CURRENT ISSUES OF RESEARCH, DEVELOPMENT AND INNOVATION IN ROMANIA*

Andreea Vass, Steliana Sandu**

Abstract. The research, development and innovation system (RDI) represents a key segment of activity, both in theory and in international practice, as an engine of social and economic progress. For Romania, the transition period has represented a major transformation step in a structural, institutional and functional perspective in association with networking with other components, so that the present configuration of the R&D system in Romania differs substantially from that of the early 1990s.

The present standing of the RDI system, according to Romania's main aims to stimulate development and integration into the EU, enables highlighting the way the R&D system plays a crucial role in boosting economic growth and social progress. It also highlights the compatibility with the structures, overseas trends and demands of the European integration process. In this approach, the present EU context must be taken into account; the restructuring of the R&D system and increasing its performance aiming at reducing productivity and competitive gaps between the EU and other international competitors, especially the USA, are priority objectives on its agenda.

From the broad RDI arena, the present study focuses on three aspects that define the current features and potential of configuration:

- *First, we provide a brief profile of the current S&T system, where we highlight the main institutional characteristics and the magnitude of inputs and outputs from the functionality point of view.*
- *Second, we assess the selection and implementation of RDI priorities in Romania, aiming at highlighting the degree of compliance between:*
  - *breakthroughs in science and technology,*
  - *technical and scientific changes in the economy and society,*
  - *and globalization tendencies of markets for goods and services, including the technical-scientific field.*
- *Third, Romanian integration into the European Research Area will be tackled. Romania is engaged in preparation for the integration process, the chapter on R&D being one of the 31 negotiation chapters. Within this framework special attention is granted to the National Innovation System as a key point for economic benefit and securing the necessary premises for reducing competitive gaps between Romania and EU countries.*

1. BRIEF S&T PROFILE OF ROMANIA

Institutions. The main bodies coordinating S&T policy-making and innovation activities are the Romanian Ministry of Education and Research and the Romanian Academy. In Spring 2003, the Ministry of National Education was reorganized as the Ministry of Education, Research and Youth, and in March 2004 it became the Ministry of Education and

* *This study has been developed within a NATO research grant program, held at IKU - Budapest, 2004.*

** *Andreea Vass is a scientific researcher at the Institute of National Economy and expert at the Romanian Presidential Administration, within the Department of Economic and Social Analysis and Strategies.*

Steliana Sandu is scientific researcher at the Institute of National Economy.

Research. Previously, in 2001, it had also taken over the responsibilities of the former National Agency for Science, Technology and Innovation (NASTI), with a view to establishing closer links between higher education and research. The Inter-ministerial Council for Science, Technology and Innovation (CISTI) was reorganized in December 2001 and in August 2002, and was given the responsibility for drawing up and implementing strategies and programs for research, development and innovation. CISTI also advises on proposals for updating the National Plan.

study:

➢*The National Plan for Research-Development;*

➢*The Horizon 2000 Research-Development program;*

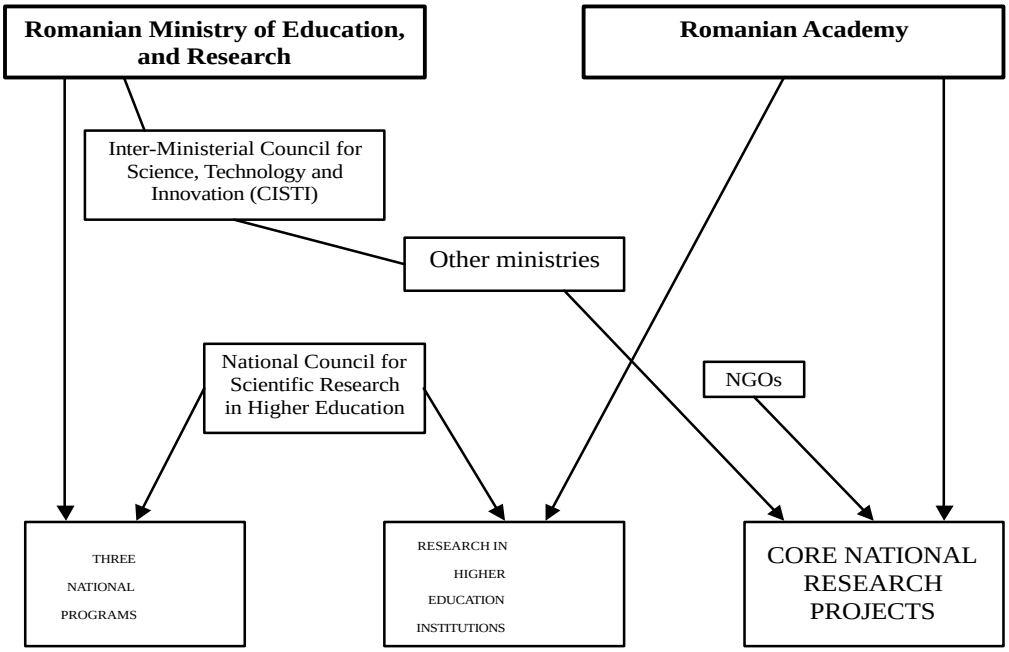
➢*The Grants Programs for Scientific Research.*

The principal research programs coordinated by the Romanian Academy include:

➢ *national priority projects* (for high complexity scientific and cultural matters, with great impact at national level);

➢ *program of grants for scientific research* (GAR - Romanian Academy Grants Program).

Figure 1: Institutional Linkages and Capacity for S&T Policy-making in Romania (2004)



Source: Authors' compilation

Presently, the national programs for research and development are coordinated by the Ministry of Education and Research through the Research Department, and will be presented in more detail in the second and third part of this

R&D funding comes from at least three sources:

➢ state budget (Ministry of Education and Research, Romanian Academy and other ministries);

- economic unit co-financing;
- EU funding.

The major national research programs coordinated by the Romanian Academy are complex projects approaching important issues for Romania from a multidisciplinary point of view and involving in their design the research institutes and centres, as well as the most competent persons in both the humanities and the exact sciences within and outside the Romanian Academy system (including the Diaspora). A few significant examples of projects relating to the Romanian cultural patrimony are as follows: *Thesaurus Dictionary of the Romanian Language; General Dictionary of the Romanian Literature; Romanian History Treaty*. In order to evaluate Romania within the current political, social-economic and cultural context the Romania 2020 and Informational society - Society of Knowledge projects are running within the Romanian Academy. The latter has involved more than 40 specialists (including 7 members of the Romanian Academy) and 10 institutes of the Romanian Academy (economic, social and legal sciences, information techniques, philosophy, psychology, and genomics). In order to develop a knowledge-based economy in Romania, the set of policy measures and actions is concentrated on the following three main objectives: stimulation of R&D investments in enterprises, attracting and training more human resources for R&D, and innovation activities.

NGOs are important players in academic research and policy design in Romania. A few examples are worth mentioning here:

- *The Romanian Centre for Economic Policies* (CERP) has organized, as part of a PHARE financed project, a team of young economists advising the Office of the Prime Minister. CERP has also maintained close research-policy interaction with the Ministry of Integration, the Ministry of Finance and the National Bank of Romania.
- *Romanian Academic Society* has worked with the UNDP office in Romania to issue regular Early Warning Reports under the eye of the Romanian Ministry of Foreign Affairs.
- The *Centre for Policy Studies and Comparative Analysis*, the *Romanian Centre for Economic Modelling*, the *New Europe College* and numerous other NGOs cooperate in numerous foreign-financed projects of policy-relevant research.

