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Bulgarian Innovation Policy: Options for the Next Decade

enterprise europe network

CENTRE FOR INNOVATIONS
OF THE BULGARIAN ACADEMY OF SCIENCES

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cip competitiveness and innovation framework programme 2007–2013

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CONTENTS

LIST OF ABBREVIATIONS

AA	– Agricultural Academy
ADSL	– Asymmetric Digital Subscriber Line
AES	– Adult Education Survey
ARC Fund	– Applied Research and Communications Fund
BAS	– Bulgarian Academy of Sciences
BPO	– Bulgarian Patent Office
BSMEPA	– Bulgarian Small and Medium Enterprises Promotion Agency
BTC	– Bulgarian Telecommunications Company
COST	– European Cooperation in Science and Technology
CR	– Commercial Registry
CRM	– Customer Relationship Management
DSL	– Digital Subscriber Line
EB	– Eurobarometer
EC	– European Commission
EEA	– European Economic Area
EIIT	– European Institute of Innovation and Technology
ERDF	– European Regional Development Fund
ERP	– Enterprise Resource Planning
EU	– European Union
FOSS	– Free/Open Source Software
FP	– Framework program
FP CIP	– Framework program "Competitiveness and Innovation"
FTE	– Full Time Employment
GDP	– Gross Domestic Product
ICT	– Information and Communication Technologies
INA	– Survey of Innovation Activity of Bulgarian Business conducted by the Applied Research and Communications Fund
IP	– Intellectual Property
IT	– Information Technologies
LAN	– Local Area Network
MC	– Multinational company
MEET	– Ministry of Economy, Energy and Tourism
MESY	– Ministry of Education Science and Youth
MID	– Mathematics and Informatics Department
NACE	– National Classification of Economic Activities
NGO	– Non-governmental organization
NIF	– National Innovation Fund
NSF	– National Science Fund
NSI	– National Statistical Institute
OECD	– Organisation for Economic Cooperation and Development
OP	– Operational Program
OPHRD	– Operational Program Human Resources Development
R&D	– Research and Development
SAITC	– State Agency for Information Technologies and Communications
SCI	– Science Citation Index
SITC	– Standard International Trade Classification
SMEs	– Small and Medium-Sized Enterprises
SMS	– Short Message Service
SU	– Sofia University
UCTM	– University of Chemical Technology and Metallurgy
UNDP	– United Nations Development Program
USA	– United States of America
VAT	– Value Added Tax

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EXECUTIVE SUMMARY

The innovation activity of Bulgarian businesses experienced the impact of the economic crisis through the fall of public and private R&D funding, as well as through the deterioration of the overall business and innovation environment (higher risk aversion, personnel reductions, consumer markets stagnation, etc.). The long delayed reforms in science and education, the lack of systematic and institutional interaction between them and the business sector (e.g. transfers of new technological solutions are sporadic), as well as the inefficient management and utilization of European funds allotted for economic modernization additionally exacerbated the problems caused by the crisis.

Entrepreneurship

The number of **active businesses** in Bulgaria totaled some 110,000 in 2009, of which between 10,000 and 15,000 enterprises employed more than 10 staff and only between 1,000 and 2,500 – more than 50. It is precisely among these one hundred thousand enterprises where the entrepreneurs who launch innovative activity through a start-up or engage in **corporate entrepreneurship** in existing medium-sized and/or large enterprise are to be found. The dynamics of the number of **newly registered companies** in Bulgaria amongst which authentic innovative entrepreneurs can be sought show that after a peak of 9,000 in June 2008, it dropped more than threefold, reaching slightly over 3,000 a month after March 2009.

Highly innovative and particularly **academic entrepreneurship** is definitive for the development of some industries of the national economy (for example information and communication technologies). Combined with the global dynamics in the development of ICT, this fact could explain differences in the structure of R&D expenditure between the areas of natural and technological sciences in Bulgaria – while in the case of natural sciences funding from the state is the leading force, in the case of technological – the business provides the larger portion of the funding. At the same time, there is a need for sector

policies in the field of innovation and enterprise, which take into account the development specifics of the respective scientific and technological areas and industries of the economy.

Data concerning R&D expenditure in Bulgaria are largely unreliable, which hampers the generation of sector policies additionally. This drawback directly concerns the link between science and business. On the one hand, there are varied hidden forms of science – business interaction like the undisclosed establishment of spin-off companies related to state R&D institutes, parallel engagement (moonlighting) of scientists and researchers in public scientific and private business enterprise, consulting and expert services, as well as cooperation on personal (as opposed to institutional) basis in national and international research projects. On the other hand, business enterprises very often fail to declare formally to the authorities their R&D expenditure because of the lack of fiscal and/or reporting incentives. For example, detailed analysis of public and private R&D investment in the sector of information and communication technologies showed that official statistical data accounted for only about a half of the actual R&D activity of the enterprises.

Innovation activity of Bulgarian enterprises

The fourth survey of innovation activity of Bulgarian business (INA-4), conducted by the Applied Research and Communications Fund, revealed **a considerable increase of innovation activity in 2009.** The share of companies, which declared they had innovation activity increased to 71% in 2009 compared to 43% in 2008. This reflects the positive consequences of the country's accession to the European Union and the efforts of business to respond to the requirements of competitive European markets and legislation. The crisis encouraged enterprises to seek ways to differentiate their products and services, as well as to send clearer messages to consumers, which led to a particularly strong increase of marketing innovations. It is expected that 2009/2010 will mark a significant decline in innovation activity, with only the most innovative enterprises (about 35%) continuing to develop new products and services.

Nearly **19% of the Bulgarian enterprises introduced successfully process innovations** in 2008/2009 – projects, which require serious commitment by management, both in the form of coordinated vision about the long-term development of the company and in respect to the investments made. The **share of companies, which launched new and improved products or services was slightly bigger (26%).** As a rule, the technological solutions introduced by Bulgarian companies are borrowed from foreign partners.

The innovations declared by Bulgarian companies **are such mainly at company and national level and are not novel for the international market,** although a considerable portion of the managers have defined them as such. The results of patent and licensing activity of Bulgarian enterprises show that there are practically no process and product innovations of international significance in Bulgaria. The numbers for the last nearly ten years are: an average of 103 protection documents (half of the submitted applications) were issued annually by the Bulgarian Patent Office, significantly more applications were submitted by individuals than by research institutes or small and medium-sized enterprises, and **only 63 licensing contracts** at an insignificant market value were concluded for obtaining rights on inventions.

Self-reporting by Bulgarian managers puts the share of innovative enterprises in the country at 71% in 2009. The considerable increase compared to 2008 (65% on an annual basis) is due mainly to enterprises, which have introduced organizational (30%) and market innovations (42%), aimed at streamlining operations in response to the influence of the economic crisis (streamlining organizational units, restructuring product portfolios, redefining relations with partners, changing the packaging and marketing of products and so on). Although this trend is still nascent in Bulgaria, **negative external factors have less influence on innovative enterprises and they are more successful in mobilizing internal potential to resist them** – new products form consumer loyalty, ensure stable market presence, enterprise orientation and readiness to take risks.

