in place in the Bulgarian Academy of Sciences, and weak integration with the universities, do not make Bulgaria an attractive place in which to build a research career.

Globalisation is as much a feature of the scientific community as it is of transactions in goods and services. Critical mass requires mobility and the sharing of facilities. Bulgaria's successful emergence from the communist era, and its pre-accession status in the EU, make it easier and more attractive for such integration to take place.

The team's experience in visiting institutions in Bulgaria suggests that there is some distance to go in *building trust* between the elements of the domestic scientific system. In fact, many researchers find it easier to co-operate with colleagues abroad; but this type of participation in international programmes is normally small-scale, and unlikely to induce the system-wide effects that would ultimately see Bulgarian laboratories become lead partners in major international projects.

International co-operation is vital for the development of the Bulgarian research system. Again, it is important to note the role being played *by industry* in research programmes. The co-ordinated model has replaced the old "sequential" model of basic research, ultimately leading to commercial exploitation after a lag of up to a half a century. In this model, concerns for commercial exploitation and curiosity-driven enquiry are present at all stages.

In this environment, a national framework for the *protection and exploitation of intellectual property* is essential. If this is missing, the historic problem of brain drain will be compounded by the flight of intellectual capital. Innovative policy interventions will be undermined if they are not accompanied by a framework that shares the characteristics of the robust intellectual property protection mechanisms now in place in most innovation systems.

The national framework will need to address issues relating to: the ownership of intellectual property, the duty to report discoveries, and the duty to exploit patentable discoveries. In addition there will need to be mechanisms for sharing the commercial income with inventors, and for regulating the transfer or sale of the ownership of intellectual property.

The main conclusions of this section are that, in order for Bulgaria not to be at a disadvantage in the 21st century's "open market" in researchers, the various components of its research system must collaborate, create incentives, and protect (and wisely use) its intellectual property.

The research system: overhead costs and capital investment

Capital investment must be linked to the researchers: *the researchers* must be the "drivers" of the investment. A suitable mechanism needs to be devised to accomplish this – a mechanism that allows for strategic investments to be funded from the successes achieved by leading scientists. A useful comparison of international systems exists in Ireland (2003). The Irish have chosen to follow a version of the American model for overhead costs.

For example, one of the central factors in the success of the research system in the United States is the mechanism by which funds to support the development and sustainability of institutions follow the best scientists. In the first half of the 20th century, the now-famous American research universities were far closer in "mission" to the modern liberal arts colleges. The Cold War – and, it has to said, a concern for the health of citizens – ushered in a transformation of the relationship between the private universities and the State.

Another example is the increased awareness that major diseases could be tackled through the application of science. Heart disease was the first target; but most famous has been the "War on Cancer". In relation to this, James Watson (2000) is informative on the conflict often emerging between advanced treatment and basic research.

Institutions were established to channel funds into research – the National Institutes of Health and the National Science Foundation, for example. In addition, the military also established research divisions such as the Office of Naval Research. These institutions grappled early on with the problem of funding the institutions. What emerged was a policy that has proven robust since its creation in the 1950s. It involves *paying to the institution that houses the scholar who wins funding* an additional percentage to cover overhead costs. [This system and its proposed application in Ireland are described in Ireland (2003), see References].

The mechanism for calculating overhead costs allows for variation across institutions and is able, in particular, to take account of variation in utility costs and in weather-determined utility bills. The system is not without its problems. These mainly relate to the excessive effort that is devoted to negotiation on accountancy matters.

At present (2004) the average overhead rate in the US system is 50%.

Two elements of the overhead calculation are of particular significance: (1) allowance for depreciation, and (2) allowance for the interest charges on borrowings. This latter was introduced in the early 1980s and is having a significant impact on strategic investment in research facilities. In essence what this means is that institutions focus on attracting *quality researchers*, knowing that they can win research funding. At the same time the institutions borrow money to build research facilities that will attract these researchers. In due course, the researchers in turn will pay for these buildings through the overhead costs (depreciation and interest component) that will be attached to their research grants.

