

Romania's Research & Development and Innovation Potential

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Abstract

The paper deals with the evolution of the National Research & Development and Innovation system during 2001-2006 years, its institutional organization and contribution to enhancing national creation potential in the field of technical and technological news. A special attention is given to dissimilar R&D and innovation potential of manufacturing industry sectors, as well as causes of differences between the respective sectors. Finally recommendations are formulated aiming at improving the national R&D and innovation potential, according to the requirements of Romania's integration into the European Area of Knowledge.

Key words: *national R&D and Innovation system, R&D activity financing, human potential, innovation potential, scientific and technological parks*

JEL Classification: *03, 032*

Introduction

The essential role of Research & Development (R&D) and innovation activity, among the most dynamic in modern economy, as the main driving force of economic development, was postulated long ago.

The most revealing vision about this role belongs to M. Porter – related to a country economic development stages and, implicitly, to its increasing competitiveness on international arena, respectively to the evolution from resource based economy to the investment based one and, then, to the knowledge based one ¹.

According to this author, prosperity of a country is created, not inherited, its economy's competitiveness depending on the industry's capacity to innovate and to modernize itself, and its companies' competitiveness – on the pressures and challenges they are subjected to, respectively on the existence of rival domestic strong companies, aggressive suppliers and demanding domestic clients. In the growing global competition, its fundamentals are moving from factors endowment and investment to creativity and knowledge assimilation, competitive advantage being achieved by increasingly localized processes; in this sense, a determining contribution is offered by the differences in economic structures, institutional framework, traditions, national values, and culture. Such a vision adds new qualitative elements to

¹ Porter, M., *Competitive Advantage of Nations*, Free Press, New York, 1980

traditional conceptions - as labour force cost, scale economies, interest rates, exchange rate of national currency - which are the most important competitiveness determining factors.

In the world competition, the companies conceive and apply their own strategies, but the common action modes and trajectories pursued are, in general, the same, all of them placing innovation efforts at the development basis of both technology and new activities achievement ways. Consequently, innovation becomes manifest, prevailingly, in constructive and functional improvement of products, technological modernizing, new marketing approaches, improvement of human resources training processes. Even if the majority of innovations are incremental, based on limited progress in knowledge and outcomes, increase of innovation potential supposes substantial investment in the field of knowledge and new abilities development, as well as in incorporated assets and company's image building.

In the process of action stimulating of all companies, including the small and medium sized ones, aiming at developing their innovation potential and consolidating competitive advantages on domestic and international markets, an essential role devolves upon R&D and innovation (RDI) national system, consisting of institutional framework of national and local specialized bodies, functional mechanisms connecting this framework to companies, legal regulations concerning intellectual property rights, venture-capital promotion, fiscal facilities granted to strong innovative companies, etc. The force of RDI national system lies, chiefly, in its capacity to harmonize, in the context of macroeconomic stability, different factors such as governance quality, society capacity to develop its technological capabilities and new competition ways, to stimulate structural adjustment of companies.

Romanian RDI Institutional System

In the light of these pre-requisites, the present paper will focus on the current condition of the national RDI system and the extent to which it stimulates the innovation potential of companies and increases their competitiveness.

The system is made up of „institutions, organizations and persons' network that contribute to generating, spreading and use of technologies and other knowledge, which, in their turn, explain the model, the pace, and the innovation rate and their economic successes”². The system includes:

1. *parliamentary institutions: commissions for Education, Science, and Sports*, in both chambers of the Parliament;
2. *governmental institutions:*
 - *ministries coordinating R&D national institutes (11 ministries, 34 national institutes);*
 - *National Council for Science and Technology Policy* (coordinating and correlating body of RDI policies and other economic and social policies);
 - *Quality National System – Romanian Agency for Standardization (ASRO) and Romanian Accrediting Association (RENAR);*
 - *National System for Intellectual Property Protection – National Office for Inventions and Trade Marks and Romanian Office for Author Rights;*

² Lundvall, B. Å., “Introduction, National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning”, in: Martin, B.R., Nightingale, P., *The Political Economy of Science, Technology and Innovation*, Cheltenham: Edward Elgar Publishing Ltd., 2000, ISBN 1858989612, pp. 524-43