Innovation climate in Bulgaria

The measures undertaken by the Bulgarian government to date in supporting innovations as a major factor for overcoming the crisis and for maintaining sustainable economic growth are inadequate. If national policy and the development of micro-economic programs for innovations, information technologies and scientific and technological development are not formulated, in the long term Bulgaria will come out of the economic crisis in the same position in which it entered it and the benefits of the stable macro-economic policy of the last decade will remain unused.

Bulgaria remains the only EU member-state, which does not have a national target for the level of R&D intensity. Although this is not the only important condition for the development of innovation activity in the country, it is indicative of the government's neglect of this aspect of the economy. **In 2009, budget financing for R&D was reduced.** The National Innovation Fund with the Ministry of Economy, Energy and Tourism funded no projects and the statute of the fund itself remains unclear. The funds for research and creative activities of universities were also reduced within the framework of already smaller overall budgets for 2010. In 2009, the budgets of research projects at universities completed the year with 40% lower accounted expenditures than the amounts approved in advance.

Like in most of the other EU-27 countries, in Bulgaria **the share of the enterprise sector in R&D expenditure increased after 2005** at the expense of the government sector. In spite of this positive development, in absolute terms R&D expenditure remained very low in both the state and the private sector, with the Bulgarian state consistently reducing the intensity of its R&D spending – from 0.36% of GDP in 2000 to 0.28% for 2008. **The lack of adequate instruments to trigger or complement private R&D funding through state funds** remains a key problem for the country's innovation system. The two sectors, public and private, work in parallel, which leads to waste of financial and human resources. The state continues to support activities without clear commitment in respect to results, while viable R&D projects financed by the private sector and implemented by public research institutes do not increase the capacity of the participating state funded research organizations but remain for the personal benefit of individual researchers. There is **no system and/or instruments for productive collaboration and interaction between the state and the private R&D sector.**

In 2010, the planned budget expenditure for science amounts to 221 million levs or 1% of all budget expenditures. As in previous years, these resources will

be spent almost entirely (nearly 97%) for covering operational (running) costs (mainly salaries) and only 3% are budgeted for capital costs, including for the development of research infrastructure. At the same time, EU funds intended for the development of innovation, science and technology are among the least used even against the background of the overall sluggishness in the implementation of European funds. **The Operational Program „Competitiveness" suffers a lack of vision and organizational capacity,** which ranked its implementation among the most significantly delayed. The **Operational Program „Human Resources Development" remains skewed towards traditional measures for providing subsidized (usually low skill) employment.** It should instead strive to create a market and opportunities for improving the qualification and training of staff for the technological renovation of the economy.

On an international scale there is a considerable increase of the **number of researchers and those engaged in science and technology activity.** The change for Bulgaria for the period 2000 – 2008 was a positive one, but within less than 2%, which is evidence of a continuing lagging behind. In 2008, **the sectoral distribution of staff engaged in R&D remained highly unbalanced** – unlike the countries leading in terms of innovation in the EU, in Bulgaria employment is provided mainly by the state sector. As a share of total staff engaged in science and technology **the share of individuals engaged in scientific and technological activity in the high-tech sectors of industry and knowledge-intensive services** in Bulgaria in 2008 approached 6%, which is close to the average level of the indicator for EU-27 (6,84%).

The increase of the number of persons engaged in science and technology for the period 2000-2008 (by nearly 102,000) was accompanied by a considerably more effective use of their potential. While in 2000 the unemployed in this group amounted to 5.5%, in 2008 their share dropped to 2.2%. However, **the declining share of young people who have chosen science and technology as a field for their career (also confirmed by the data for scientists), remains a worrying trend.** The falling numbers of academic staff employed **in the technical fields of science** (nearly 12% decrease) and in medical sciences (slightly over 8% decrease) will be an essential obstacle for the development of these promising high-tech fields in the country in the foreseeable future.

In 2010 R&D investment is expected to follow the general trend of decline of investment activity, albeit to a lesser degree. One of the surprising characteristics of the present global economic crisis is precisely **the slower shrinking of investments in R&D.** The survey of investment plans in industry conducted by the National Statistical Institute forecasts a 11.2% reduction of the volume of investments on an annual basis for 2010 compared to a decline of 37.2% in 2009. According to the IMD Annual Competitiveness Yearbook, legislative support for company registration in Bulgaria improved in 2009. At the same time, the ranking showed that access to credit from the banking system and from venture capital – a definitive factor for the success of entrepreneurs and innovators – deteriorated.

Priorities for Bulgaria's innovation policy until 2020

2010 is a year of great risk and opportunity. The financial and economic crisis allowed critical decisions – the ones for which there was a lack of will or determination in the conditions of intensive growth – to be made by the political elite and to be accepted easier by the business. After the momentum of the

past few years, when external factors drove up growth in productivity and exports, has waned, the time has come for the mobilization of internal growth factors – enterprise and innovation activity, and intellectual capital.

In an environment of increased debate and expectations for reforms, the government needs to show a clear will for qualitative change in the field of innovation, science and technology in Bulgaria. Understanding the significance of innovation as a growth machine (new products and processes, better organization of work and approaches to marketing) is a prerequisite for choosing economic policy priorities (economic sectors, technological fields), as well as for implementing working mechanisms to achieve Bulgaria's strategic goals as a EU member. The drafting of an integrated national innovation, science and technology strategy for the next ten years needs to rest on several building blocks:

• Innovation policy aimed at economic recovery and sustainable growth

The European economy is facing a number of challenges – climate change, an ageing population, lagging behind in key innovation indicators to the U.S. and emerging markets, etc. Some of the main solutions for these challenges are to be found at national level and within the framework of innovation policy. For Bulgaria, this means **updating of the current National Innovation Strategy, providing linkages to the development of science and the economy, and a clear commitment for the implementation of the strategy at the highest level of government.**

• Instruments to achieve the priorities

Government institutions responsible for implementing innovation policy – Ministry of Economy, Energy and Tourism and the Ministry of Education, Youth and Science – **do not put innovation at the core of the economic development agenda of the country.** This necessitates the outlining – by means of a wide public debate and analysis of the opportunities for innovative development of priority economic sectors and leading technological fields – of **a roadmap for defining, commissioning and achieving strategic targets to promote national innovation and knowledge-based competitiveness.**

The roadmap should aim to **improve the functioning mechanisms of the innovation system,** as well as to increase the intensity of interaction between the units of the national innovation system as regards R&D, protection of intellectual property, technological transfer, labor mobility and life-long learning.

• Investing in innovation potential

Given squeezed external funding (reduced foreign direct investment and restricted access to commercial credit) it is important that **the priorities for economic development of the country are set to correspond directly to the capacity of the national innovation system** – scientific and technological fields in which Bulgaria possesses internationally recognized experience and applicable new knowledge. **The mobilization of larger financial resources** (through the already functioning instruments – the National Innovation Fund and

the National Science Fund, as well as through effective use of the European funds and the EU framework programs for research and for competitiveness and innovation) is a necessary requirement for overcoming the gap between Bulgarian and average European level of innovation activity.

Bulgaria should **adopt a national target for R&D funding as a share of GDP.** Increasing the amount of public funding available for R&D should be combined with the application of several basic principles: ensuring transparency of funds' management, prevalence of project over institutional financing, and introducing mechanisms of monitoring and control of the achieved results.