Policy priorities of the Bulgarian Ministry for Education & Science

The July 2002 position paper

The OECD review team has drawn on several sources to identify current policy priorities. Chief among these is the 15 July 2002 Position Paper prepared by the Ministry of Education and Science and the Ministry of Economics, entitled *Towards a Science, Technology, and Innovation Policy for Bulgaria.* The team is aware that this Position Paper, for a variety of reasons, was not formally adopted, but it still contains important and valuable recommendations (Actions) that should not be lost, and that have guided the OECD team's own recommendations set out in Chapter 5. The main ones are listed here:

- Peer reviews by mixed teams of Bulgarian and foreign scientists;

- A shift from input financing (*i.e.*, the direct financing of scientific and educational institutions by the government) to output financing (*i.e.*, institutes or faculties are paid for specific, defined achievements/outputs. (Both peer reviews and output financing are covered in Action 1);

- The establishment of two main channels of funding, through the Bulgarian Science Foundation (Action 2) and the Bulgarian Technology Foundation (Action 3). In the opinion of the OECD review team, the Science Foundation could encompass a fund for additional professors and senior scientists (Action 4), and the Technology Foundation could encompass the establishment of Advisory Boards (Action 6).

List of Programmes and Policies of the Ministry of Education and Science for 2004

This list, produced by the MES in November 2003, contains a number of policy priorities that pertain to Bulgarian science, technology and innovation. In the view of the OECD team, a number of these remain highly relevant, in particular the following:

Policy 2: Providing scientific services to the general public and to the State. Developing scientific research and innovation to build a knowledge-based society. Under this policy, a programme (action) is proposed that would "Build a knowledge-based society; create a national innovations system, with a modern infrastructure and competence centres to actualise and develop the dialogue between Science and Society, which is fundamental for the achievement of social and economic stability of the country and for the integration of national scientific potential in Europe and the world."

Policy 3: Creation and development of a scientific domain as part of the European and global scientific domain. Under this policy, several programmes (actions) are proposed to support Bulgaria's participation in European and trans-European scientific programmes to support the process of integration; creation of a network of multi-national centres of knowledge to help minimise economic differences both within and outside Bulgaria; and strategic research to help build a stable and sustainable region.

Clearly, the priorities and policy directions listed above are broadly in line with the suggestions and recommendations made in this review, in particular the alignment with the European Research Area (ERA, see Chapter 3) and the Lisbon/Bologna agendas. Less clear, from the text, is how the MES would go about carrying out programmes as vaguely described as "building a knowledge-based society", or to what extent "multi-national centres of knowledge" can help minimise the economic differences between Bulgaria and other parts of Europe. It is hoped that these intentions will be worked out in greater detail, with implementation plans, realistic costings, and indicators related to the desired outcomes.

Priorities of the Bulgarian Academy of Sciences until 2005

The Bulgarian Academy of Sciences has formulated its functional priorities for the period 2001-2005, within the framework of three basic aims (policies):

- Scientific aid and counselling of the state and society;
- Development and integration of Bulgaria's research potential and infrastructure in the European Research Area) (ERA);
- Supporting and sustaining national values and identity.

The programmes (10 in total) along these policy lines specify activities in greater detail.

The Bulgarian Academy of Sciences is well aware of the major problems it faces, primarily the need for restructuring its existing campuses, issues of ageing and brain drain, etc. These problems, while serious, can and should be overcome in an atmosphere of co-operation and trust within the academic and governmental community. Striving for excellence in research and for close co-operation with universities, BAS will continue to play a strong part in the high international reputation and forward-looking spirit of Bulgaria's S&T system.

Chapter 5
CONCLUSIONS AND RECOMMENDATIONS

> This chapter provides general conclusions and recommendations while summarising the basic structural impediments to policymaking.

Summary

The main message of this OECD review is that robustness in any research system – including Bulgaria’s research system – comes down to the challenge of aligning strong institutions with high-quality researchers. Much of Chapters 3 and 4 has been devoted to setting out the argument to support that message.