- *specialized strategic agencies coordinating R&D in specific fields – Nuclear Agency, Romanian Spacial Agency;*
- 3. *national coordinating institutions:* The Romanian Academy (structured in 14 specialized sections in technical sciences, fundamental sciences, and socio-human sciences; it has its own national network including 65 institutions and centers of research, and manages own research programs); branch academies – Medical Sciences Academy (23 research institutes and centers, 12 clinics affiliated to medical universities) and Agricultural and Forest Sciences Academy (25 research institutes și centers, 91 production and research units);
- 4. *consultative bodies of the Education and Research Ministry:* *Interministerial Council for Science, Technology, and Innovation* (including secretaries of state from different ministries, providing for correlation of RDI policy with other governmental strategies and policies), *Consultative Committee for RDI* (including representative personalities of scientific and technological community from R&D institutes, universities, industry, and services), *National Council for Scientific Research in Tertiary Education - CNCSIS* (including representatives of academic community), *strategical orientation councils related to programs of the RDI National Plan* (establishes and up-dates priorities and objectives of these programs), *Tripartite Commission for Social Dialogue* (ensures constitutional framework for consultations with social partners – trade unions and employers), *Council of Research Grants of the Romanian Academy* (including representatives of research sections of the Academy);
- 5. *proper R&D organizations;*
- 6. *universities:* 56 public, with more than 700 faculties, and 18 private;
- 7. *other institutions related to innovation,* included in *Romanian Network for Innovation and Technological Transfer – functional scientific and technological parks, techological transfer centers, techological and business incubators.*

In the national RDI system, R&D activity is carried out on three major *coordinates*:

- *technological research* (about 85% of total activity volume), achieved within the National RDI Plan and financed on competitive basis by the Education and Research Ministry;
- *oriented research* in fields of natural, exact, and socio-human sciences (about 10% out of total volume), achieved by the Romanian Academy network units and, partially, by those of branch academies, financed, prevailingly, on institutional basis;
- *university research* (about 5% out of total volume), achieved within programs coordinated by the CNCSIS and financed on competitive basis from special granted funds.

In conclusion, one can appreciate that the national RDI system has a comprehensive institutional framework, with diversified bodies, able to accordingly manage the actions intended to apply science and technology strategy and policies; but scanty articulation of constitutive parts of the system is brought about by their insufficient communication, generating numerous dysfunctions and harming efficiency and performances of the whole system.

R&D Activity Financing

R&D activity achieved by the specialized units mentioned above are financed from the national budget ear-marked to R&D, and from non-budgetary sources belonging to economic agents.

Public expenses are ensured for different *programs* as follows:

- programs coordinated by the Ministry of Education and Research – RDI National Plan, programs for scientific research grants, nucleus - research programs, sectoral R&D plans, other programs (for organizing scientific events, exhibitions, for researchers' mobility, etc.);

- research programs coordinated by the Romanian Academy – priority and essential national projects concerning scientific and cultural complex themes, with effects at the national level; scientific research programs granted by the Romanian Academy.

During the period 2001-2006, evolution of R&D expenditures – total and by execution sector, is shown in the next table.

Table 1. R&D expenditure, total amount and by execution sector, 2001-2006

	2001	2002	2003	2004	2005	2006
Total expenditure, thousand lei current prices	459,343	574,386	762,065	952,872	1,183,659	1,565,802
%, of which:	100.0	100.0	100.0	100.0	100.0	100.0
Enterprises sector (%)	61.6	60.2	58.2	55.3	49.7	48.5
Governmental sector (%)	27.1	24.2	32.1	34.1	34.2	32.3
Tertiary education sector (%)	11.3	15.6	9.4	10.1	13.7	17.7
Non-profit private sector (%)	...	...	0.3	0.4	2.4	1.5
Current expenditure, thousand lei current prices	404,841	499,045	673,211	861,256	1,040,367	1,319,247
%, of which:	100.0	100.0	100.0	100.0	100.0	100.0
Enterprises sector (%)	64.8	63.6	58.5	54.6	50.5	49.2
Governmental sector (%)	27.1	26.9	34.9	36.1	35.4	33.0
Tertiary education sector (%)	8.0	9.6	6.3	8.8	11.6	16.1
Non-profit private sector (%)	...	...	0.3	0.5	2.5	1.7
Capital expenditure (investment), thousand lei current prices	54,502	75,341	88,854	91,616	143,292	246,555
%, of which:	100.0	100.0	100.0	100.0	100.0	100.0
Enterprises sector (%)	38.0	38.4	55.4	61.9	44.4	44.6
Governmental sector (%)	26.3	6.3	11.1	15.8	25.3	29.0
Tertiary education sector (%)	35.7	55.3	33.2	22.0	28.6	26.4
Non-profit private sector (%)	...	...	0.3	0.3	1.7	0.03