INTRODUCTION

There are many reasons why 2010 could be the year of innovation in Bulgaria: (1) the 2008-2009 crisis has significantly altered the economic map of the world, marked the end of two decades of continuous economic growth and created unprecedented opportunities for repositioning of the national economies; (2) Bulgaria faced the crisis in fine general macroeconomic shape but now needs to turn this advantage into a good macroeconomic platform by modernizing public administration and developing long-term growth policies and priorities; (3) the European Union consolidated its institutional development and the newly established European Commission is initiating the negotiations on Union policy and budget for the period up to 2020. The year is bound to be a hard one for the Bulgarian economy and the decline in national budget revenues will continue; still, now is the time to formulate Bulgaria's 2020 goals and to prioritize market and social innovation as a means of attaining them. Only in this way would Bulgaria speak the same language as the most advanced economies in the world and would be able to improve the standard of living and welfare of its citizens.

The annual *Innovation.bg* report provides a reliable assessment of the innovation potential of the Bulgarian economy and the situation and development capacity of the Bulgarian innovation system. It puts forward recommendations for an improved public policy on innovation in Bulgaria and EU drawing on the latest international theoretical and empirical research while taking into account the specific economic, political, cultural, and institutional framework in which the country's innovation system is operating. For a sixth consecutive year the report aims to be a part of the process of raising awareness of the importance of innovation as a factor for national competitiveness and to serve as the basis for development of national priorities supporting the implementation of the new EU 2020 Strategy.

The report is intended for leaders and decision-makers in the public and private sectors. The present edition, *Innovation.bg 2010,* examines the impact of the crisis on innovation activity in the Bulgarian economy and suggests possible

directions for Bulgarian innovation policy over the next decade. Following the established methodology of the four preceding editions, *Innovation.bg 2010* analyzes the state and development capacity of the national innovation system based on five groups of indicators:

- overall innovation product;
- entrepreneurship;
- investment and financing of innovation;
- human capital for innovation;
- information and communication technologies.

Innovation.bg 2010 presents an updated **Innovation Index of Bulgarian enterprises.** The Index is based on findings of the annual surveys of innovation by Bulgarian businesses conducted by the Innovation Relay Center with the Applied Research and Communications Fund (ARC Fund), panel data, and statistical analysis. The Report was reviewed and approved by the Expert Council on Innovation with the Applied Research and Communications Fund.

Methodologically, *Innovation.bg* is based on several existing models in the assessment and comparative analysis of innovation systems: 1. The European Commission's *European Innovation Scoreboard*. 2. The *Science, Technology and Industry Scoreboard* of OECD. 3. The US *National Innovation Initiative;* and 4. *Executive Index of the Massachusetts Innovation Economy.*

More extensive methodological notes and the sources of information are presented in Appendix 1. The theoretical rationale for the structure of the report is provided in greater detail in *Innovation.bg: Innovation Potential of the Bulgarian Economy,* ARC Fund (2005).

Gross Innovation Product

The gross innovation product of an economy or its innovativeness is assessed by the new products and services introduced, the new technologies created and the new scientific results achieved. It consists of and results from the interaction of the innovation, technological and scientific products of the country. It is a major benchmark for innovation policy because it allows decision-makers to compare the outcome of the innovation system in temporal and geographical terms, as well as to estimate the needs of changes in the organization and resources invested in the innovation process.

Innovation Product

The innovation product is the result of innovation activity in the form of new and significantly improved processes, products and services based on new and/or adapted knowledge and know-how. It is determined by the innovation activity in the country and is the most important indicator for assessing the operation of the national innovation system. The key features of this indicator, its market orientation and the fact that it represents the final stage of the innovation process, determine the leading role of business in its realization.

Innovation Index

National innovation systems react differently to external shocks, domestic imbalances and crises. The economic crisis in Bulgaria in 2009 did not bear the features of a typical financial crisis. It resulted from the combination of internal structural and economic disparities whose negative effects increased additionally as a result of the accumulation of a number of external shocks – shrinking foreign direct investments and the principal markets for Bulgarian production, as well as the natural gas crisis, among others.

The influence of the crisis on business innovation materialized in the limitation of private funding for R&D and technological innovation, both because of the shortage of available financial resources (decline of sales and rising credit prices) and as an indirect effect of the behavior of external partners, including the government (political corruption and administrative incompetence in public procurement and management of the structural funds).

The *Innovation.bg 2009* report[1] provided arguments in support of the positive influence of external markets on the degree of innovative company activity. The fact that a number of foreign strategic investors left the country in the past year, as well as the partial or total closure of enterprises undoubtedly limited this effect. At the same time, the global crisis proved an opportunity for enterprises which managed to compensate the limited demand on the existing markets by winning over new clients and, as a result, to introduce new technological solutions.

While in most countries the short-term measures of the governments against the crisis were related to enormous financial bailouts for the private sector – banks, insurance companies and the automotive industry, in Bulgaria, particularly in the second half of 2009, the reaction was drastic cuts of the unrealistically planned public expenditure in the national budget.

In the long term, most European countries like Germany, Portugal and Sweden laid down education, R&D and innovation as priorities of their anti-crisis policies. Bulgaria, on the other hand, continues to prefer tobacco production to science, as well as the development of golf courses over infrastructure, or as a whole state support is directed at preserving low-technology, low-paid and greatly detrimental to the environment activities. In the field of high-tech, state policy in 2009 was marked by hasty and chaotic attempts for acquiring positions and the absorption of funds without a strategic vision.[2] A case in point is the establishment of the state-owned nanotechnology company effected as it was without preliminary analysis and coordination with the needs of the leading scientists and the existing enterprises in this sector.

A strategic mistake in the preparation of the operational programs and the management of finances under the structural funds was made with the decision to direct the Operational Program Human Resources Development (OPHRD) towards the traditional active measures for creating employment, which are effective for cushioning the effect for people who have lost their jobs in the conditions of a growing economy, but are not adapted for the development of human resources for restructuring the economy after a crisis. As a result, OPHRD is directed towards the least educated strata of the population, with an expected low effect of the training and a complementary role in respect to the temporary employment programs at the expense of using it as an effective tool to promote the competitiveness of the human factor in the country. The few exceptions, when employees of high-tech companies were trained, created the impression of typical for the country shortcomings like political pressure and conflict of interests instead of an attempt to develop human resources based on concrete needs. A case in point was the project for the development of train-

[1] *Innovation.bg 2009: The Bulgarian Innovation System in a Time of Global Economic Crisis,* ARC Fund, 2009, pp. 25-28.

[2] A Bulgarian Supercomputing Center with the State Agency for Information Technology and Communications (SAITC) was established with state funding in 2008 but does not actually work because of the lack of appropriate scientific and application-oriented research assignments.

ing centers for staff of the Bulgarian Telecommunication Company (BTC) in IT skills under OPHRD. The centers are a typical example of a quasi-state not-for-profit association with the participation of senior civil servants in its management, financed by the state on a non-competitive basis (albeit through the UNDP) and which operates in conditions of non-transparency.