However, there are some basic structural impediments to any attempt towards policy-making in the sector; these derive, in the main, from the pattern of budgeting and from the general normative (legal) framework in Bulgaria. Budgeting, for example, is expenditure-based, and the way institutions are organised makes it nearly impossible for them to take any *policy* responsibility for budget decisions. Science and Technology policy – or *any* educational policy – will not have any real force unless institutions change their structures to allow a much closer link between the setting of policy and pro-active budgetary control.

The pattern of budgeting, at present, is based on expense-coverage and on “historical” principles that preclude rational and accountable policy-making. An alternative to this pattern is a *project-based and effectiveness-oriented* pattern of funding. This approach has been successfully piloted by the Ministry of the Environment in Bulgaria, and might provide a useful model for the MES. The key point is that the new approach should target *all* institutions in the field of science and education, not just in terms of grant distribution but in terms of effectiveness. Present funding supports the *status quo*; it provides no incentives for development. Development should be the *conditio sine qua non* for any institution's continued existence: any half-way measure will be futile. Funding for BAS institutes could be made conditional upon evidence of innovation and development – for example, over a 3-5 year period. Universities could be made accountable for achieving specific goals if they are to be eligible for funding. It is *accountability* that is missing in the present funding arrangements, and unless the notion of accountability is introduced into the way budgets are prepared, there will be no real change in educational policy in Bulgaria, S&T policy included.

The State Administration Act and the State (Public) Servant Act at present do not provide any basis or tools for innovative policy-making. They, again, are designed only to define and support (administer) the *status quo.* If the MES wishes to move towards project-based and effectiveness-oriented policy-making, such a move needs to be supported by new legislation. This obviously applies not only to S&T; it is a fundamental premise for reform in the education and research sector as a whole.

Public institutions in Bulgaria need a new design to make them truly public rather than "State-ic". They need to be open, transparent, accountable and effective in serving the public. Likewise, the administration of S&T needs to become less governmental and more open to public scrutiny.[43]

The OECD team is aware that these seemingly simple points involve a great deal of political will, commitment and effort. There is much at stake. The traditional strengths of science, research and innovation in Bulgaria provide a firm foundation; but the "architecture" – legal, institutional, administrative – will need to change to meet the requirements of an open, 21st century democracy.

The team's general recommendations are as follows:

- Carry out the changes set out in the July 2002 Position Paper – especially important are clear strategy and horizontal links among the various Ministries in order to create a well-functioning State system. *The OECD found strong support for these changes among the scientific and research communities;*

- Increase systematically the public funding of research, together with extending the part played by competitive funding – this is in accordance with recommendations by EURAB;

- Combine national evaluation of S&T with international peer-review evaluation – without external evaluation, the system may become inward-looking and lose its credibility;

---

43 Reform in public administration is one of the key targets of the third Bulgaria/World Bank Programmatic Adjustment Loan (PAL-3) initiative.

- Introduce special incentives for young scientists and researchers – special measures should be elaborated in order to reduce both internal and external brain drain;

- Support the National Programmes together with programmes of Ministries – this allows the scientific and research communities to concentrate their attention directly on the needs of society. The funding of those programmes should not hinder the core funding of research;

- Pay greater attention to science communication and public awareness of science – without public support, the ideas of a knowledge-based society remain illusory.

Note: While the focus of these recommendations is largely on science and technology, the team recognises that it is also essential not *to pursue these areas to the detriment of research in the social sciences and the humanities. Therefore, in addition to the above:*

- Invest in research to provide greater understanding of social processes such as “globalisation” and “brain drain”, so that Bulgaria might be better equipped to deal with the challenges posed by social and economic change.