Not an NGO, but also a policy-influencing institute, is the *European Institute of Romania*. This is a public institution that completed during 2001-2005 the task of preparing, with independent experts, a collection of three series of pre-accession impact studies (dealing with the chapters of negotiations with the EU and their implications).

According to the statistics of MER Research Department (2003), the number of units developing research-development activities in 2002 was 590, grouped in the following way:

- 34 national research-development institutes, under the coordination of the central public administration;
- 227 public institutions, subordinated to MER, other ministries, the Romanian Academy and the Academy for Agricultural and Forestry Sciences (AAFS);
- 15 research-development institutes operating on the basis of the *GD No. 100 of 1991* and which are in the process of re-organization in legal forms according to the norms in force;
- 310 joint-stock companies, public or private companies, that have research-development as their main object of

activity, of which there are:

- 70 private limited companies;
- 67 companies included in the APAPS portfolio.

Inputs: R&D investment and human resources in S&T. In 2001 the gross domestic expenditure on R&D (GERD) was 0.39% of the national GDP, much lower than in the EU-25 (1.93%) or the other countries taken for benchmarking (see Table 1). Due to the economic crisis at the end of the 1990s GERD was declining by 9.2% per year during 1997-2001. Nevertheless the share of the business sector in financing GERD (61.6%) is relatively high compared to other EU candidate countries (e.g. Bulgaria 21.4%) and close to the EU-25 average (65.3%). Moreover, the share of business-financed R&D in the value added in industry was higher in Romania than in the EU-25 average, in 2001. The overall picture of the level of commitment to the

Table 1. R&D Investment in 1997-2003

	Romania (A)	Bulgaria	Greece	Portugal	EU-25	EU-15 (B)	Gap: EU-15 and Romania (B – A)
R&D Intensity (GERD as % of GDP), 2001 (1)	0.39	0.47	0.67	0.77	1.93	1.98	1.59
R&D Intensity average annual real growth rate (%) in 1997 – 2001 (2)	-9.2	-9.2	15.3	4.4	1.3	1.5	10.7
R&D Investment average annual real growth rate (%) in 1997–2001(3)	-8.8	-4.9	16.7	7.3	4.5	4.5	13.3
Government budget allocated to R&D (GBAORD as % of GDP), 2003 (4)	0.17	n.a.	0.28	0.66	0.76	0.77	0.6
Government R&D budgets (average annual real growth rate, %), in 1997 – 2003 (5)	-6.0	n.a.	2.1	12.3	3.2	3.2	9.2
Business expenditure share of R&D (BERD as % of GERD), in 2001 (6)	61.6	21.4	28.5	40.5	65.3	65.6	4.0
Business expenditure share of R&D budgets (average annual real growth rate (%), in 1997 – 2001 (7)	-6.7	3.9	5.6	12.5	0.8	0.9	7.6
Business-financed R&D (BERD as % of VAI - value added of industry), in 2001 (8)	0.24	n.a.	0.24	0.51	1.56	1.61	1.37
Industry-financed R&D average annual growth rate, in 1997 - 2001 (9)	-11.2	3.6	23.5	22.4	1.7	5.6	16.8
Share of SMEs in publicly funded R&D executed by the business sector (%), in 2001 (10)	48.1	75.7	71.1	70.8	n.a.	n.a.	n.a.
Publicly funded R&D in the SME sector, average annual growth rate, in 1997 - 2001 (11)	0.6	-54.8	4.0	-10.4	n.a.	n.a.	n.a.

(1) EU-15 and EU-25 does not include Malta; Greece: 1999; Portugal: 2002;
(2) EU-15 and EU-25 does not include Luxembourg and Malta; Bulgaria: 1999 – 2001; Greece: 1997-1999;
(3) EU-15 does not include Luxembourg and values were estimated for 2001; EU-25 does not include Luxembourg and Malta and values were estimated for 1997 and 2001; Bulgaria: 1999 – 2001; Greece: 1997-1999;

(4) EU-25 does not include Czech Republic, Cyprus, Hungary and Malta; EU-15 and EU-25: 2001;
(5) EU-15 does not include Luxembourg; EU-25 does not include Luxembourg, Czech Republic, Cyprus, Greece, Hungary and Malta; EU-15 and EU-25: 1997 – 2001;
(6) EU-15 does not include Luxembourg; EU-25 does not include Luxembourg and Malta; EU-15 and EU-25: 1997 – 2001; Portugal: 2002; Bulgaria: 2000; Greece: 1999;
(7) EU-15 does not include Luxembourg; EU-25 does not include Luxembourg and Malta; Portugal: 1997 - 2002; Bulgaria: 1999 - 2000; Greece: 1997 – 1999;
(8) EU-15 and EU-25 does not include Luxembourg, Estonia, Lithuania, Latvia, Malta; Greece: 1999; Portugal: 2002;
(9) EU-15 and EU-25 does not include Luxembourg, Lithuania and Malta; Greece: 1997 - 1999; Portugal: 1997 - 2002; Bulgaria: 1999 – 2001;
(10) Greece: 1999; Portugal 2002.
(11) Greece: 1997 - 1999; Portugal: 1997 - 2002; Bulgaria: 1999 – 2001; Romania: 2000 - 2001

Source: EUROSTAT, European Commission DG Research – Key Figures, 2003-2004

creation of new knowledge and to the exploitation of research results is unfavourable for Romania, in both comparative and dynamic perspectives. Innovation capacity, estimated with the R&D investment indicator as a proxy, declined at an average rate of 8.8% during 1997-2001. Industry-financed R&D declined even more in the same period, by 11.2% per annum.

According to the structure of financing, government is a relatively more important source of funds in the national R&D system (Table 2), but the gap between the government budget's share in GDP allocated (in 2003) in Romania and the EU-15 (in 2001) was still 0.6 percentage points (Table 1).

A key determinant of the future competitiveness of the Romanian economy is the level and intensity of private expenditure on R&D. The business sector in Romania spends less than 0.25% of its value added on R&D, being seven times lower than the EU-15 average. The business sector, in relative terms, was not catching up with the EU during 1997-2001 (see Table 1), despite its high share in national R&D expenditure during this period.

Larger gaps in venture capital investments are ever present in Romania relative to the EU: 5.5 times lower early-stage venture capital as percent of GDP in 2002 (see Table 3). Despite the fact that a very high number of start-ups have been created, early stage venture capital was only half that allocated for expansion, in 2002. The relatively high importance of the expansion phase is a common feature of all the member and acceding EU countries. Actually, the venture capital investments are oriented towards high-tech and knowledge-intensive sectors, with very high risk new companies. An important issue in Romania, and the acceding countries as well, is that the exit markets for venture capital investments are not yet well developed. The crisis of the new economy is negatively influencing investments in venture capital, as can be seen in the very strong decline between 2001 and 2002.

Total R&D full-time equivalent

Table 2. R&D Expenditure by main sources of funds (%), in 2001

	Business enterprise	Government	Other national sources	Abroad
Romania	47.6	43.0	1.2	8.2
Bulgaria	24.4	69.2	1.1	5.3
Greece	24.2	48.7	2.5	24.7
Portugal	32.4	61.2	2.1	4.4
EU-25(1)	55.8	34.4	2.2	7.6
EU-15(2)	56.1	34.0	2.2	7.7

(1) EU-25 does not include Luxembourg, Malta and Lithuania;
(2) EU-15 does not include Luxembourg.