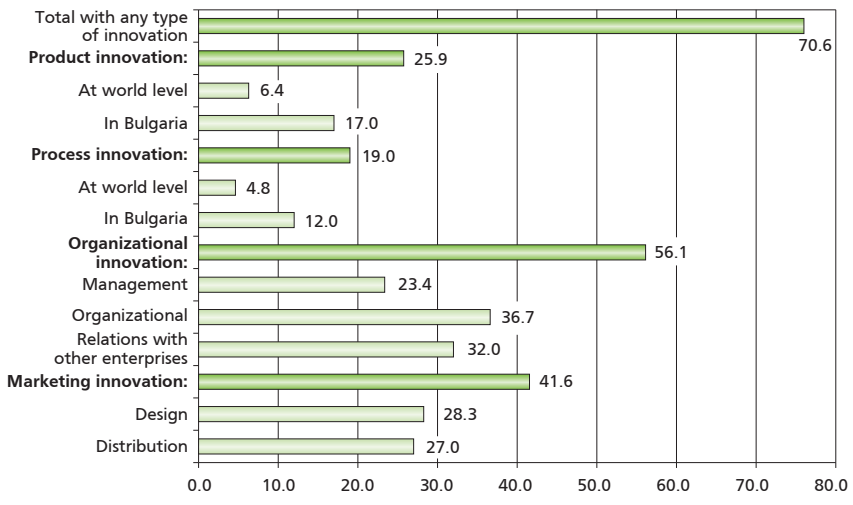
An essential feature of the innovation process is its duration. **Process innovations** require a longer time for implementation and very rarely result from lightning reactions during crisis. Usually enterprises freeze their new projects, with the effect becoming visible to the economy after one to three years. In this sense, the 19 % of process innovations registered by the annual Survey of the Innovation Activity of Bulgarian Business conducted by the Applied Research and Communications Fund at the end of 2009 (INA-4) are the result of pre-crisis planning in and around 2007 – the first year of Bulgaria's full-fledged membership in the European Union and a year of optimism supported by the sustained growth of GDP. Along with this, EU requirements for the quality of end products and the opportunities for funding made a number of enterprises (mainly in the sectors of agricultural produce processing, food and drink industry, energy, including energy efficiency and green energy) invest in new technologies and process innovation. It is expected that in 2010 and 2011 process innovation will drop sharply as a reaction to the crisis of 2009, as well as due to the large portion of the enterprises which had such a need have already implemented it. Enterprises will focus on product and marketing innovation at the level of the already introduced technological solutions.

The fact that the most part – 3/4 of the process innovations – are, as expected, transfer of technologies from abroad which have already found application in the same industry explains the relatively high percentage of process innovations. The surprise for 2009 was the fact that 4.8 % of the enterprises thought that the process innovation introduced in them were new to the world. Additional research showed that in these cases it was most frequently a matter of Bulgarian enterprises which had overestimated the potential of the introduced innovations or were not familiar with the foreign experience to a sufficient degree, or else it was a matter of foreign enterprises (multinational companies) having introduced their own projects in divisions located in Bulgaria, frequently with the help of a Bulgarian subcontractor.

Product innovations (launching new products or services), registered by INA-4, were introduced by 26 % of the enterprises in the country in 2009. The structure by degree of innovation is similar to that of process innovations. About 3/4 of the enterprises offered products new to Bulgaria or to the company; the share of enterprises which developed products or services new to the world market was 4.8 %. Probably in this case, too, as with process innovations, there was a measure of overestimation by the enterprises. At the same time, the novelty of the product, even with established multinational companies, may frequently be doubtful and be related to a new design of packaging or product characteristics difficult to discern by consumers. The claim of novelty is frequently part of a company advertisement strategy.[3] In a number of cases, the "innovation" explicitly featured in the advertisements of the respective products is an excuse for the price premium the consumer is asked to pay, or a distinguishing tool. A positive development is observed with Bulgarian producers who branded new product series precisely as "innovation".

About 10 % of all enterprises (half of the cases with process innovation and nearly 40 % of those with product innovation) **invested simultaneously in new processes and prod-**

Figure 1. INNOVATION ACTIVITY OF ENTERPRISES IN BULGARIA (%)



Source: INA-4, Applied Research and Communications Fund

[3] Most frequently the stress is placed on the innovative nature of products in the sphere of cosmetics, in the case of goods with fast turnover (foods and drinks), as well as goods subject to teletrade and multilevel marketing.

ucts in 2009, with 2/3 of these also registering the effect of introduced marketing and organizational innovations.

Innovation enterprises (with product or process innovation) constitute 35 %. This share corresponds to the 29-34 % consistently innovating enterprises, assessed as such in *Innovation.bg 2009.*[4] The same analysis showed that another 7 % to 10 % of enterprises innovate only occasionally, bringing their total number to 36-44 %. In INA-4 **the self-assessment concerning the total share of innovative enterprises stood at 71 %.**

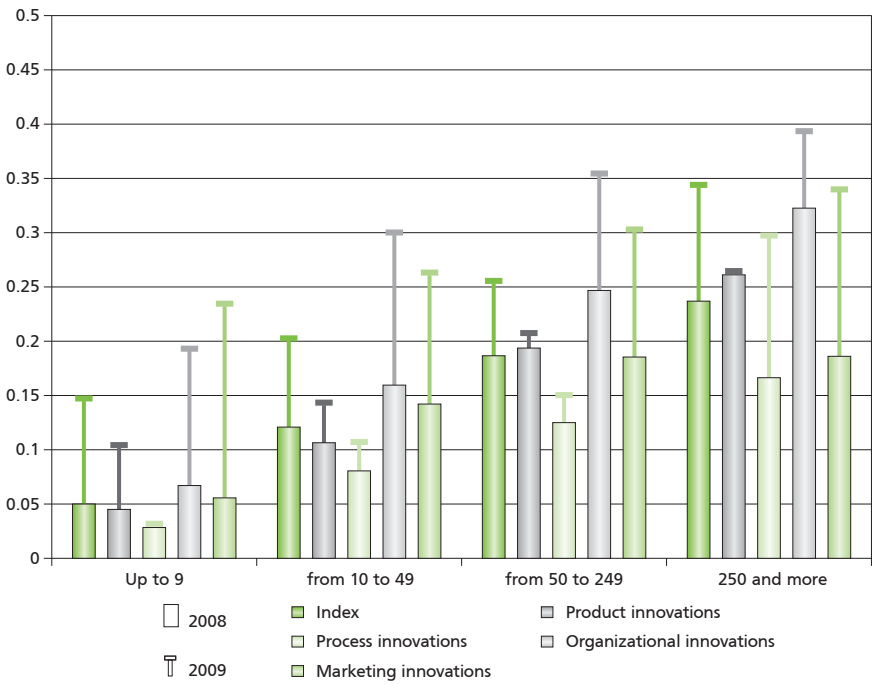
The explanation of the large difference[5] (growth nearly doubled in a year) lies in the so-called "optimizing enterprises", estimated at some 26 %. Their innovation activity is limited mainly to organizational and marketing innovation. Such an approach could be considered as a reaction to the crisis – considerable changes in the organization of work, mainly with the objective of cost cutting (minimizing losses) and/or restructuring of operation (37 %); new or considerably changed relations with partners along the value chain (32 %); changes in product design or packaging (28 %); application of new or considerably changed methods of sale and distribution of the goods and/or services (23 %). Most of these activities actually constitute optimization in the conditions of a crisis. In most cases, the financing of purely organizational and marketing innovations was part of the im-