Specifically, the review team wishes to make recommendations in five key areas:

1. *Budget.* General observations about the pattern of budgeting, and some suggestions for change, have been made above. More specifically, the Bulgarian Science Foundation is primarily for basic research, and can fund individuals or teams of researchers. The Bulgarian Technology Foundation is essentially an innovation fund, and has a particular focus on joint ventures and partnerships both with public and private institutions. While the establishment of these Foundations could broadly cater for basic and technological research, there will also be a need to provide a mechanism to fund applied research. *It is recommended that government departments/ministries maintain a budget for funding applied projects in their functional areas*. Looking at the Actions in the July 2002 Position Paper, it would seem to the review team that many of these could be assigned to one or the other of these two Foundations. *The guiding principle in the allocation of all funds should be a peer-review-based system, concentrating primarily on the achievement of excellence but also addressing questions of capacity building.*

2. *Policy co-ordination*. The team recommends the creation of a Research Policy Co-Ordinating Council [see the study by Benner & Sandstrom, (2000)] to be chaired by the Prime Minister with representatives from the Academy, industry and Government across the range of relevant ministries. The team recommends that policy moves towards using *incentives* rather than laws as a mechanism for achieving identified goals. The team also recommended that policy concentrate on long-term, higher level goals; in addition, there will be a need for benchmarking against international standards and a long-term commitment to providing a financial framework consistent with achieving the benchmark objectives. In this respect, the team emphasises that *one of the greatest dangers is to adopt a "Stop/Go" approach to policy implementation.*

3. *Alignment.* The co-ordinating principle of research policy, as already noted, should be the alignment of strong institutions with quality researchers. The team has identified above the need to use peer-review mechanisms in allocating funding. International experience suggests that selectivity and targeting will be features of a sound, internationally competitive research system. In the short term, transition to this approach will mean considerable displacement within the existing system. It is therefore important that the approach to targeting *is seen to come from the bottom upwards,* in order to promote collaboration and ultimately, *trust* between researchers in existing institutions. For this purpose, a mechanism such as the PRTLI, a system employed in Ireland and described in Chapter 4 could be a possibility. It is likely that consolidation of existing university institutions will be required in order to create sufficient resources to fund a stronger research base.

The second element of the alignment is the need for a better integrated career structure for researchers, starting from the beginning of university education to a sustained career as a research scientist.

4. *International "market" in talent*. The open market in researchers is one that has been of major concern in Bulgaria for quite some time. Historically, there has been brain drain which undermines the capacity of the system to sustain itself. The alignment of strong institutions and good researchers discussed above should bring about profound structural change that will make a research career in Bulgaria more attractive. In this respect, it should also be pointed out that it would be important to create *a national code for the protection of intellectual property.*

5. A strong research system requires capital investment. It is to be hoped that accession to the EU will enhance the capacity of Bulgaria to attract funding for its research infrastructure. In the shorter term, the team believes that a simple but effective mechanism for promoting strategic investment can be

established which *ties available funding to the researcher.* This is what has been described as an "overhead recovery" model.

Most of the reform packages suggested in this report will strengthen Bulgaria's capacity to take advantage of EU pre-accession funding.

Recent communications from the European Commission (14 January 2004) and the Irish Presidency Symposium in Dublin (17 February 2004)[44] stress the importance of reinforcing support for basic research in the context of developing the European Research Area (ERA). It was agreed that specific funding for basic research should be provided in the next Framework Programme (7th), while maintaining a balance with other priorities and activities in the research area.

It was also agreed that there is a need to enhance the excellence of European research through the partnership of national initiatives. However, national initiatives on their own will not be sufficient: a European initiative is required to promote excellence in basic research by encouraging international competition among individual research teams. "*The sole selection criterion should be excellence, identified by international peer review".*

These policy directions are clearly in line with the key recommendations made in this OECD review – aligning strong institutions with researchers; making excellence the sole criterion for selection for funding; and relying on peer review – including, where appropriate, international experts – to evaluate funding applications and research quality.

44 "Europe and Basic Research", Communication from the European Commission,, COM(2004)9, 14/01/04; and "Europe's Search for Excellence in Basic Research", Symposium Conclusions – Final, Dublin 16/17 February 2004.

REFERENCES

Baltov, A. and Simeonova, K. (1999), "Science Evaluation as Rational and Social Process: The Experience of the Bulgarian Academy of Sciences". In: *Science Evaluation and its Management*, V. Paces *et al*., (Eds.), IOS Press.