Source: processing of data from Institutul Național de Statistică. Anuarul Statistic al României, 2007, București, 2008, p. 483

The figures highlight very sinuous evolutions of different sectors' weights in total amount of expenditure, both of current and capital one; this reality makes it difficult to draw some clear conclusions concerning the trends of respective sectors participating to expenditure. However, some *conclusions* can be formulated as follows:

- diminishing of enterprise sector weight in the total amount and current one, which represents a diverging trend with existing conditions in developed countries;
- fluctuating trend of increasing governmental sector weight in the three categories of expenditure mentioned above, increasing pressure on public budget;
- significant increase of tertiary education sector weight in the total amount of expenditure and in the current one, which represents a converging trend with the situation existing in a good part of the European Union member countries; maintaining a poor level of its weight in investment (equipment, apparatus, etc.), explaining the precarious level of technical infrastructure in most universities;
- insignificant weight of the non-profit sector in all analysed expenditure categories;
- it is also worth mentioning the noticeable weight of public sector in all categories of expenditure by 2006: 71.5% in total amount, 72.5% in current expenditure and 65.8% in capital one, reflecting still modest contribution of private sector in the national RDI system.

In spite of political rhetorics, R&D activity has strongly been under-financed after 1990, the weight of the total R&D expenditure, public and private, in GDP, shown for the years 2001-2006 in the next table, being one of the scantiest among the European countries.

Table 2. Weight of total R&D expenditure in GDP, 2001-2006

	2001	2002	2003	2004	2005	2006
%	0.39	0.38	0.39	0.39	0.41	0.45

Source: processing of data from Institutul Național de Statistică. Anuarul Statistic al României, 2007, București, 2008, pp. 437 and 483

It should be recalled that, for instance, by 2004, R&D intensity, namely the weight of expenditure for this activity in GDP, was of 3.74% in Sweden, 3.51% in Finland, 2.63% in Denmark, 2.49% in Germany, 2.16% in France, 1.88% in the United Kingdom, 1.28% in the Czech Republic, 1.14% in Hungary, 0.51% in Bulgaria, 1.9% at the level EU-25, 1.95% at the level EU-15, 2.59% in the United States, 1.17% in the Russian Federation, etc.³

Expenditure ear-marking by economic activity, in general, by industrial activity, particularly, and by research field, presents noteworthy incongruities with respective activity and field importance. Thus, sectors with a high weight in industrial production value derived modest advantages from R&D funds, as, for instance, textiles, clothing articles, leather goods and footwear industries, which were cronicallly under-financed in comparison with other industries – metallic construction and machinery and equipment, etc., as shown by the figures in the next table.

Table 3. Weight of some manufacturing industry activity in the total amount of R&D expenditure and in the industrial production value, 2006

	Weight in total amount of R&D expenditure of manufacturing industry, enterprises sector (%)	Weight in industrial output value (%)
Food, beverages, and tobacco products	1.7	14.2
Textile products, clothing articles, leather goods and footwear	0.6	6.0
Chemical substances and products	13.0	4.5
Metallic constructions, machinery and equipment	62.1	6.7

Source: processing of data from Institutul Național de Statistică. Anuarul Statistic al României, 2007, București, 2008, pp. 495 and 648

According to the type of research and sector, the figures related to current expenditure point also out the existence of some lack of balance, in diminishing process, particularly since 2006 (see the next table).

Table 4. Current expenditure in R&D activity, by sector and type of research, 2001-2006

	2001	2002	2003	2004	2005	2006
Total (thousand lei current prices)	404,841	499,045	673,211	861,256	1,040,367	1,319,247
Fundamental research (%)	20.7	20.7	25.4	23.2	23.9	38.9
Applied research (%)	62.3	56.4	58.2	58.0	65.4	51.0
Experimental development (%)	17.0	22.9	16.4	18.8	10.7	10.1
Enterprises sector (thousand lei current prices)	262,314	317,213	394,137	470,284	525,019	649,238
Fundamental research (%)	5.4	5.7	14.0	12.3	9.2	21.8
Applied research (%)	75.4	63.6	63.6	60.3	73.1	62.9

³ European Communities. *Science and Technology in Europe. Data 1990-2004*, Office for Official Publications of the European Communities, Luxembourg, 2006

Table 4 (cont.)