Source: EUROSTAT, European Commission DG Research – Key Figures, 2003-2004

Table 3. Venture Capital Investments in 2001-2002

	Romania	Greece	Portugal	EU-25	EU-15
Venture capital investments (m. EURO) in 2002, total	8.329	45.384	61.565	9 212.560	9 106.929
1- seed	0.000	1.301	0.013	292.647	292.430
2- start - up	2.443	11.658	10.248	2 325.375	2 312.154
3- expansion	5.885	32.425	51.304	6 594.538	6 502.346
Relative change (%) in 2001 - 2002	-51.3	-50.4	-15.7	-55.7	-21.7
4- seed	0.0	37.4	85.7	-134.0	-41.5
5- start - up	54.6	-61.8	-35.9	-105.7	-33.7
6- expansion	-62.1	-45.9	-10.1	-31.0	-14.9
Venture capital investments in early stages per m GDP (%), 2002	51	92	79	275	285
Venture capital investments in early stages average annual real growth (%), 2000 - 2002	26.5	15.5	-44.8	-38.2	-37.8

Seed + Start-up = Early Stage.
EU-15 does not include Luxembourg; EU-25 does not include Luxembourg, Czech Rep., Estonia, Lithuania, Latvia, Malta;

Source: EUROSTAT, European Commission DG Research Key Figures, 2003-2004

personnel in Romania was 19,726 people in 2001, which represented 1.71 per 1000 of the labour force. This represents the lowest share of researchers in the labour force of all the member and acceding countries, excepting only Cyprus. The share of researchers employed in the business sector is relatively high in Romania: with 57.2% of researchers employed there, Romania has the highest proportion among the EU candidate countries and higher than in some of the current EU member states (see Table 4). Human Resources in S&T provide the capacity to produce scientific and technological knowledge. In Romania the capacity to produce and absorb knowledge is highest in the business sector, which is a promising indicator of the potential future development of the production of knowledge. In terms of gender balance Romania performs better than the EU-15 (27.2%) average with 42.8% of female researchers (in FTEs).

Nevertheless there is significant potential of human resources and distribution of human resources in Romania *(see Table 4)* if proper measures are taken and sufficient resources invested. According to the *European Trend Chart on Innovation 2002*, relative weaknesses of Romania are in the fields of current lifelong learning, public expenditure on R&D, and patents applied for at the European Patent Office. On the other hand, major strengths in innovation are in the trend for lifelong learning.

Outputs: S&T and economic performance for the knowledge-based economy. The significant disparities in R&D system inputs are reflected in the output gaps between Romania and the EU, and the macroeconomic dynamics as well. In the field of S&T and performance in the knowledge-based economy, Romania is behind the current EU-15 level (as were all the acceding and candidate countries in 2001), and behind the average of the EU acceding and candidate countries. This was especially pronounced for technological performance (patents), relative to the scientific performance or overall productivity, where the picture is less negative (*see Table 5*). Romania is doing well in the speed of closing the gap in the number of publications and in the world market share of exports of high-tech products. Low gaps are also recorded in the employment in high-tech and medium high-tech industries as percentages of total employment (5% for Romania, relative to 6.2% in the EU-15, in 2001).

Table 4. Human Resources in S&T in Romania, in 1996-2001

	Romania	**Bulgaria**	**Greece**	**Portugal**	**EU-25**[3]	**EU-15**[3]
Total number of researchers (FTE) [1]	**19 726**	9 217	14 748	17 584	1 084 726	972 448
% by sector:						
• business enterprises (%)	**57.2**	n.a.	15.2	15.5	47.3	49.7
• government (%)	**28.4**	n.a.	13.6	21.0	14.5	13.4
• higher-education (%)	**14.4**	n.a.	71.0	50.3	36.0	34.5
Average annual growth rates of researchers (FTE), %, in 1996 – 2001 [2]	**-8.23**	-8.98	11.03	6.55	3.68	3.90
Number of researchers (FTE) per 1000 labour force, in 2001 [4]	**1.71**	2.68	3.30	3.51	n.a.	5.58
Number of researchers (FTE) per 1000 labour force, average annual growth rates (%), in 1996 – 2001 [5]	**-8.2**	-3.0	13.3	4.9	n.a.	2.6
Female researchers as % of all researchers (in HC), in 2001 [6]	**42.8**	45.5	40.9	46.6	n.a.	27.2
R&D expenditures per researcher (FTE) (in thousands of EURO), in 2001 [7]	**9**	8	54	58	156	171
By sector (000 EURO)**:**						
• business enterprises	**10**	13	101	121	214	225
• government	**9**	8	86	59	147	170
• higher-education	**7**	4	38	41	90	103

FTE = full-time equivalent researchers.

(1) Greece: 1999; EU-15 and EU-25: 2000;
(2) Greece: 1995 1999; EU-15 and EU-25: 1996 2000;
(3) EU-15 and EU-25 does not include Luxembourg and Malta. In % by sector, EU-25 does not include Luxembourg, Cyprus, Estonia, Lithuania, Latvia and Malta;
(4) Portugal: 2002; Greece: 1999;
(5) Portugal: 1996 - 2002; Greece: 1997 - 1999; Bulgaria: 2000 2001; Romania: 1997 2001;
(6) Portugal and Greece: 1999;
(7) EU-15 and EU-25: 2000; Greece: 1999;

Source: EUROSTAT, European Commission DG Research Key Figures, 2003-2004

Table 5. S&T and economic performance, 1995-2002

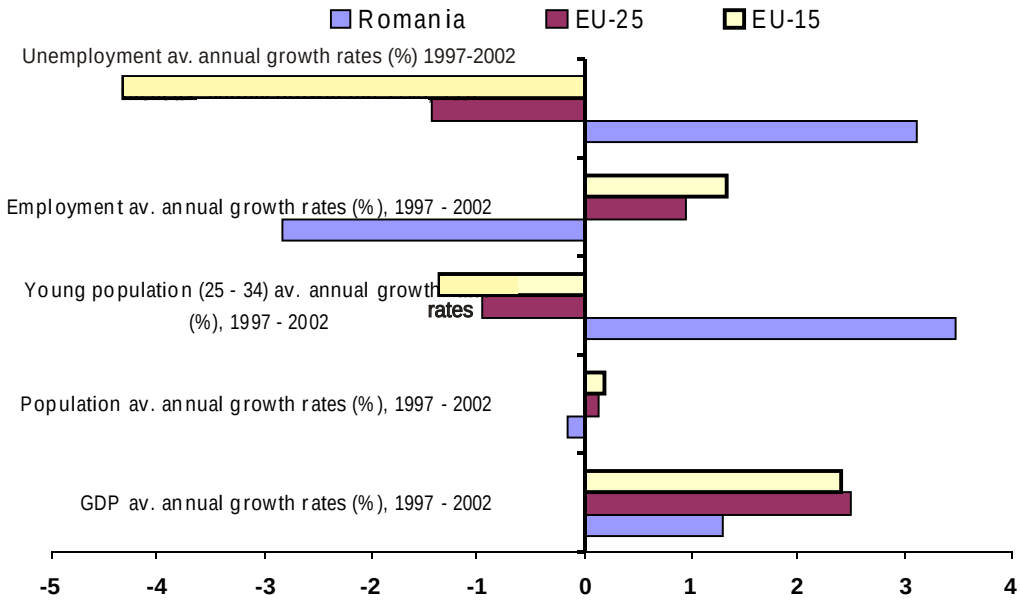
	Romania (A)	Bulgaria	Greece	Portugal	EU-25	EU-15 (B)	Gap: EU-15 and Romania (B – A)
Scientific performance [1]:							
1- Number of publications per million population, in 2002	84	182	458	339	n.a.	673	589
2- Growth rates of publications (%), in 1995 - 2002	4.9	-1.6	7.8	12.7	n.a.	2.1	-2.8
Technological Performance:							
3- Shares EPO (patent applications), in 2000	0.01	0.01	0.04	0.03	47.06	46.79	46.78
4- Shares USPTO (granted patents), in 2002	0.00	0.00	0.01	0.01	16.26	16.17	16.17
5- Patent applications at the European Patent Office per million population, 2000	0.3	1.0	2.9	4.2	107.7	128.4	128.1
6- Patent applications at the US Patent Office per million population, 2002	0.2	0.8	2.0	1.3	59.9	71.2	71
7- High-tech exports as a % of total exports, in 2001	5.0	1.6	5.5	6.8	n.a.	19.8	14.8
8- World market share of exports of high-tech products (%), in 2001 [2]	0.05	n.a.	0.05	0.15	n.a.	37.51	37.46
9- World market share of exports of high-tech products – average annual growth rates (%), in 1996 - 2001 [2]	29.01	n.a.	2.69	6.42	n.a.	0.62	-28.39
10- Technology balance of payments receipts as % of GDP, in 2001 [3]	0.05	n.a.	n.a.	0.31	n.a.	n.a.	n.a.
11- Technology balance of payments – average annual growth rates (%), in 1996 - 2001 [3]	105.2	n.a.	n.a.	7.1	n.a.	n.a.	n.a.
Productivity Performance:							
12- Value added of high-tech and medium high-tech industries as % of total gross value added, 2001 [4]	4.82	4.15	1.64	4.45	8.38	8.44	3.62
13- Employment in high-tech and medium high-tech industries as % of total employment, 2001 [4]	5.01	5.07	1.13	3.21	6.18	6.23	1.22