Benner, M. and Sandstrom, U. (2000), "Institutionalizing the Triple Helix: Research Funding and Norms in the Academic System." In: *Research Policy*. Vol. 29, pp. 291-301. Amsterdam: Elsevier Science Publications, Amsterdam.

Bullock, M. (2002), "Big Science for Small Countries: What are the Issues and What are the Priorities?" In*: National Strategies of Research in Smaller European Countries.* Amsterdam: ALLEA - [All European Academies] and Estonian Academy of Sciences.

Commission of the European Communities (2000), *Towards a European Research Area (ERA)*. Brussels: European Commission.

Commission of the European Communities European (June 2002), *Quality Indicators of Lifelong Learning. Fifteen Quality Indicators*. Report based on the work of the Working Group on Quality Indicators. Brussels: Commission of the European Communities. (95 pp.)

Commission of the European Communities: Communication from the Commission (16 October 2002), *The European Research Area: Providing New Momentum*. Strengthening – Reorienting – Opening up new perspectives. Brussels: Commission of the European Communities. (16 pp.)

Commission of the European Communities: Communication from the Commission (20 November 2002) – "*European benchmarks in education and training: follow-up to the Lisbon European Council".* Brussels: Commission of the European Communities. (28 pp.)

Commission of the European Communities: Communication from the Commission (10 January 2003) – *"Investing efficiently in education and training: an imperative for Europe"*, Brussels: Commission of the European Communities. (32 pp.)

Commission of the European Communities: Communication from the Commission (5 February 2003), *"The role of universities in the Europe of knowledge."* Brussels: Commission of the European Communities. (23 pp.)

Commission of the European Communities: Communication from the Commission, (14 January 2004), *"Europe and Basic Research."* COM(2004)9.

Commission of the European Communities (16-17 February 2004), *"Europe's Search for Excellence in Basic Research"*, Symposium Conclusions – Final. Dublin.

Council of Europe Meeting Report. First Plenary Session, Strasbourg, (7 February 2003), Steering Committee for Higher Education and Research (CD-ESR). (7 pp.)

Crow, M. (2001), "Universities and the New Manifest Destiny: Organizing Principles for Strategically Re-Aligning American Research Universities". Presentation at Columbia University, New York. Unpublished.

Engelbrecht, J. (2002), "National Strategies of Research in the European Context". In: *National Strategies of Research in Smaller European Countries,* Amsterdam: ALLEA and Estonian Academy of Sciences.

Etzkowitz, H. *et al.* (2000), "The Future of the University and the University of the Future: Evolution of Ivory Tower to Entrepreneurial Paradigm." In: *Research Policy* Vol. 29, pp 213-330.

European Commission Directorate-General for Research (2002), "Benchmarking National Research Policies." Brussels: European Commission. Web site http://1europa.eu.int/comm/education.html

European Commission (2000), "Towards a European Research Area (ERA)", Brussels: European Commission. Web site http://1europa.eu.int/comm/research/area.html

European Federation of National Academies of Sciences and Humanities (2002) *National Strategies of Research in Smaller European Countries*. Amsterdam: ALLEA and Estonian Academy of Sciences.

European Science Foundation (2000) "Europe's Framework for Research: an ESF Position Paper, Strasbourg: ESF.

Georgieva, P., Todorova, L. and Pilev, D. (2002), "*Higher Education in Bulgaria"*. Monographs in Higher Education. Bucharest: UNESCO CEPES.

Guena, A., Hidayat, D. and Martin, B. (1999), "Resource Allocation and Research Performance: The Assessment of Research.". Final Report. HEFCE: Science and Technology Policy Research. London: Her Majesty's Stationery Office.

Higher Education Authority of Ireland (2002), "Creating and Sustaining the Innovation Society." Forfas/Higher Education Authority. Dublin: Government of the Republic of Ireland. Government Publication Service Office, Ireland.

Higher Education Authority of Ireland (2003),"Report of the Group on Research Overheads." Forfas/Higher Education Authority. Dublin: Government of the Republic of Ireland. Government Publication Service Office, Ireland.