Experimental development (%)	19.2	30.7	22.4	27.4	17.7	15.3
Governmental sector (thousand lei current prices)	110,024	134,061	234,820	310,930	368,150	435,009
Fundamental research (%)	50.2	42.8	40.6	35.9	39.5	55.7
Applied research (%)	38.2	48.5	52.0	55.9	56.4	39.8
Experimental development (%)	11.6	8.7	7.4	8.2	4.1	4.5
Tertiary education sector (thousand lei current prices)	32,503	47,771	42,310	76,146	120,751	212,373
Fundamental research (%)	44.3	58.1	47.6	39.9	45.4	60.4
Applied research (%)	38.7	30.6	40.1	50.6	52.4	37.6
Experimental development (%)	17.0	11.3	12.3	9.5	2.2	2.0
Non-profit private sector (thousand lei current prices)	...	...	1,944	3,896	26,447	22,627
Fundamental research (%)	...	...	...	7.6	1.1	2.4
Applied research (%)	...	...	100.0	91.9	97.1	53.2
Experimental development (%)				0.5	1.8	44.4

Source: processing of data from Institutul Național de Statistică. Anuarul Statistic al României, 2007, București, 2008, p. 492

Conclusions arising from the analysis of the table figures can be synthesized as follows:

- applied research was unchanging in the course of the analysed period, the main beneficiary of current expenditure ear-marked to R&D activity, both on its whole and by enterprise and governmental sectors, with the exception of tertiary education sector;
- by 2006, expenditure allotted to fundamental research increased by more than two times in comparison with the previous year level, as a result of noticeable increases registered in enterprises and governmental sectors, mirroring a more judicious orientation of the Science&Technology policy, concordant with the trend shown in this sense in the developed countries (nevertheless, in the enterprises sector expenditure of fundamental research represented only about one fifth of the R&D total expenditure registered in 2006 and very little in previous years);
- the weight of enterprises sector in total current expenditure decreased constantly during the analysed period (64.8% in 2001, 54.6% in 2004, 49.2% in 2006), highlighted the reality that the enterprises R&D function is still far from playing the determining role it has in modern economies;
- the weight of governmental sector expenditure increased in course of the analysed period (27.2% in 2001, 36.1% in 2004, 33.0% in 2006), reflecting the R&D activity pressure increase on the national budget;
- a gladdening fact is the increase of the tertiary education sector expenditure weight (8.0% in 2001, 8.8% in 2004, 16.1% in 2006), a trend concordant with evolutions registered in the developed countries, in which the financial efforts devoted to R&D activity lay stress upon enterprises and tertiary education sectors;
- non-profit private sector has an unassuming role, as mentioned above, on the whole of R&D activity (1.7% weight in total current expenditure of respective activity in 2006), pointing out the existence of noticeable reserves in order to increase its contribution to the national R&D system.

Human Potential

The human factor is the most important constituent part of the national R&D system, whose quantitative and qualitative level is directly related with its creative capacity and, implicitly, its performances, measured by the real output of RDI activity. The return of mark registered by respective activity after 1990 was also experienced as regards the human potential, first of all by the drastic cut, in the last decade of the past century, of personnel employed in the sector and, particularly, of the researchers' number, this state beginning to straighten out slowly after 2000 (see the figures in the next table).

Table 5. Evolution of significant indicators level concerning the human potential in R&D activity, 2001-2006

	2001	2002	2003	2004	2005	2006
Number of researchers (on 31 December)	37,696	38,433	39,985	40,725	41,035	42,220
Researchers	23,597	24,636	25,968	27,253	29,608	30,122
of which: certified	8,507	8,513	9,219	9,318	10,339	9,341
by scientific fields						
o natural and exact sciences	3,781	4,471	4,403	4,633	6,238	4,544
o engineer and technological sciences	13,987	13,062	13,971	13,769	13,040	13,044
o social sciences	1,842	2,077	2,590	2,433	3,833	3,785
With tertiary education	25,273	26,102	29,268	29,663	31,622	33,620
of which: PhD	6,536	6,428	8,421	8,954	8,746	12,309
Number of employees (full time equivalent)	32,639	32,799	33,077	33,361	33,222	30,802
By execution sector						
o enterprises sector	19,930	18,399	16,942	16,368	16,157	13,761
o governmental sector	8,421	8,930	9,395	9,853	10,055	8,381
o tertiary education sector	4,288	5,470	6,537	6,917	6,803	8,563
o non-profit private sector	-	-	203	223	207	97