EPO European Patent Office; USPTO US Patent and Trademark Office

(1) Population in 2001;
(2) Includes intra-EU trade. If we exclude it, the EU-15 share drops to 20.11 %;
(3) Portugal: 2002, respectively: 1997 - 2002
(4) EU-25 does not include Luxembourg; Bulgaria and Romania: 2000;

Source: EUROSTAT, European Commission DG Research Key Figures, 2003-2004

Figure 1. Macroeconomic performance dynamics: Romania vs. EU



Source: Authors' computations

In terms of growth in overall performance[1] during 2000-2001, Romania (5%) is a member of the group that is catching up with the EU-25 average (along with Lithuania 13%, Latvia, Hungary, the Czech Republic, Malta almost 6%, and to a lesser extent Poland 3%), in contrast with the group that has a lower growth rate than the EU-25 average (Bulgaria, Turkey, Cyprus, Estonia, and to a lesser extent Slovakia and Slovenia). But the performance level was still lower in 2001 than in all the other acceding and candidate countries, except Turkey and Bulgaria which are very close to Romania.

2. SCIENCE AND INNOVATION POLICY AND STRATEGY ASSESSMENT: FOCUS ON PRIORITY SETTING AND IMPLEMENTATION

Identification and selection of priorities in R&D constitute an especially complex process, which requires the existence of some dedicated institutions and following some procedures validated by international practice. Taking into consideration those premises is a key issue for Romania, whose economic and social system is undergoing a stage of many difficulties and uncertainties.

Despite the diversity of the decision-making mechanisms of different countries, a series of criteria and common features of the process of selecting scientific priorities can be identified, as follows:

- the interaction between the purposes of the scientific and technological community and those of political factors;
- the impact of the greater balance of science and technology cycles, compared to those from administration and politics, on the time period for making priorities, for the

[1] *The composite index of performance in the transition to the knowledge-based economy takes into account four most important elements: overall labour productivity, scientific and technological performance, usage of the information infrastructure, and effectiveness of the education system (EC DG Research, 2004).*

financing method for implementing them, and for training the research personnel, requiring a long-term vision;

- the existence of special dedicated institutions for setting R&D priorities, generally known as "councils of research" or "national committees for science and technology", as non-political organizations, based on teams of objective experts, who also decide over the allocation targets of R&D funds;
- there is periodical control of the priority-setting system taking into account the fact that the most steady priorities are in wider scientific fields and in fundamental research compared to technological research;
- in the advanced S&T countries there are consulting systems, as general mechanisms for setting R&D priorities, where scientists, together with firms, government, union representatives and experts in different fields participate, and the consulting procedures are flexible, in order to rapidly adjust to changes in the social and economic environment;
- users of R&D outputs play a key role in setting priorities especially for applicable research;
- priorities once settled are invoked in long-term programs or strategic plans, and are correlated with the political, social and economic frameworks on one hand, and with the state-of-the-art in science and technology on the other hand.

In the successful implementation of priorities, international practice, especially the European one, reveals a series of key features that this process depends upon:

- taking into consideration, to a greater extent, the strategic role of science and technology in tackling some pressing social and economic issues, like environmental protection and sustainable development, within the frame of increasing tension between available resources and the needs of operational actors for R&D activity;
- the strengthening of the relationships between science, technology, economy and society in accordance with the increasing cost of research and innovation, the increasing speed of scientific and technological breakthroughs, and the growing need for fast data and technology transfer from research to the economy and society;
- the powerful sway of political and regional factors over the S&T system;
- the international framework has a powerful influence on selecting and implementing priorities in S&T, following the increasing globalization process, to which the R&D itself contributes.

Stages in the Process of Selecting Priorities for the R&D System. Since 1990 selecting priorities has been influenced by the new and changing economic, social and political framework. Due to the specific transition conditions it can be stated that, until quite recently in Romania, the matter of priorities was not a major concern of the political actors. We can distinguish four stages of R&D system transformations that influenced the priority-setting system to a great extent.

From 1990 to 1992, the lack of demand for applicable research and of funding resources created a state of confusion, leading to changing most of the technological research institutes into commercial companies; the Romanian Academy's research was reorganized on the basis of budget allowances, leading to a greater security and steadiness. In this period, the economic priorities issue, and even more those in science, were not a concern for the policy-makers.

From 1992 to 1994, *a structural priority* was set of preserving the technological research resources and

potential, more as a consequence of the pressures from the scientific community in industrial research, and less as an effect of the awareness among policy-makers of the role of this field in reviving economic growth. For implementing this priority the *Special Fund for R&D* was designed, financed by a 1% contribution of the turnover of public, and later private, business people. Without a direct interest of the firms in supporting R&D, this system has drawbacks, working on a short time limit. In this period, thematic and structural priorities were not selected, but a large number of funding requests for wide thematic areas of research were financed (every year they financed over 4000 projects, most of them without any direct connection to the needs of financing economic agents).

Starting from 1994 to 1995 the idea of selecting priorities in R&D came to be stated. The *National R&D " 2000 Horizon" Program* was used for this purpose, being initially managed by the Ministry of Research and Technology (MRT), later on by the National Agency for Science Technology and Innovation (NASTI), and finally by the Ministry of Education and Research (MER). The program was launched with the purpose of "fund allocation on priority objectives and programs, having a inter-disciplinary and inter-sectoral approach to promote partnerships for managing complex issues".

A step forward in designing priorities in accordance with the major objectives of economic and social development was made in 1999, when the national priority programs, RELANSIN, CALIST, INFRAS and CORINT were launched, as a part of the RDI National Plan.

Through these programs the following structural priorities of R&D were set:

- increasing the impact of R&D activities on the economy and society, following the view of economic revival and sustainable development,
- speeding and intensifying the innovation processes and their transformation into direct support to increasing the quality and competitiveness of products and services offered by Romanian companies in domestic and international markets;
- the focusing of competencies and resources in science and technology with the purposes of extending the national heritage of scientific, technological and innovation;
- the compliance with the legislation and institutional systems and proceedings of the EU, to a rapid and efficient implementation of the partnership for accession.

These objectives expressed somewhat too general intentions, without being applied in target sub-programs, which led to accepting offers over a wide thematic range, and consequently to wasting Romanian R&D resources.