Husso, K. *et al.*, ed. (2000), "The State and Quality of Scientific Research in Finland: A Review of Scientific Research and its Environment in the Late 1990s.", University of Helsinki.

Ministry of Education and Science, Sofia (2002), "A Brief History of SEE Regional Research Co-operation." Sofia: MES.

Ministry of Education and Science, Sofia (October 2002), "Attracting Young Scientists: Strategies Against Brain Drain." Conference Proceedings. Sofia: MES with DAAD [German Academic Exchange Service], and HRK [Higher Education Rectors' Conference].

Ministry of Education and Science, and Ministry of Economics, Sofia. "Towards a Science, Technology and Innovation Policy for Bulgaria." 15 July 2002. Sofia: MES with the Ministry of Economics. Draft.

National Institute of Statistics Labour Force Survey 3 (2004), Sofia: NIS.

OECD Review of National Policies for Education – Bulgaria (2004). Paris: OECD.

"Prague Communiqué" 19 May 2001, Prague Communiqué about the European Higher Education Area (EHEA). See Commission of the European Communities, "Towards a European Higher Education Area." Prague: European Ministers in Charge of Higher Education, (4 pp.)

Radosevic, S. (1999), *Restructuring and Reintegration of Science and Technology Systems in Economies in Transition*, EC SOE1-CT95-1008.

Senker, J. *et al*. (September 1999), "European Comparison of Public Research Systems." TSER Project No. SOE1 – CT96 – 1036 pertaining to The Changing Structure, Organisation and Nature of 12 European PSR Systems, University of Sussex: SPRU.

Simeonova, K. (Ed.) (1999), *Analysis of the State and Development of Scientific Research in the Bulgarian Academy of Sciences and the Country 1988-1998*, Sofia: Centre for Science Studies and Science History, Bulgarian Academy of Sciences.

Skilbeck, M. (2001), *The University Challenged: A Review of International Trends and Issues with Particular Reference to Ireland*. HEA/CHIU Dublin: The Higher Education Authority. Available from www.hea.ie

Thornhill, D. (2002), "Incentives and Accountability: Instruments of Change in Higher Education. National Policy Instrument and Institutional Behaviour: an Irish Case Study." Paper delivered at the IMHE General Conference, September 2002. Paris OECD. Available from www.hea.ie

UNESCO (2002), World Conference on Science Round Table of Ministers of Science on Rebuilding Scientific Co-Operation in South East Europe, 24 October 2002. Paris: UNESCO.

UNESCO (2000), World Conference on Science Declaration on Science and the Use of Scientific Knowledge. Paris: UNESCO.

Vesselinov, K. (2002), "Brain Drain – Opportunities for Narrowing the Scope of this Phenomenon in Bulgaria". In: *Attracting Young Scientists – Strategies Against Brain Drain,* Conference Proceedings. October 2002. Sofia: MES et al.

Watson, J. (2000), “The Academic Community and Cancer Research (1974)”. In: J. Watson, (Ed.), *A Passion for DNA*, Oxford University Press.

Internet

Council of Europe “Bologna” web site
http://www.coe.int/T/E/Cultural_Co-operation/education/Higher_Education/Activities/Bologna_Process/

European Commission, Directorate General for Education and Culture
http://1europa.eu.int/comm/education.html and
http://europa.eu.int/comm/research/area.html.

European Credit Transfer System (ECTS)
http:/europe.eu.int/comm/education/socrates/ectswww.html

National Institute of Statistics, Bulgaria http://www.nsi.bg/Index

TUNING Educational Structures in Europe
http://www.relint.deusto.es/TuningProject/index.htm

ANNEX 1

1. Bulgaria's position paper on the "European Research Area" (ERA) Initiative

Bulgaria supports the ERA initiative as a considerable contribution to the integration processes in the sphere of scientific research and technological development. The contribution of the ERA initiative can be summarised as follows:

- The ERA initiative is of importance not only for the EU member-states, but also for the candidate countries;

- It is a strategic document which creates opportunities for a comprehensive analysis of European scientific research put into a past-present-future perspective;