Source: Institutul Național de Statistică. Anuarul Statistic al României 2007, București, 2008, pp. 483 and 485

On the whole of R&D activity, the decrease was from 148,513 employees in 1990 to 42,220 in 2006, manufacturing industry and enterprises sector registering dramatic lowerings. The main reasons that determined this restriction were the following: delay in adoption of laws concerning scientific research and intellectual property protection, as well as researcher's status; lack of researchers scientific motivation and proper conditions for carrying out research work properly; lack of material and non-material incentives for patents and insufficient legislative regulations in this field; unlawful possibilities to trade non-registered inventions and innovations; numerous specialists leaving the field because of low level of wages, doubtful prospects of the sector, attractiveness of other activity sectors; diminishing of public effort intended to support this activity, policy that still began since 1990 and continued in the course of the whole decade. Since 2001, the number of employees registered in R&D activity increased unchangingly, as well as the number of researchers and certified researchers, the last registering however a return in 2006 as compared to the previous year.

Also during the period 2001-2006, the number of employees full time equivalent diminished, and within it, by execution sector, the enterprises sector registering the most dramatic reduction (but however having the highest weight in the total number – 44.7% in 2006), the governmental sector increasing constantly up to 2005 and limiting itself with 16.6% in 2006 as against 2005, and tertiary education sector doubling its personnel. These un-coordinated and, sometimes, contradictory evolutions highlight the fact that R & D activity is still far from a normal function, it continues to present low attractiveness on the labor market, and have a palpable diminished potential of creativity and performances.

Noticeable unbalances are also with regard to weights of employees and researchers' effectives by manufacturing industry sector, in comparison with their weights in the production value of this industry, as shown by the figures in the next table.

Table 6. Weight of R&D personnel by manufacturing industry activity compared with weight of activity in the respective industry production value, in 2006

	Employees		of which: researchers		Weight in manufacturing industry production value
	Number	%	Number	%	
Manufacturing industry, of which:	6,680	100.0	4,329	100.0	100.0
Food and beverages, tobacco products	86	1.3	66	1.5	17.5
Textile products, clothing articles, leather goods and footwear	138	2.1	48	1.1	7.5
Pulp, paper, and paper products	77	1.2	55	1.3	0.95
Crude oil processing, coal coking, and nuclear fuel treatment	448	6.7	283	6.5	14.8
Chemical substances and products	687	10.3	392	9.1	5.6
Rubber and plastic products	161	2.4	107	2.5	3.3
Manufacturing of construction materials and other products of nonmetallic minerals	61	0.9	22	0.5	4.4
Metallurgy	491	7.35	351	8.1	11.1
Metallic constructions, machinery and equipment	4,382	65.6	2,937	67.8	8.35
Furniture and other industrial activities not elsewhere classified	712	10.7	485	11.2	3.1

Source: processing of data from Institutul Național de Statistică. Anuarul Statistic al României, 2007, București, 2008, pag. 491

The only activities where there is a certain correlation between personnel and R&D researchers weights in the total amount of manufacturing industry personnel and researchers number, on the one hand, and weights of the respective activities in manufacturing industry production value, on the other hand, were represented by *Pulp, paper and paper products*, and *Rubber and plastic products*. The main incongruity between compared elements was registered in *Metallic constructions, machinery and equipment* activity, over 65% of the number of manufacturing industry employees and researchers working in, while the weight of this activity in the manufacturing industry production value was only 8%. Disproportions in the same sense but with lower amplitude were evinced also by *Chemical substances and products*, and *Furniture and other industrial activities not elsewhere classified* activities.

In exchange, activities with noticeable weight in manufacturing industry production value have comparatively registered very low weights of R&D personnel, highlighting the outstanding potential of the respective personnel to create added value - is the case of *Food and beverage, tobacco products*, *Textile products, clothing articles, leather goods and footwear*, *Oil processing, coal coking, and nuclear fuel treatment*, *Manufacturing of constructions materials and other products of nonmetallic minerals* activities.