The National R&D Plan was updated from 2001 to 2005, through launching in September 2001 other priority programs: AGRAL, MENER, ANTRANS, BIOTECH, MANNANTECH, AEROSPATIAL, CERES. According to the perceptions of the European Commission in the Country Report in 2001: "*The New Plan shifted from actions focused on offers to those focused on demand, to better answer the needs of economy and society. The Cooperation with companies was put on a solid basis*" (The EU Commission: *2001 Regular Report on Romanian Progress towards Accession*, Brussels 13/11/2001, pp. 71-72)

These favourable trends were still insufficient for really meeting R&D priorities and for their efficient implementation. According to European Commission

Box 1: Development objectives of Romania: priority national programs in 2001 - 2005

- **Agriculture and food (AGRAL);**
- **Life and health (VIASAN);**
- **Environment, energy, resources (MENER);**
- **Territory arrangement and transportation (AMTRANS);**
- **Stimulation of the application of inventions (INVENT), oriented towards the achievement of new products and technologies, based on patents owned by Romanian inventors;**
- **Economic re-launching by research and innovation (RELANSIN), targeting the modernization of the products, technologies and services supplied/used by economic units;**
- **Quality and standardization (CALIST), supporting the increase of quality of Romanian products and technologies, partly in order to facilitate access to the EU Single Market;**
- **Consolidation of the quality infrastructures (INFRAS) supporting the development of quality infrastructures in accordance with EU principles and practices;**
- **Informational society (INFOSOC);**
- **Biotechnologies (BIOTECH);**
- **New materials, micro and nano-technologies (MANNANTECH);**
- **Technologies in the spatial and aeronautics field (AEROSPATIAL)**
- **Program for international cooperation and partnership (CORINT);**
- **Program for Fundamental research of social, economic and cultural interest (CERES).**

Source: National Plan for R&D and Innovation

statements in the same evaluation report, "The National Plan was only partially implemented, due to lack of funds. The funding of R&D activities in Romania is very low (0.41% from GDP in 1999) compared to many European countries, falling much under the European average (1.92% in 1999)." For realizing the scale of under-financing of the R&D area in Romania, we must mention that this percentage applies to Romanian GDP, which is ten times lower than in the advanced European countries. In the latter, the R&D share has already reached 3% in some countries.

The difficulties the R&D field has to meet due to under-financing, as well as the assessment of the European Commission concerning the "*efforts that must be made for ensuring a proper level of financing the R&D sector*" must keep making the decision actors responsible for public funds allocation, as well as finding new financing resources and incentives for the expenditure on R&D to reach at least 1% of GDP.

The National R&D "2000 Horizon" Program an important stage of setting and implementing priorities.[2] The program was designed to combine the structural and thematic priorities for economic and social development, on the following criteria:

- the alignment with the priority areas for economic and social development, in conformity with the sectoral and national government strategies and with the thematic criteria of the EU's Fourth R&D Framework Program;
- dealing with inter-disciplinary research areas;
- preservation of R&D capacity;
- sustaining R&D programs through support actions.

From a structural perspective, this program aims at the following objectives:

[2]*The "2000 Horizon" Program was constructed from 1994 to 1995 and adopted through the Government Decision nr.1095/1995 as a national version of the Fourth EU Framework Program.*

- building an efficient and secure infrastructure
- increase of industrial competitiveness and technological and industrial integration into European standards and regulations;
- environmental protection and quality;
- increase of the degree of Romania's participation in international scientific and technical activities.

The selected thematic directions, starting with the provisions of the government strategies and in the view of the Fourth EU Framework Program, are the following:

- infrastructure, communication and information technology networks
  - making infrastructure networks compatible with European and world standards and tendencies;
  - dealing with components of the future information society;
- energy and resources
  - discovering new sources and technologies;
  - national capitalization of the natural resources;
- food and agriculture
  - better capitalization of agricultu-ral, wood and fish natural resources to ensure the food security of population;
- environment and environmental and monitoring technologies, the Black Sea
  - environmental protection and monitoring methods and techniques
- health and biotechnologies
  - improving conditions of health;
  - new diagnostic techniques and methods;
  - treatment and prevention.

The "2000 Horizon" Program started in 1996 and was designed to end in 2002. It was launched through an open competition system, allowing all public and private, as well as university, academic and industrial units to access the research programs, elaborated and coordinated by the 22 R&D commissions. The financing of this program was obtained from the state budget, through the responsible governmental authority (MCT, ANSTI, MEC).

Regarding the selection of thematic priorities, it could be appreciated that there was certain concern at the public authorities' level, which created 22 commissions to direct the R&D activity on priority areas. However, due to a series of drawbacks and opposing patterns (the disappearance of some research institutes and the appearance of others, the obvious tendency of researchers to migrate to other better-paid fields or to other countries) or to the way of working of consultative commissions for research functioning, in practice there were identified several divergences in priority selection from the perspective of the National Program provisions.

Among the factors which contributed to the "non-priority" funds allocation, the following can be mentioned: the expert commissions where the thematic offers were selected for financing included representatives of the main funding beneficiaries; the evaluation system was not always based on scientific awards criteria and met difficulties in dealing with the, sometimes, partial evaluators; the small numbers relative to the wide choice of offers and extreme thematic variety; the restrictions enforced by the Ministry of Finance in allocation of funds to different destinations; the granting of only a small amount of the needed funds for most of the projects, therefore under-financing them. In fact in the opinion of one of the ANSTI presidents, the "2000 Horizon" National Plan aimed at financing "all that Romanian science could offer". For instance, in 1998, there were financed 8286 themes, operational programs, zoning and various

subject programs, carried out in hundreds of national institutes, the Romanian Academy, higher education units, nongovernmental organizations, as well as public and private commercial companies, leading to multiplying thematic priorities to the limit of granting financing to extremely reduced shares compared to the need for quality research of an important part of the funds demands.

Data analysis from 1997 to 1999 referring to the "2000 Horizon" Program, the main instrument of promoting R&D policy in Romania, allows evaluation of the way of establishing and implementing priorities through funds allocation towards scientific commissions (structural priorities) and towards thematic directions as well.

The allocation of funds within this program towards scientific commissions chiefly reveals a phenomenon of inertia about scientific concerns inherited from the former period, and on a different scale a similar industrial and economic structure and R&D. Thus, from 1997 to 1999, with a background of substantial cutbacks on allocated funds on commissions within the "2000 Horizon" Program, the expenditure structure actually remained the same. The most important part of the funds was allocated to financing projects from the following fields: mechanical engineering (Commission 4), agriculture, food and wood industry (Commission 12), electro-technical, electronics, and mechanics (Commission 6), physics, mathematics (commission 15), and chemistry (Commission 7). In 1999, the projects financed within those five above-mentioned commissions represented almost 60% of the total of funds allocated to this program.

Analysis of priorities within Scientific Commissions that absorbed most of the funds from 1997-1999 allows the observation that the priorities in applied research fields, relevant for economic fields, were too general in character, without a channelling of funds to real priority fields for the development stages being undergone in this period in Romania.

The high degree of generality of "thematic priorities" is revealed by the great similarity between their formulation and the name of the commissions and even by defining programs established within each thematic direction. On the other hand, over the three years of data analyzed here, the thematic structure of funds remained almost unchanged. In other words:

- 37% of the total funds were given to projects on industrial products and technologies,
- 14% on agriculture, wood and food industry,
- 13% on basic sciences,
- 5% on town planning, construction and construction materials.