Table 1. INNOVATIVE CLUSTERS

Innovation index value	Innovation leaders	Optimizers	Laggards	Catching up
Product innovations	53	6	1	77
Process innovations	78	7	4	6
Organizational innovations	68	38	18	42
Marketing innovations	62	63	0	43
Weighted index	63	30	4	48
Share of enterprises, %	10	26	52	12
Mean number of employed per 1 enterprise within the respective cluster	174	77	59	96
Change in employment (2009/2008)[6]	-0.01	-0.05	-0.12	-0.11
Share of companies in cluster with over 50 % foreign ownership, %	19	12	9	14
Average age of cluster companies, number of years	18	15	16	19
Share of enterprises having a website, %	72	49	37	74

Source: INA-4, Applied Research and Communications Fund, 2010

Figure 2. DEGREE OF ENTERPRISE INNOVATIVENESS BY SIZE (2008 AND 2009)



Source: INA-3 and INA-4, Applied Research and Communications Fund, 2010

[4] *Innovation.bg 2009: The Bulgarian Innovation System in a Time of Global Economic Crisis,* ARC Fund, 2009, p. 24.

[5] The Innovation Index gives higher values – 80 % innovative enterprises. In comparison, if enterprises with less than 20 employees (39 %) from the sample of INA-4 are excluded the share of innovative enterprises reaches the level of 76 %.

[6] Because of the large differences in the size of the enterprises in the sample and inside the clusters, the adopted indicator of change at company level which smoothes over these differences is a logarithm of employment in the respective years. The data for 2009 refer to the time until August.

plementation of projects under the Operational Programs, or else was effected in the context of the use of information and communication technologies (ICT) in business (ERP, CRM and others).

Another two sub-groups (in addition to innovators and optimizers) were determined as a result of cluster analysis[7] of the various sub-indexes. The group of the "laggards" with almost no innovation activity is quite noticeable. In this group the average index of organizational innovations has positive values, although close to 0. It reflects the type of organizational changes introduced not because of strategy by the management and the owners of the enterprise, but by necessity. This is the largest group, including more than half (52 %) of the enterprises in the sample.

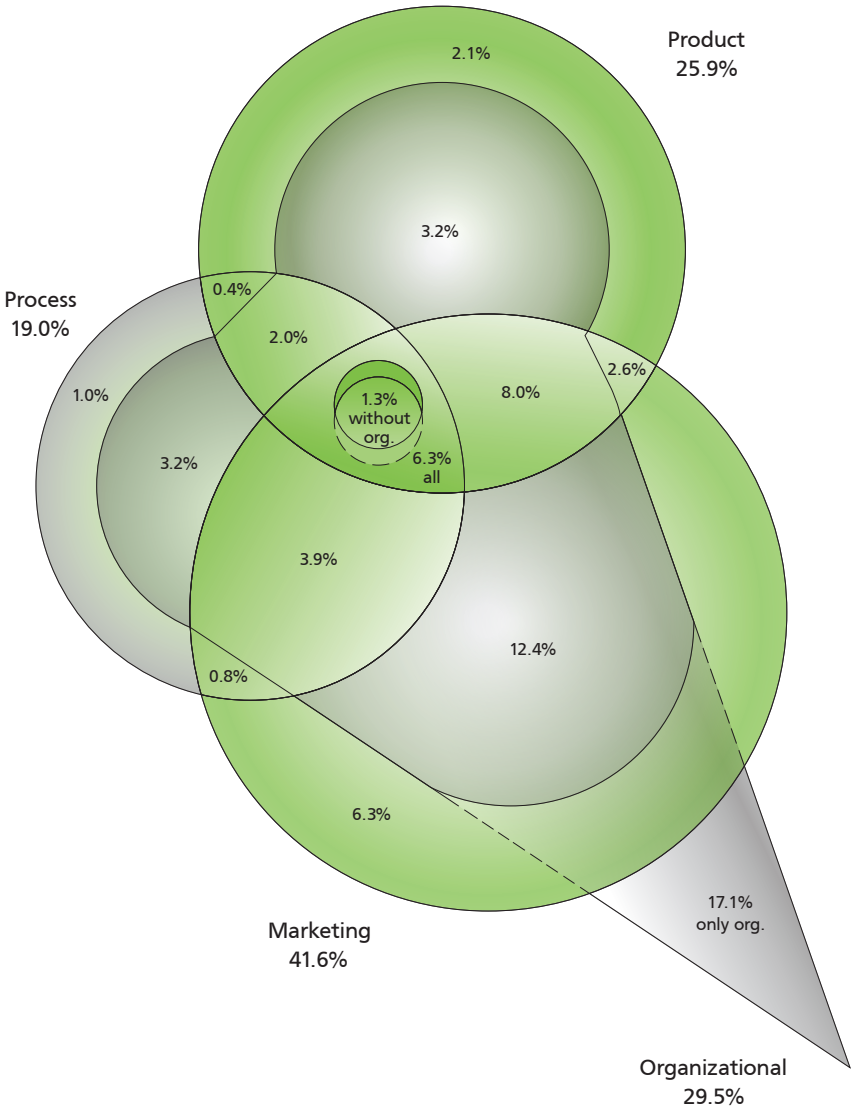
The group of those catching up relies on product diversification and partly on process innovations already made in previous reporting periods. This group constitutes 12 % of all enterprises, demonstrating a higher innovative potential than the "optimizers" – a result of the new products they have already launched on the market (local, regional or national).

Enterprise innovation is related to the percentage of employment change – the more innovative ones have less loss of jobs or have even increased employment. As in previous years[8], the matter of how large a company is has a direct positive influence on its innovativeness (as measured by all indices).

Marketing innovations have the largest contribution to the growth of the innovation index (both as a whole and by enterprise size), with the exception that the influence of organizational innovations in the group of enterprises with 10-49 employees is most significant. The various groups of enterprises contribute differently to the growth of the respective sub-indexes. For example, product index growth depends on micro- and small enterprises (up to 49 employees), process innovation growth distinctively comes from large enterprises (over 250), growth of organizational innovation is evenly distributed, while growth in the case of marketing innovation is dictated by micro-enterprises (under 10) and the group of the large enterprises (over 250).