- It will ensure the concentration of the present "know-how" in the Community for the purpose of improving the scientific research potential and the management of Scientific Research and Technological Development in Europe;

- The ERA initiative serves as a basis for:

  – holding public debates about primary issues of Europe's future R&D, Technological and Innovative policy;

  – laying the foundations of a competitive Europe that will influence the improvement of R&D, technological and innovative policy of each of the European countries and of Europe as a whole;

  – analysing the relation "resources utilised – competence level";

  – studying BEST practice of EU member-states and the candidate countries – implementing the best achievements; encouraging the development of entrepreneurship through the system of education;

– establishing a harmonised European policy in the sphere of scientific research and technological development which will subsequently exert its influence on the development of the national economies of the European countries as a whole;

– achieving a more effective co-ordination in the process of carrying out the national and European R&D and technological activities;

– incorporating within a common framework the European priorities for scientific research and other spheres of mutual interest such as health and healthy food, environmental issues, power engineering, increasing the level of scientific knowledge as well as the educational level of society, establishing a contemporary IT society.

2. For Bulgaria the "European Research Area" initiative serves as an instrument for:

- Developing a common framework of the European R&D, Technological and Innovative policy as an essential prerequisite for steady economic growth;

- Increasing the mobility of scientists with a view to establishing the "Science without Borders" initiative;

- Establishing a common specialised data base including not only Scientific Research & Technological Development projects but also the results of their execution leading to cluster effect;

- Implementing new approaches and activities, which aim at involving the new generation of scientists. The new generation should actively participate in the building of an economy based on knowledge. Developing programmes for special scholarships and courses with the purpose of improving the qualification of young scientists;

- For each of the candidate countries specific scientific areas standing at the position of close attention should be appointed with a view to improving the quality of scientific research done in these areas;

- Bringing together various national R&D and technological programmes with the aim of ensuring a synergic effect;

- Building national scientific and R&D networks which, together with effective educational activities, should establish the connection between universities, research units and industry;

- Establishing a connection between representatives of science, industry and financial institutions; In the process of executing national and European research programmes and technological developments "contact markets" should be organised with the aim of creating conditions for building new and innovative forms and ensuring the participation of "venture capital";

- Introducing a common European approach for funding the scientific and technological infrastructure; creating funds which should give impetus to the building of new scientific and technological parks and business incubators as well as for the building of new innovative business establishments with the participation of "risk capital";

- Introducing suitable instruments that will effectively protect intellectual property. From an international point of view, the TRIPS (Trade-Related Aspects of Intellectual Property Rights) agreements on intellectual property, which concern the most recent technological developments, should be observed;

- Encouraging the technological transfer in the direction "scientific research – economy".

3. With a view to Bulgaria's participation in the "European Research Area" initiative, our country should pay specific attention to:

- Concentration of knowledge and skills in national centres of competence that will be not only research units but also a place for training where the students will be actively involved in the scientific activities. That will also include the establishment High-tech Parks & Centres;

- Establishment of "Virtual Centres of Competence" in which universities and economies will actively participate;

- Building bridges between the national network of High-tech Centres and the European Centres (building a national network of high-tech centres in the candidate countries will provide a good start for conducting modern scientific research and technological developments);

- Carrying out a subsequent policy for involving young personnel in science. Increasing the mobility of scientists belonging to the spheres of universities and industry;

- Introducing European models and criteria for evaluation of scientific structures and scientists;

- Increasing the share of scientific research funding as a percentage of GDP in accordance with the recommendations of the European Commission;

- Introducing incentives and specialised measures for increasing the revenues for scientific research from non-governmental organisations;

- Supporting multidisciplinary R&D projects and technological developments;

- Funding thematically oriented scientific and technological programmes; reorientation from a project to a programme approach;

- In the preparation for participation in the Sixth Framework Program for scientific research and technological development, co-ordinated actions are needed which should be in accordance with the future plans for an united European research area;

- Co-ordinated actions in the process of evaluation institutional, scientific and R&D projects.