The relationship between the R&D priorities and social and economic development. The slow progress of the selection of priorities in R&D in Romania was determined by many factors, generated by inertia regarding legacy models and by the meanders and risks of the evolution of the whole economic, social and political transition process. Furthermore, the priority selection mechanism was influenced by a series of elements specific to the R&D system, under pressure after 1990 to search for new paths. In the absence of a new strategy for selecting viable priority fields, the industrial research system went bankrupt through an inability to be self-sustaining financially, following the cutting of funds from 1990 and breaking the links with the economic system, in an uncertain context. Worthy teams of researchers, trained over decades in Romania, fell apart after 1990; some of them emigrated and established themselves as researchers abroad and others migrated to fields of

activity capable of providing a decent life. However, even now, a market for industrial research has not been built and the demand for this activity has not been formulated yet, which has led to defining "priorities" by the supply, with policy-makers not giving enough signals related to the long-term economic development strategy. As a result, R&D activity could define priorities in the light of worldwide tendencies in science and technology, because of the present situation and especially the perspectives of the Romanian economy.

This lack of compatibility between the evolution of the R&D and the industrial system is revealed by comparative analysis of the structure of the allocated research funds for the main branches of manufacturing, and of importance of the branches of industrial production in overall exports. It is noticeable that "priorities" in the allocation of funds for R&D do not match with the tendencies of present development of Romanian industry. Thus, in branches making an important contribution to industrial production and exports, a reduced research activity was registered, for instance in textiles or leather footwear. The fields absorbing most of the research funds instead, like metallic construction, machinery and equipment, contribute only 8.8% to industrial production and 8.3% to exports. The latter activities together with a few others such as chemistry and metallurgy absorb 90% of the expenditures on R&D (allocated to the sector of processing industry), while having only 28.7% of total production and 23.4% of exports.

In this context, there arises the question of defining the priorities for Romanian industry for the next period, and whether they will be those of the first 14 years of transition or other new basic priorities both in industry and in research and development.

In conclusion, establishing priorities in R&D is at a preliminary stage, taking into account that only after 1999 was this problem was seriously raised within the context of approaches to European integration. The issue of setting priorities, although extremely important and pressing, under the conditions of serious cuts in R&D expenditure in GDP over the last 5 years, is tackled at present only at a formal level, without institutions, mechanisms or even resources for implementing selected priorities. Extreme thematic and institutional loss, lack of participation of branch ministries, and of users of the research outputs, all constitute a barrier blocking the setting of priorities on key scientific, technical, social and economic fields of interest. Building on these, there has been confusion existing over a long period of time regarding the restructuring directions of the main branches of the economy.

Through the project of the new *Law of Scientific Research and Technological Development* there appeared a series of favourable premises through setting up a National Council for Science and Technology Policy, having as its role that of setting viable priorities within the National R&D Strategy. There were also set out initiatives for building consultative committees for Research, Development and Innovation, having a large representation of the scientific community, of ministries and of relevant economic agents.

3. PRESENT KEY CHALLENGES: S&T POLICY-MAKING IN ROMANIA IN A EUROPEAN CONTEXT

R&D Priorities in government documents:

- The National Strategy of Romanian Medium-Term Economic Development: 2000-2004. The issue of establishing priorities in R&D was given new significance in

December 1999, once Romania was invited to start negotiations to join the EU. The preparation of Romania for integration into the EU is a complex process aiming at promoting a coherent policy, compatible with the EU mechanisms in R&D. In the National Strategy for Economic Development of Romania in the medium term, comprising the main objectives and policy needed for Romania to meet the main requirements to accede to the EU in 2007, policy-making in science and technology takes a special place. It contains the priority objectives of RDI referring to:

- the development of the capacity for producing scientific and technological knowledge;
- the increase of the R&D units' quality and efficiency through developing specific infrastructure, improving management and pay, and increasing the capacity of absorption of the research outputs;
- the development of the R&D and innovation potential at the firm level through conducting joint projects with the institutions and the expert centres and using co-financing incentive schemes;
- the gradual increase of R&D and innovation expenditure shares in GDP, to levels compatible with the EU member countries.

As can be noticed, the formulation of these objectives is quite general and does not allow the revealing of specific strategic priorities in the field for the next period.

- Priorities of RDI in the Government Program from 2001 to 2004 (The Official Monitor of Romania nr. 700, 2000, Dec. 28). From the government program the following priorities for the RDI field can be drawn:

- the restructuring of the national system of scientific research through defining the strategic fields and financing of research in these areas; the diversification of funding sources; a better capitalization of the research outputs and Romanian inventions;
- the adjusting of the national system of RDI to the requirements of the process of EU integration;
- the endowment and informatization of a research unit system providing better compatibility with EU levels;
- the strengthening of networks between research and industry at a national and regional level through developing specific institutions;
- the increase of interest in science through a specific training and incentive system;
- the provision of a legislative framework (the research law and the researcher regulations) needed for efficient functioning and development of the national system of research, development and innovation.

In the years following the launching of this program, there have been slight concerns to apply a series of measures aiming at meeting the targeted objectives. Thus, a package of laws to deal with the unsettled issues was forwarded to the parliament for debate in 2001-2004. These concern: the Law Project of Scientific Research and Technological Development; the Law Project referring to Regulations affecting R&D Personnel; the Law Project referring to establishing the way of Approving the Budgets of Incomes and Expenses of national institutions of research and development; the Law Project for completion of the Government Decision nr. 25/1995 regarding the regulations for organizing and financing research and development activity; the Law regarding the organization and functioning of the Ministry of Education and Research; the Law dealing with ethical concerns in developing technological research and innovation. The provisions of these laws constitute a

favourable basis for meeting the above objectives. There has been increasing concern recently related to the capitalization of research outputs, especially in technological terms, through creating industrial and scientific parks (starting from 2002).

In this context, there are some examples of achievements that indicate the reliability of measures undertaken in 2001-2002, mentioned in the *RDI between 2001-2002 Report* drafted by the Ministry of Education and Research (January 2003), such as:

- 5 times increase of the amount of funds from the economy that went to the R&D units in 2001 compared to 2000.
- 9 times more funds from the European Union granted to the R&D units through participation in the Fifth Framework Program of technological research and development.
- In 2001 and 2002, a new positive trend was inaugurated, targeting stabilization and increase in the number of employees in the research-development-innovation field. The younger generation (students, young researchers) has become more motivated and involved in national RDI projects. More than 2,800 new young researchers entered the doors of institutes and units that have research, development, design and innovation as their main activity. The Romanian scientific community is thus relatively protected, being ensured of the regeneration of the specialist groups.
- For the first time in the history of Romanian scientific research, the country won first place in 2001 and 2002 in international inventions showrooms, the majority with gold medals (awards for acknowledgement at a global level).

The Romanian RDI integration into the European Research Area. By 2001, the focus on setting objectives and priorities in RDI came almost exclusively to be put on European integration, within the framework of creating the European Research Area (ERA) as its main direction. This concern for complying with EU directions and priorities is expected to result in boosting scientific research and technological development in Romania. It must be taken into account that the European RDI system itself is undergoing a new stage of restructuring for closing the performance gaps relative to its main overseas competitor, the USA.

The European Research Area is a long-term strategy of the EU. In the medium term, from 2002 to 2006, the priorities were defined through the document "*Making a Reality of the European Research Area*", where the practical actions and instruments of the ERA that would be implemented through the Fourth to Sixth Framework Programs were mentioned.

The Romanian standpoint regarding integration into the ERA was sustained through a series of documents reflecting the acceptance of *acquis communitaire* regarding science and research. In these documents, a series of general priorities are recorded, for instance:

- developing the legislative, financial and organizational support for assuring the participation in the EC Framework Programs;
- the general preparation of the field for accession, and for integration into the ERA;
- the correlation of national research programs, building networks of excellence and specific large research projects.