The age of the companies correlates significantly only with the index of product innovations, i.e. better established companies launch more new products. The average degree of innovativeness in new companies (aged up to 4 years) remains at the

Figure 3. STRUCTURE OF BULGARIAN ENTERPRISES BY INNOVATION TYPE



Source: Applied Research and Communications Fund, 2010

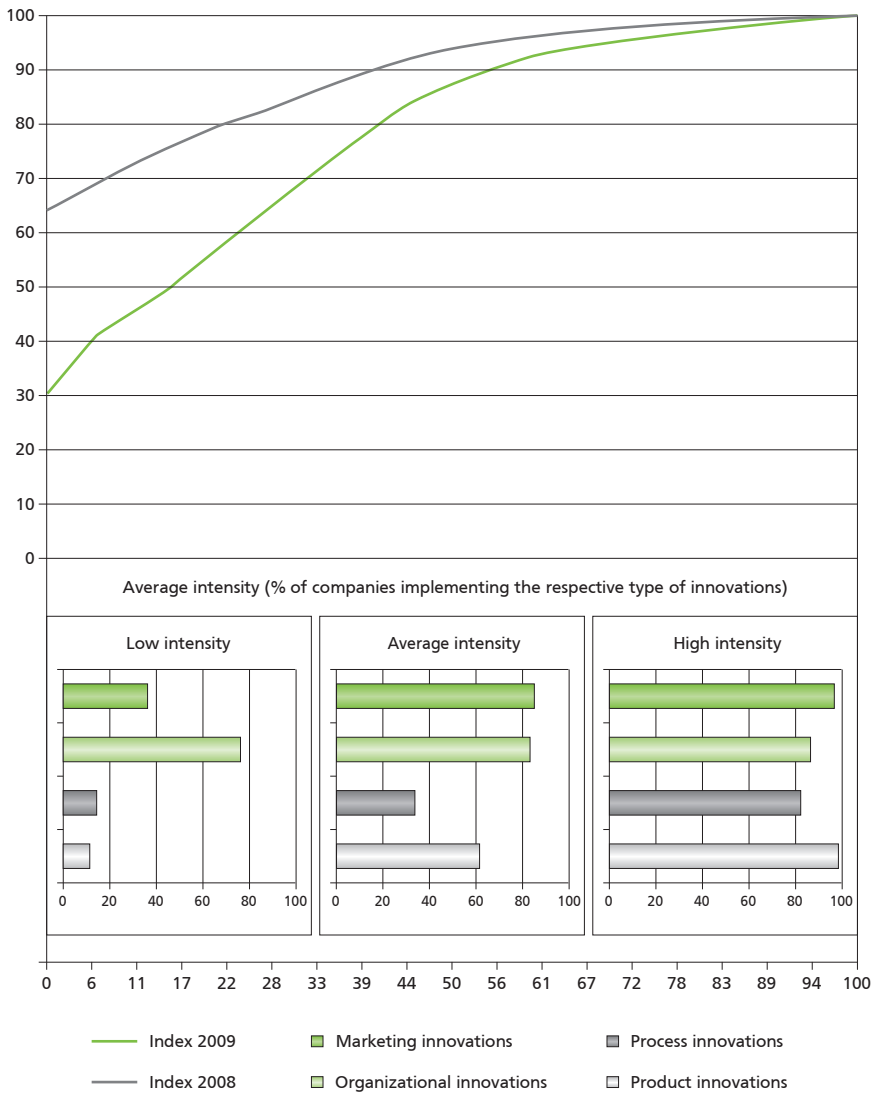
[7] K-means cluster analysis was used. In spite of the instability of the resulting cluster centers, the choice focused on those where the group of the least innovative enterprises showed the lowest dispersion at the lowest mean value of the summary index.

[8] All correlation ratios remain significant with p<0.01, albeit at minimal reduction of value. For example, coefficient r=0.259 for 2008, and for 2009 r=0.230.

levels of the whole sample. Although seemingly counterintuitive,[9] this can be explained by the fact that frequently the establishment of a new economic agent is not necessarily the result of entrepreneurship, but is rather the emergence of an additional "front" of an already existing enterprise. New companies essentially duplicating old ones are established both by innovative entrepreneurs (to meet the requirements for a start-up when seeking financing under the structural funds) and for the purpose of better risk management, transfer of business to a company with a different ownership structure or one not registered under VAT, etc. Many such cases are present in the sample.[10]

Companies in the leaders group invest in three or four types of innovations, those catching up – in two or three types of innovations, the optimizing ones do so in one or two, while the laggards do not innovate or register innovation of one type only. Compared to 2008, the "innovation periphery" outlined by the last group of companies has increased by 8 percentage points, reaching 26 % of all enterprises or 38 % of those with innovation activity. At the same time, the most innovative stratum of enterprises which implemented all four types of innovations, remains the same as a share of the companies. As a result, the innovation index as an aggregate measurement of the innovativeness of enterprises rose by 50 % in a year and reached 22 points.

Figure 4. INNOVATION INDEX OF BULGARIAN ENTERPRISES AND LEADING INNOVATIONS IN BULGARIA



Source: INA-4, Applied Research and Communications Fund, 2010

Profile of innovative firms in Bulgaria. Innovation intensity

The latest survey of the European Commission's Flash Eurobarometer[11] series focuses on the role of the different sources of funding for innovations, including in an economic crisis, and the effect of state policy and private initiatives for promoting innovation activity. Innobarometer 2009 studies companies with at least 20 employees in certain innovation intensive business sectors. In spite of the differences in the methodology used to analyze company innovation and the factors that condition it, the results of the European survey support the conclusions and findings of the INA-4 survey of the Applied Research and Communications Fund.

The 2006-2008 period was favorable to the development of Bulgarian enterprises included in the survey. Nearly 55 % of them registered increased income from sales, while for another 22 % there was no change in

[9] It is usually assumed that new enterprises come with new ideas for products.

[10] At least some 12-14 % of the companies in the sample are actually related through control of operations to other companies in the sample.

[11] *Innobarometer 2009: Strategic Trends in Innovation 2006-2008*, Flash EB #267, European Commission, May 2009; http://cordis.europa.eu/innovation/en/policy/innobarometer.htm

2008 compared to 2006 – levels close to the EU average. Traditionally, the best financial health is demonstrated by enterprises from the Scandinavian countries (Norway – 81.4 %; Sweden – 77.7 %; Finland – 75.1 %), which is also the reason for their greater capacity to invest in innovation. Of the new member states, the results for Lithuania and Romania – respectively 81.2 % and 70.2 % of the enterprises there showed a positive trend in their financial condition.

By the indicator of expenditure on innovation in structural terms Bulgarian enterprises follow the European pattern – 24.7 % of the enterprises in the sample invest less than 5 % of their turnover in innovation, followed by those which invest up to 25 % (18.4 % of the enterprises) and over 25 % of the turnover (3.9 % of the enterprises). There is, however, a substantial difference in respect to the relative share of enterprises that make such investments – for EU-27 85.2 % of the interviewed enterprises declared they invest in R&D, **while in Bulgaria a mere 47 % of the companies set aside funds for research and innovation and more than half of these limit this expenditure to 5 % of turnover.** In spite of that, 52.6 % of the enterprises with investments in R&D declared that they had increased their amount over the three-year period under survey, and only 10.1 % were forced to reduce that amount. With 37.3 % of the companies there is no change in the expenditure for research and innovation.