In conclusion, the human potential of R&D activity specific to manufacturing industry diminished, in the last decade of the past century, in a disquieting manner, registered modest

progress starting from 2000, and still presents disturbing unbalances – by qualification level, certification, execution sector, and industrial activity.

Innovation Potential

The human potential sharp cut, rendered above evident, brought about logical reduction of creative potential, namely of R&D activity final output, which proved to be very modest as compared with those of the European Union countries.

The most relevant indicators in this sense are the number of patent applications and the number of patents issued, both being influenced by the culture of intellectual property rights, the level of these indicators having contrary evolutions to those registered in the developed countries (see the next table).

Table 7. Total number of applications for invention patents and patents issued, 2001-2006

	2001	2002	2003	2004	2005	2006
Total number of applications for invention patents	5,687	6,567	5,955	5,120	1,365	1,097
o Romanian applicants	1,128	1,477	881	937	916	814
o Enterprises (exclusively research units)	189	208	189	189	166	156
o Research, education units	114	143	104	146	133	175
o Inventors (natural persons)	825	1,126	588	602	617	483
o Foreign applicants	281	205	165	164	68	62
o Applications of European patents extension	4,278	4,885	4,909	4,019	381	221
Total number of patents issued of which:	832	1,183	1,521	1,292	1,547	1,831
o Romanian holders	478	496	431	435	423	369
o Foreign holders	251	190	217	170	113	133
o Validated European patents	103	497	873	677	961	1,329

Sursa: State Office for Inventions and Trademarks, in: Institutul Național de Statistică. Anuarul Statistic al României 2007, București, 2008, pag. 498

The decrease in the number of applications for invention patents was ceaseless since 1992, with fluctuations registered by applicants category and applications of European patents extension. The total number of patents issued increased in the same period, as a consequence of multiplication of validated European patents number, the number of patents issued for Romanian and foreign holders sharply decreasing. The figures highlighted the reality that the national RDI system, as was defined above, did not manage to stimulate intensive creative effervescence extended to all levels, absolutely necessary for sustaining modernization of Romanian economy, in general, and manufacturing industry, particularly.

As far as innovative enterprises typology is concerned, this registre noticeable changes, during the period 2000-2004, being the last one for which Romanian Statistical Yearbook presents data. Thus, if during the period 2000-2002 there were registered 3,983 innovative enterprises from industry and services, during the period 2002-2004 their number increased to 5,171, their weights in the total enterprises number (23,404 and, respectively, 26,024) being of 17.0% and, respectively, 19.9% (we remind that innovative enterprises are those launching new or significantly improved products, innovations relying on the result of technological development, new combination of current technologies or using other knowledge required by the enterprise. The term covers all types of product, process innovators as well as enterprises with on – going or abandoned innovations and it refers to active enterprises).

Out of total innovative enterprises number, weight of successful innovators was, in the first mentioned period, 99.5%, and in the second – 99.3%; a gladdening fact is that, in both periods, weights of products and process innovators were high – 74.5% and, respectively, 66.9%, indicating their concerns balancing between products constructive and functional improvement and production technologies improvement. However, deeply negative was the large weight of non-innovative enterprises (which had no innovative activity during analysed period) – 83.0% and, respectively, 80.1%.

In manufacturing industry, in the same periods, the structure of innovative enterprises by size class (depending on employees number) is shown in the next table, revealing that small enterprises proved to be the most numerous from the standpoint of innovation, followed by medium and large enterprises. As a matter of fact, it is acknowledged that small and medium sized enterprises have an innovation potential relatively superior in comparison with large enterprises, the explanation consists in their closer relationship with market, their closer contacts with clients, their superior adaptability to changes occurred on market.

Table 8. Weight of innovative enterprises from manufacturing industry by size class, during 2000-2002 and 2002-2004 periods (%)

Small		Medium		Large	
2000-2002	2002-2004	2000-2002	2002-2004	2000-2002	2002-2004
49.6	49.3	31.1	34.0	19.3	16.7

Source: Institutul Național de Statistică. Anuarul Statistic al României 2007, București, 2008, p. 499

In the manufacturing industry, the weight of innovative enterprises in total enterprises number from different activities varied in large limits, highlighting their actual and, especially, future competitive potential, that depends, to a determined extent, on the number and creative force of innovative enterprises (see the next table).