Romania aims at permanently meeting the needs of the national RDI with the EU, of building the ERA and the priority actions for creating it as a similar framework. Nonetheless, the priorities of scientific research and Romanian technological development formulated in the documents regarding integration into the European

Research Area involve national specificities, coming from the restructuring and re-engineering of the needs of some structural components of the R&D system, having a higher degree of inertia, and meeting the present and future needs of the country.

Thus, promoting the training and development of the centres of excellence and ensuring some domestic professional competency and expert sources in state-of-the-art science and technology in priority economic fields is considered a key priority for Romania, too. Starting with the present situation, and taking into account the future possibilities and needs in this field, the responsible actors consider that this intent is applicable through evaluation and systematic accreditation of RDI organizations, using European criteria to allow selecting expert RDI and therefore a better allocation of public funds for R&D. To meet this objective in the *Project of the Research Law* that was discussed and approved by the parliament, there is provision for creating an institution of expert evaluation, as a key to setting priorities in expert and applicable R&D fields and to a better allocation of R&D public funds. Ensuring competence and high scientific and technological expertise will be realized through cooperation with the European countries in science and technology as well as developing a network system to include the RDI organization of the EU member states and candidate countries.

The gap between infrastructure development in Romania compared to other European developed countries is rather alarming. Within the context of low and decreasing investment funds over the last few years and of slight concern for improving the facilities of some institutes with state-of-the-art equipment, up-to-date research work and the building of modern, applicable partnerships to allow the access of Romanian researchers to European programs are difficult to foresee. In 1996, the capital expenditure share in total R&D expenditure was about 7.2% and in 2001 this indicator reached 11.9% (from an extremely reduced volume of R&D expenditure representing only 0.39% of GDP, even if the nominal dynamics in 2001-2002 were favourable as stated earlier). Therefore, an important objective that Romania must have in view to approach compatibility with the EU level proposals is the development of the research infra-structure.

To improve its existing standing, Romania aims at developing some centres providing facilities and work conditions at the European level, supporting the access of Romanian researchers to important EU research facilities, developing information and communication infrastructure in R&D units, creating a national network of computers for research and a rapid communication environment, having high capacity networks to include both the RDI units of the EU member states and Romania.

The creative potential of a country, in producing and using knowledge, can be seen in the indicator "the share of researchers in the total workforce". Having 1.71 full-time researchers per 1000 employees, Romania is under the average of EU (5.5/1000 employees) and well under some developed EU countries: Finland, Sweden, Denmark, France, Germany, Great Britain (*see Table 4* for more details). Romania has a human research potential expressed in a small number of researchers per 1000 inhabitants, far less than other European country, and there have been important cuts in recorded researchers lately. Thus, in 2001, the recorded researchers represented a third less than in 1995. This decrease in the number of researchers must be evaluated in connection

with the research personnel flows, considering the fact that a series of valuable young researchers have left this field for better-paid workplaces throughout the country or abroad. The share of young researchers under 30 was in 2001 only 14.3% of the total researchers.

Taking into consideration the above-mentioned facts, another priority in the Governmental Programs of Integration into the European Research Area is the development of human resources in the scientific, technical and innovation area. With this purpose in mind, there are planned actions of recruiting and training young researchers following the European model of scientific careers and making and promoting a legislative framework for researchers.

To comply with the EC objective of strengthening the innovation capacity of firms through scientific and technological research, Romania intends the promotion of some specific national programs, the cooperation between R&D units and high-tech firms, the design of programs to build an information network, documentation and support for SMEs oriented to new technologies, and the increased capacity of the R&D units to spread knowledge and research outputs as well as their experience. The stimulation of technological transfer, of demand for research services and of research output absorption in existing firms will be supported by setting up the *National Investment Fund for Research and Development* (a Risk Fund for applying R&D results).

In meeting this objective, the low level of research in Romania and the low capitalization of research outputs in industrial production must be taken into consideration. From the existing statistical data it can be stated that the share of enterprises undertaking R&D activity out of a total of enterprises in the processing industry decreased from 10.1% in 1999 to 5.2% in 2001.The lowest rate of decrease can be observed in the traditional industry branches as follows: *the processing of crude oil and coal, rubber and plastics, chemistry and synthetic and artificial fibres, and metallurgy*.

Regarding the overall processing industry, the share of enterprises where new and improved products have an important share in business and exports is much reduced compared to firms that undertake R&D activities. In 1999, 2.8% of the total number of enterprises had a higher share of new and updated products than 10% of their turnover and 2% in terms of exports, but by 2001 these shares were respectively 2.1% and 2.4%. Even for enterprises in modern branches producing higher value-added goods and with strong research activity (machinery and electrical devices, radios, TVs and telecommunication equipment, medical precision instruments, optics and clock-making), there is no tight correlation between research activity and their economic performance.

At present, at the European level there is the opinion that the key to success in research is partnership and scientific collaboration.

Within this context, a condition of participation in the EU R&D Framework Programs is, on the one hand, the building of a complex multinational team, of high professional training and an openness to cooperate and integrate into international teams, and on the other hand, the capacity and the co-financing will of the governments in the participating countries. Romania, which lacks sufficient resources to develop research activity at the present level of requirements, could capitalize, to a greater extent, on the advantages offered by collaboration with European plans within

Box 2. Success stories: Romanian Innovations of global use in the IT industry

1. Microsoft, the leading global software producer, acquired in June 2003 the Romanian owned private company **GeCad** – a firm started from scratch in the early 1990s by a group of students. The main product of the Romanian company was a locally developed antivirus program named RAV. Following this acquisition, Microsoft announced plans to use the RAV application in its products.

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

3. Another IT company of local origin, benefiting from continuous product innovation, is **Flamingo** – it has now become a multinational company *de facto*, with affiliates in seven EU member states and candidate countries.

the Fifth and Sixth Framework Programs. The capitalization of these opportunities implies both a long-term financial effort by Romania itself and the increased capacity of Romanian research to offer expert partners and to improve the quality and efficiency of participation in the European programs.

According to the assessment of the European Commission, the financial contribution of Romania to the budget of the Fifth Framework Program was significant for a limited resource country. Despite the fact that Romania increasingly supports the budget of European programs, unfortunately, the degree of participation of researchers in the Community programs was not in accordance with the national financial effort. Thus, in 2001, Romania registered the lowest participation rate of European countries applying for integration as well as a reduced number of signed contracts.

There are many factors explaining the low efficiency of the participation of Romania in the research activity carried out in the European programs, among which we can mention: the Romanian research isolation from the international scientific community before 1989, leading to behaviours and constraints on collaboration with expert partners from abroad; the lack of domestic cooperation even between the research units in industrial scientific academies and universities; administrative, institutional and legislative malfunctions; the lack of proper infrastructure for outstanding research; etc. However, the European Commission appreciates that "*the recent reorganization of research activities at a governmental level is an important accomplishment. Nevertheless, the intensifying of cooperation between the research centres, universities and enterprises to ensure a successful participation in the EU Framework Programs is compulsory*."

The improvement of the quality and efficiency of Romanian researchers' participation in the EU R&D programs constitutes a concern for the responsible institutions under the circumstances of being a negotiation chapter for accession to the EU. Within this context the government involvement must not curb the financial contribution to the budget of European

Framework Programs, but there is a need for greater concern for co-financing the winning projects and ensuring a satisfactory management of them, as well as of some specific structures for their implementation (committees, consultant groups and evaluation teams).