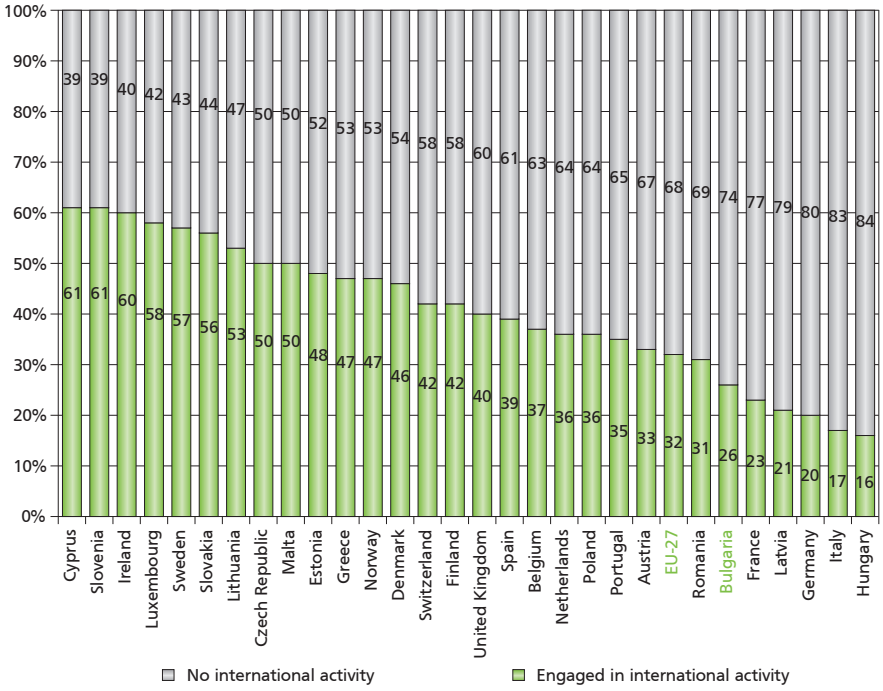
Many of the small open economies in the EU maintain intensive international cooperation in the field of innovation. Slovenia and Cyprus are leaders in this respect (with 61 % each), as well as Ireland (60 %) and Luxembourg (58 %). Three-quarters of the companies with international activities in support of innovation declare their main partners remain within the EU, Norway or Switzerland.

Table 2. R&D EXPENDITURES OF BULGARIAN ENTERPRISES, BY TYPE

Application	Enterprises with investments in the respective field, %	Enterprises which have increased investments in respective field, %
R&D in enterprise	24.2	71.0
R&D conducted by another company or research institute	14.3	56.0
Purchase of new or considerably improved machines, equipment and software	71.2	76.0
Purchase or license contract for patent, know-how or other objects of intellectual property	25.1	62.4
Courses and training in support of innovation	37.4	68.0
Design (packaging, product, process, service or industrial design)	25.4	73.5
Submission of application for patent or industrial design	15.1	79.1

Source: Innobarometer 2009

Figure 5. ENTERPRISES ENGAGED IN INTERNATIONAL COOPERATION IN SUPPORT OF INNOVATION, %



Source: Innobarometer 2009

Only 26 % of the Bulgarian enterprises operating in innovation-intensive business sectors engage in international exchanges in support of innovation, such as cooperation with partners from other countries, employment of staff from other countries at full-time or part-time jobs, market tests of innovation products in other countries and outsourcing or investment aimed at foreign companies.

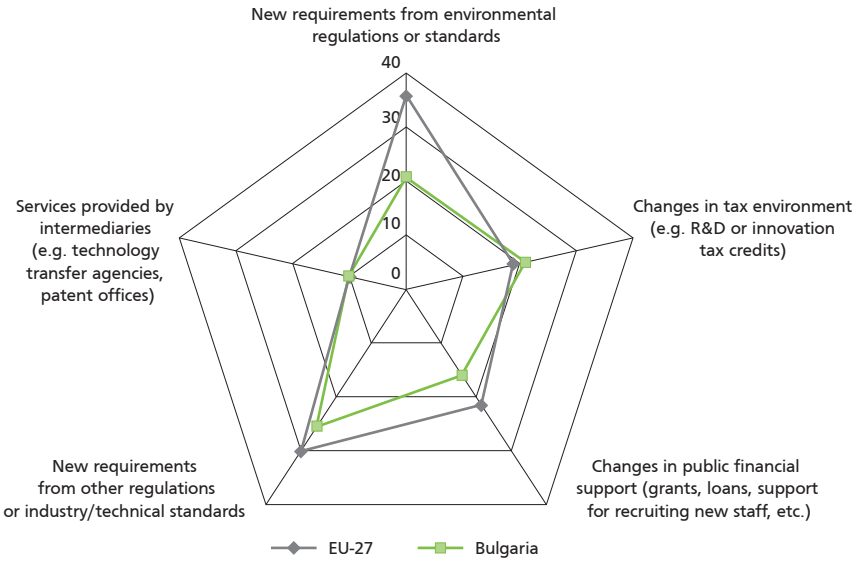
Innovation-supporting environment

In Bulgaria's case, the strongest influence on innovation activity (25 % of the enterprises from the sample) is exercised by the new requirements, regulations or industry / technical standards. This trend is also observed in EU-27, where 30 % of the companies say regulations and standards have a positive effect on innovation in enterprises. Environmental standards rank first as a factor with a positive influence on innovation development in EU-27 (35 %). Changes in the tax environment in Bulgaria have a more tangible influence on company development through innovation compared to the rest of the EU countries.

Strategic prospects for innovation development in an economic crisis

In 2009, the strategic solutions for the development of the business sector were considerably influenced by the global economic crisis. **Only a small portion of the enterprises are aware of the significance of innovation as a factor for overcoming the negative effects of the crisis and the number of those which focus on preserving and enhancing the**

Figure 6. POLICY AREAS THAT HAVE HAD A POSITIVE EFFECT ON INNOVATION IN ENTERPRISES, %



Source: Innobarometer 2009

Box 1. SIGNIFICANCE OF NEW TECHNOLOGICAL SOLUTIONS IN BIDDING FOR PUBLIC PROCUREMENT CONTRACTS

The market of public procurement in European and national terms is expanding constantly, both as a number of contracts and by cost of commissioned activities. The result – an increase of the share of public procurement in GDP to 9.5 % at 16,589 contracts concluded for 2008[12] – is evidence of a stronger effect (positive or negative) and the added value (where there is such) on increasingly larger communities. Introducing targeted eligibility requirements for the contracts at a level higher than the average for the respective branch, on the one hand, and a response by the bidding enterprises in the form of their own innovative projects as a source of competitive advantage, on the other, could turn this form of interaction between public authorities and business into an important factor for promoting the innovation intensity of the economy.

Within the sample from the survey of Innobarometer[13] for Bulgaria 29.2 % of the enterprises declared they had won public procurement contracts in the preceding three-year period, another 8.3 % made efforts to participate in procedures for the award of such. Nearly 40 % of the enterprises are not interested in such an opportunity.

Of the enterprises in the country that won public procurement after 2006 nearly 46 % declared that in the process of implementing the contracts they had the opportunity to offer a new or improved product developed by them. Within EU-27 higher results under this indicator were registered only for Denmark (51.9 %) and Portugal (48.6 %). Only 16.6 per cent of the enterprises managed to do so in Romania, and in Slovakia – 17.1 %. Of the newly acceded member-states there are values close to those of Bulgarian enterprises only for the Czech Republic (42.1 %).

[12] *Crime without Punishment: Countering Corruption and Organized Crime in Bulgaria*, Center for the Study of Democracy, 2009.

[13] *Innobarometer 2009: Strategic Trends in Innovation 2006-2008*, May 2009.

new knowledge already created is even smaller.