4. Bulgaria is carrying out and will carry out an active policy in relation to:

- Developing and implementing effective mechanisms with a view to effectively using the financial resources intended for scientific, R&D and technological activities;

- Developing specialised methodologies for distributing the resources given for additional funding of R&D, technological and innovative activities;

- Developing measures for stimulating the development of entrepreneurship and the establishment of S&M enterprises – encouraging innovations in M&S enterprises and increasing their importance;

- Striking a balance between funding and conducting fundamental, applied and innovative research while taking into consideration that fundamental research are most influential on a knowledge-based society;

- Binding the level of scientific competence with the provided resources on the basis of scientific and institutional assessment;

- Developing an optimal institutional framework for supporting innovations and technological development (centres for innovations and technological development, specialised funds)

- Strengthening regional co-operation in the spheres of science, research and technological development – the Balkan region and the countries of Central and Eastern Europe;

- Introducing and improving incentives for transfer of technologies in the direction "scientific research – technological developments – industry (production)";

- Enhancing the integration of universities and scientific organisations into scientifically oriented firms and innovative SME's

- Modernising the system of intellectual property with the aim of increasing the compatibility of Bulgarian industry, SME's, R&D organisations;

- Attributing importance to the role of scientific research in universities with a view to achieving effective co-operation with the representatives of SME businesses;

- Active participation in the Framework Programmes of the Community, and more specifically in the Sixth Framework Programme for research and technological development as well as in other European programmes, on the basis of bilateral and multilateral co-operation;

- Binding the programmes and projects of the bilateral co-operation with the programmes and projects of the European Community as a basis for active participation in the Framework Programs of the Community.

Questionnaire on the quality of OECD publications

We would like to ensure that our publications meet your requirements in terms of presentation and editorial content. We would welcome your feedback and any comments you may have for improvement. Please take a few minutes to complete the following questionnaire. Answers should be given on a scale of 1 to 5 (1 = poor, 5 = excellent).

Fax or post your answer before 31 December 2004, and you will automatically be entered into the prize draw to **win a year's subscription to *OECD's Observer magazine*.***

A. Presentation and layout

1. What do you think about the presentation and layout in terms of the following:

	Poor	Adequate		Excellent	
Readability (font, typeface)	1	2	3	4	5
Organisation of the book	1	2	3	4	5
Statistical tables	1	2	3	4	5
Graphs	1	2	3	4	5

B. Printing and binding

2. What do you think about the quality of the printed edition in terms of the following:

Quality of the printing	1	2	3	4	5
Quality of the paper	1	2	3	4	5
Type of binding	1	2	3	4	5
Not relevant, I am using the e-book	❑				

3. Which delivery format do you prefer for publications in general?

Print ❑ CD ❑ E-book (PDF) via Internet ❑ Combination of formats ❑

C. Content

4. How accurate and up to date do you consider the content of this publication to be?

1 2 3 4 5

5. Are the chapter titles, headings and subheadings…

Clear	Yes ❑	No ❑
Meaningful	Yes ❑	No ❑

6. How do you rate the written style of the publication (*e.g.* language, syntax, grammar)?

1 2 3 4 5

D. General

7. Do you have any additional comments you would like to add about the publication?

....

....

....

Tell us who you are:

Name: .... **E-mail:** ....

Fax: ....

Which of the following describes you?

IGO ❑ NGO ❑ Self-employed ❑ Student ❑

Academic ❑ Government official ❑ Politician ❑ Private sector ❑

Thank you for completing the questionnaire. Please fax your answers to:
(33-1) 49 10 42 81 or mail it to the following address:
Questionnaire qualité PAC/PROD, Division des publications de l'OCDE
23, rue du Dôme – 92100 Boulogne Billancourt – France.

Title: Bulgaria: Science, Research and Technology

ISBN: 92-64-00700-8 **OECD Code (printed version):** 91 2004 06 1 P

* Please note: This offer is not open to OECD staff.

OECD PUBLICATIONS, 2, rue André-Pascal, 75775 PARIS CEDEX 16
PRINTED IN FRANCE
(91 2004 06 1 P) ISBN 92-64-00700-8 – No. 63797 2004