Another condition for developing scientific and technological activity in Romania, for its compatibility with the European level, and for increasing the international competitiveness of Romanian research, consists of ensuring its access to the facilities offered by the Internet and other communication and information technologies. "Access to the Internet at home" constitutes a key evaluation indicator of the innovative capacity of different countries. At the EU level, the share of households connected to Internet networks in the R&D field in 2000 was 28%. In the meantime, in high performance countries this indicator was over 40%: Netherlands, Sweden, Denmark, Finland, Great Britain; in the USA this share is 47%.

In Romania, the access to this infrastructure is limited at present, firstly because of extremely high cost of equipment and connection to special networks compared to the decreasing incomes of potential users. Data provided by the 2001 Human Development Report indicate the cost of connecting to the Internet in the USA, for instance, represents 1.2% of average monthly income. In our estimation, in Romania the cost of using the Internet at home was about 50% of the average net monthly salary in the economy (in March 2002).

If individual access to the internet is difficult, it must be underlined that, unfortunately, not even in the research institutes can the open access of researchers to the information offered by this infrastructure be provided; therefore this represents a major disability both in communicating with researchers from other countries and consequently in finding partners to access European programs and for rapid information in the field of interest as well. Within this context, we must mention that the budget finance, beyond its extremely low level, imposes restrictions on the allocation of funds so that most of them are channelled into payment of salaries.

There are some favourable premises for alleviating shortcomings regarding public financing, as a consequence of the Romanian RDI system's integration into the ERA, as this would imply the adoption of some package of rules concerning financing from specific public European funds of RDI: minimal rates of financing from public funds of RDI; minimal rates for institutional financing from public funds ("core funding", investments); public policies for boosting investments in RDI; and the increasing role of venture capital in financing research.

The involvement of the scientific and technological community in Romania in designing the Framework projects can be improved, both through approved actions by the public authorities aiming at developing a viable collaboration in R&D through partnership with potential participants from the EU member countries, and through stimulation of a proactive attitude towards identification and ensuring of a higher capitalization of participation opportunities and improvement of the capacity to formulate consistent and competitive proposals.

The improvement of the quality and efficiency of Romanian participation in the EU Framework Programs presupposes the harmonization and political consistency of long-term science and technology policy in the European Research Area (the formulation of objectives, planning and

correlation of activities and implementation) through: intensifying the dialogue with representative European organisations; formulation of adequate action plans to apply and implement national policies; the development of an adequate participation framework in the Community programs in accordance with the present research development potential, at program and project level, through launching negotiations on time; having in view a more realistic evaluation of national policy and the financing capacity of participating in large projects. Meeting these objectives and creating an adequate framework of participation in the EU programs is dependent on ensuring a proper financing of the R&D system in Romania; it is estimated that the minimum financing level allowing the implementation of the above objectives is more than 1% of the GDP (about 150 EURO/inhabitant or 300,000 EURO/researcher), compared to the actual figure of 0.39% in 2001.

Taking into consideration the large gap between existing and necessary resources to meet the objectives formulated by the governmental institutions in R&D, for instance: "the promoting of excellence in science and technology through a unitary system of evaluation of the R&D units of activities and personnel based on international standards; the formation and development of centres of excellence as research units that gather material and human resources of high performance in science and technology and are acknowledged worldwide; the encouraging and supporting of training and building a researcher career and the acknowledgement of the importance and value of scientists and researchers", these appear as being unrealistic and difficult to meet in a relatively short period of time.

Meeting the ambitious objectives included in the Action Plan for integration into the ERA, for instance developing the R&D infrastructure in Romania at a European level, granting adequate equipment and facilities to the institutions and universities, developing a network of research labs working in the same or similar fields and having complementary facilities, creating at a regional level an infrastructure of adequate size having a direct impact on the absorptive capacity of R&D outputs by the economic environment (parks of science and technology), developing research centres that are competitive at the European level, to attract international programs and researchers from other countries especially from Europe, and of centres or networks of services for R&D (professional training, consulting, technical assistance and information) all these imply a large volume of investments that cannot be supported from the extremely low funds allocated to the R&D field in Romania.

The increased volume of funds for R&D and especially their allocation and efficient use are even more important in view of a tight cooperation between Romania's national research area and the European one, through facilitating communication and correlation of activities between the researchers in Romania and the EU member states, the openness of the national research programs to European area researchers, the variation of forms and intensification for the mobility of researchers and professionals in the short and medium term between RDI organizations, universities and industries from member states and candidate countries.

CONCLUSION

In conclusion, the very high absolute and relative gaps between Romania and the EU indicate that we are far away from closing them. Until a few years ago, "thematic priorities" in Romanian S&T

policy continued to be set according to traditional scientific weightings rather than to meet social and economic needs. The integration of the Romanian R&D system into the European Research Area, as a major objective of the present period, presupposes not only special financial efforts but the compatibility of information, legislation and management systems as well, and especially the volume of financing with that of the European Union. At the same time, this implies overcoming barriers of communication in R&D, on both a national and international level, that would better value the national research potential and the statement of Romanian research values, the boosting of firm-level research conditioned especially by the launching of industrial production, the increasing contribution of industry to the national effort in research and development, and last but not least, a more efficient capitalization of research outputs in the economy and society.

REFERENCES:

- *Romanian Government (2000), Strategia Nationala de Dezvoltare Economica a Romaniei pe termen mediu, Bucharest , p.31;*
- *Government Program of Development in 2001-2004, Official Monitor, 1st part, no.700/28-XII-2000, chp."Scientific Research";*
- *Government of Romania, MER (2001), Romanian Position Paper on the EC Communication "Making a Reality of the European Research Area;*
- *Government of Romania, MER (2003), RDI between 2001 2002 Report*;
- *EC (1997), The European Report on Science and Tehnology Indicators 1994, Report EUR 15897, Brussels, Luxemburg;*
- *EC (1997), Second European Report on S&T Indicators 1997, EUR 17639 EN, Brussels, Luxemburg;*
- *EC (2000), Innovation in a knowledge-driven economy, in Innovation and Technology Transfer, Special Edition,*
- *EC (2000), The intangible economy impact and policy issues, RCN 15959, în CORDIS FOCUS, nr. 164/2000, p. 8*
- *EC (2000), Commision Staff Working Paper: „Trends in European Innovation Policy and the Climate for Innovation in the Union, COM(2000) 56;*
- *EC (2000), 2000 Regular Report, from the Commission on Romania's progress towards Accession;*
- *EC (2001), 2001 Regular Report from the Commission on Romania's progress towards accession;*
- *EC (2001), European Charter for Small Enterprises, în Innovation & Technology Transfer, nr.1/2001, p.3*
- *EC (2001), Spain Supports ERA but with conditions, în CORDIS FOCUS, nr.165/2001, p.3*
- *EC (2001), Report from the Commission: Research and Technology.*
- *EC (2000), Europe needs more than the RTD Framework Programme, în CORDIS FOCUS, nr.155/2000*
- *EC (2001),„Innovation in EU Candidate Countries: Flight simulator for Innovation pilots?" in Innovation and Technology Transfer , nr.6/2001.p.17*

- *EU (2001), Special Edition-Indicators for Benchmarking of National Research Policies, Luxemburg;*
- *EC (2001), European Innovation Scoreboard 2001, Cordis Focus Supplement Issue nr.18, september 2001;*
- *EC (2001), Directorate General'Enterprises, The Trend Chart on Innovation, 2000 - 2001;*
- *EC (2001), Development activities of the European Union, 2001 Annual Report, Brussels, 12/12/2001, COM92001)756 final*
- *EC (2003), S&T Institutions and Policies in the EU Acceding Countries. Challenges for the development of the Knowledge Based Economy, Blaž GOLOB, draft;*
- *EC (2004), Towards a European Research Area- Key Figures 2003-2004.*