Table 9. Weight of innovative enterprises in all enterprises, by activity of manufacturing industry, 2002-2004

Activity	Weight of innovative enterprises in all enterprises from activity (%)
Tobacco products	50
Crude oil processing, coal coking, and nuclear fuel treatment	47
Medical, precision, optical instruments and apparatus	38
Means of road transports	36
Rubber and plastic products	36
Radio, TV and communication equipment	36
Machinery and equipment (except electrical and optical equipment)	34
Electric machinery and appliances	31
Metallurgy	30
Pulp, paper, and paper products	28
IT and office means	25
Chemical substances and products	23
Food and beverages	23
Manufacturing of construction materials and other products of non-metallic minerals	23
Metallic construction and metal products	23
Means of transport not included in road transport	21
Furniture and other industrial activity not elsewhere classified	20
Publishing houses, polygraphy and recording reproducible registrations	19
Wood and wooden products manufacturing (except furniture)	19
Textile products	18
Clothing articles	18

Table 9 (cont.)

Leather goods and footwear	15
Waste recovering	9

Source: Avantaje competitive ale industriei prelucrătoare din România în Uniunea Europeană. Asociația pentru Studii și Prognoze Economico-Sociale, București, 2007, pp. 362-363

The table figures render evident the gratifying reality that on the first ranks of activity hierarchy with higher weight of innovative enterprises there are some activities considered as having high technological intensity (*Medical, precision, optical instruments and apparatus, Radio, TV and communication equipment*) or medium (*Crude oil processing, coal coking, and nuclear fuel treatment, Means of road transports, Rubber and plastic products, Machinery and equipment, except electrical and optical equipment*), although the respective weights are far from a satisfactory level registered in developed economies. The last ranks are occupied by activities considered, in light of the European Union's standards, as having a low technological intensity, therefore with R&D expenditure below the economy's average; we remind the reader that specific products of these activities are faced on international markets with the increasing pressure of products delivered by other countries with doubtless comparative advantages (particularly from South-East Asia) – cheaper raw materials and labour force.

Conclusions and Recommendations

The aspects highlighted above, resulting from the analysis we made, led to the conclusions presented at the end of each previous chapter.

The wrapping final conclusion following from these partial conclusions is that the Romanian RDI system still has noticeable reserves for improving its function and effectiveness and, thus, increasing its contribution to economic and social development of the country.

In the context of emphasized aspects, we consider that the national RDI policy should further on be joined in the following coordinates.

1. *Increase of GDP share earmarked to RDI activity, first of all for improving physical infrastructure and quality of human resources available for this activity.*

This increase must be ensured not by multiplication of public funds contribution, but by that of economic agents and other sources – education, non-profit professional associations, own sources -, as well as foreign funds whose weight amplified in the examined period.

Expenditure earmarked to R&D activity should be prevalingly directed towards development of Romanian researchers access to research facilities of the European Union, R&D units' IT infrastructure, national computer network for research and education and its connection to national networks of the European Union member countries.

2. *Establishing priorities of RDI system in correlation with Romania's economic and social development strategy, coordinates of industrial policy and sectoral strategies specific to manufacturing industry activities.*

Experience rendered evident the presence of some drawbacks resulting from poor management of RDI programs, consisting in weak correlation of RDI projects supply with economic agents real requirements, driving to funding of industrial activity with no current or potential competitive advantages, lacking, therefore, viability prospects, poor projects co-funding by economic agents and their weak applicability, concentration of projects funding in Bucharest and their disproportionate funding in other country development regions.

In the future these drawbacks can be avoided by improving communication among R&D units, universities and productive units, as well as by directing funding of R&D activity from public

and private sources towards manufacturing industry activities which proved to have good performances and sure development prospects.

3. *Stimulating excellence centers setting up and development, ensuring internal sources of high level scientific and technological expertise for national economy's vital fields.*

This coordinate supposes identification of R&D units with good performances in order to improve allotment of public funds devoted to them, by their periodical and systematic evaluation and accreditation, in line with the European evaluation criteria. Strict assessment of activity quality and outputs of these units will be made at the national level by a body specialized in institutional evaluation, which contributes both to setting up priorities in good performer R&D areas, and improving public fund allotment for them.

It is also necessary the development of R&D activity in network system, integrating units from different member countries of the European Union, contributing to obtaining high level scientific and technological expertise in economic fields.

4. *Development of human resources in R&D activity in accordance with the European scientific career model.*

Romania's research human potential, expressed by researchers number / 1000 inhabitants, is much lower by comparison with majority of the European Union member countries: Romania – 2.8; UE – 5.3. In order to stop talented researchers' exode, in which young men have an important weight, towards other more attractive jobs in country or abroad, the working conditions, the incentives system, professional development and stimulating career prospects should be improved.

5. *Intensification of companies R&D function and superior turning to account research output in industrial production.*

Shortage of R&D function in a good part of productive units drastically cuts their innovation potential and delays restructuring and modernization of their production equipment and technological processes.

Particular importance of company R&D function is emphasized by the fact that periodical evaluation of European companies innovative performances, achieved on the basis of selective statistical research (Community Innovation Survey), uses two relevant indicators – weight of companies with R&D activity and weight of companies in which new and improved products have a pregnant contribution to their turnover and export. In Romania, there is a scanty weight of companies with own R&D activity, being imperatively needful to strongly develop it.

6. *Intensification of Romanian researchers' attendance to the European Union's framework programs.*

The European Union documents devoted to Science & Technology policy give credit to the idea that, at present, research activity success is conditioned by setting up of partnership and scientific collaboration relationship among units and researchers from different countries, as well as their engagement in far-reaching international projects.

Although the Romania's financial contribution to the European Union Framework Programs V and VI was „significant for a country with limited resources”, its participation to these programs was rather modest and did not allow to turn to account all advantages they presented. For instance, by 2001, the accepting rate of projects proposed by the Romanian researchers to be funded within the European RDI programs was 18.8%, compared with the Czeck Republic –

29.4%, Hungary – 25.9%, Poland – 22.1%, Bulgaria – 21.6%, and much lower as against other developed countries outside the European Union (Switzerland – 40.5%, Norway – 38.9%)⁴.

The main ways by which Romanian researchers' participation to framework programs of the European Union can be made better are: improving technical infrastructure quality of research units, particularly of the best ones, intensifying cooperation among research units, universities, and enterprises, intensifying dissemination of information and assistance activity for projects participants by means of Contact National Points' network set up with that end in view.

7. *Strong development of industrial parks and scientific and technological parks.*

Industrial parks and scientific and technological parks constitute effective ways to improve business infrastructure, they being able to ensure intensification and modernization of industrial activity, increase of involved human resources capabilities, and competitiveness amelioration. Taking into account the positive experience resulted from the function of these forms in the European countries, Government Decision nr. 63/2001 ensured necessary conditions for promoting such an experience by offering up incentives to investors interested in creation and development of these organization forms, aiming at: developing high tech industries, with substantial R&D contribution; setting up new jobs; improving products competitiveness, increasing exports; improving employees professional skills; offering up location advantages in order to attract and house foreign investment.

Setting up scientific and technological parks began due to Law no 50/2003, which approved Government Order OG no 14/2002 as regards the organization and function of scientific and technological parks; according to this law, such entities should stimulate cooperation between universities and innovative units, so creating some prerequisites of industrial clusters function. Technological parks which function at present in Brasov, Braila, Bucharest-Baneasa, Galatzi, and Slobozia are focused on IT (software) and telecommunication activity, in the meantime any assessment of their functioning and efficiency being premature.

Difficulties encountered in industrial parks and scientific and technological parks organization and function constitute as much directions to act in order to remedy the drawbacks which hinder their good functioning and proper turning into account of the noticeable opportunity they present.

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Potențialul de cercetare & dezvoltare și inovare al României

Rezumat

Articolul prezintă evoluția sistemului național de Cercetare & Dezvoltare și Inovare în cursul anilor 2001-2006, organizarea instituțională a acestuia și contribuția sa la creșterea potențialului național de creație în domeniul noutăților tehnice și tehnologice. O atenție specială este acordată diferențelor existente între potențialul de Cercetare & Dezvoltare și Inovare al sectoarelor industriei prelucrătoare, precum și cauzelor determinante ale acestor diferențe. În final sunt formulate recomandări vizând îmbunătățirea potențialului național de Cercetare & Dezvoltare și Inovare, potrivit cerințelor integrării României în Spațiul European al Cunoașterii.