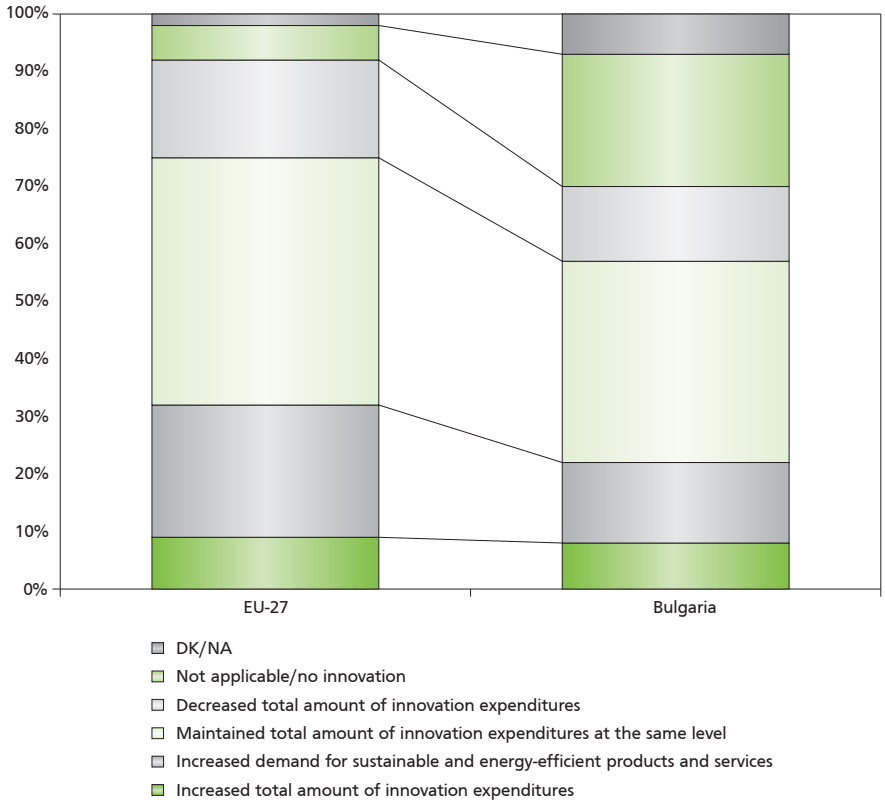
According to Innobarometer 2009, one-third of EU enterprises have increased their innovation expenditure in the last three years, with only 12 % of these expecting this trend to continue. About 28 % of the managers plan to reduce investments in innovation projects. In spite of that, most of the enterprises maintain a stable innovation budget and 51 % of them expect it to be preserved.

In Bulgaria, 7.7 % of the enterprises have managed to increase their budget for innovations – a level close to the European average of 8.8 %. Slightly over 13 % also expect to report such an increase for 2009. The share of enterprises which have allowed a decrease of expenditure for R&D is twice as large (16.6 %), and the share of those which forecast such a decrease in the future reaches 20 %. On a European scale, the largest share is that of enterprises which increase their innovation intensity – in Finland (15.8 %), Denmark (15.3 %) and Sweden (14.1 %). Sweden and Finland are also the countries where most enterprises manage quickly to adapt to the changes on global financial and commodity markets, and on this basis to expand their innovation activity – 20.6 % and 18.8 %, respectively.

Energy efficiency and entry into new markets outside Europe are a priority for about one-fifth of the Bulgarian enterprises included in the sample (18.1 % and 17.1 % respectively). Only 8.6 % opt for the provision of new services related to education and health care. The problem of ageing is not among the priorities for Bulgarian business – 3 % of the enterprises said they are ready to develop new products and services in this field. In spite of the regrettable situation in the country in terms of population numbers and structure, such a result seems explicable against the backdrop of the general disregard of the demographic problems of Bulgarian society.

More than half of the enterprises in Bulgaria (53.2 %) do not consider the discussed areas for innovation as potentially successful (29.1 %), declared they have given up on innovation (16.4 %) or abstained from making a decision (7.7 %) about the possible sources of competitive growth over the next two years. This is indicative of the lack of a national strategy in these fields and of the fact that the country is lagging behind investment and innovation trends.

Figure 7. ENTERPRISE REACTIONS TO THE ECONOMIC DOWNTURN, %



Source: Innobarometer 2009

Technological Product

Technological product is a result of the creative efforts of various participants in the innovation process. It has unique characteristics and economic significance, which makes it attractive as an object of transfer. The most frequent form of protection of technological products as intellectual property is their registration as inventions and utility models. The analysis of applicant and patent activity regarding inventions and utility models in the country as well as the attitudes of Bulgarian and foreign persons in this field make it possible to assess an essential aspect of the innovation system operation and to find ways for improving it.

Bulgarian applicants are far from the member-countries with the highest applicant activity within the European Patent Office. Nevertheless, the absolute number of patent applications is increasing and latest official data show they reached 15 in 2007. Increasing applicant activity is an indicator of development in the respective technological field. A significant percentage of the applications are submitted by large companies, not SMEs.

Applicant activity in Bulgaria in the last ten years has been at relatively stable levels. The applications submitted by Bulgarian persons under the national procedure average some 250 a year over this period. Interest in patenting technological solutions by companies and natural persons is not large. The following main factors which curb patenting of technical solutions, particularly abroad, could be outlined:

- High costs for acquiring and maintaining a patent in more than one country;
- Lack of innovation intermediaries connecting patent holders and the market with a view to making it easier to find buyers of the technological products;
- Lack of stable judicial system and practice on the protection of intellectual property rights in the country (particularly in respect to patents), which forces a large portion of the inventors of technological solutions to keep their nature secret and not patent them;
- Lack of economic incentives for introducing technological solutions such as tax concessions for innovative companies, for example, which is also a factor for the prevalence of the strategy of keeping inventions secret.

The majority (about 50 %) of applicants in Bulgaria are individuals. This explains to some degree why the applications for a European patent are so few (the applications costs are substantial, particularly if more countries are indicated in terms of interests of protection of the technological product).

Table 3. APPLICATIONS SUBMITTED TO THE BULGARIAN PATENT OFFICE AND PROTECTION DOCUMENTS GRANTED FOR INVENTIONS

Year	Submitted applications			Issued protection documents		
	Bulgarian applicants	Foreign applicants	Total	Bulgarian applicants	Foreign applicants	Total
2000	231	709	940	144	37	481
2001	283	785	1068	132	293	425
2002	289	735	1024	124	52	376
2003	281	678	959	101	214	315
2004	265	130	395	-	-	431
2005	262	51	313	-	-	313
2006	243	48	291	70	249	319
2007	210	29	239	62	188	250
2008	250	20	270	94	247	341
2009*	90	13	113	110	69	179

* 2009 data cover the first 9 months.

Source: Bulgarian Patent Office, 2009

Patent system quality, costs and effectiveness

The time and costs involved in the issuance of a patent are the main factors stopping SMEs from patenting. In the last ten years, the issue of the quality of patents also has its place on the agenda of discussions about the effectiveness of the patent system. Although it still has not been proven empirically, it is considered that the quality of issued patents (respectively that of the technological products they protect) is falling. According to a survey by the Canadian Intellectual Property Office, nearly 90 % of the

patents are small improvements of already existing inventions. The reasons for this lie mainly in the lowered standards of the criteria for patentability – particularly the criterion for inventive step (non-obviousness), as well as in the desire of patent authorities to promote applicant activity in new technological fields in which, however, the technological solutions frequently do not cover the criteria of patentability at all but receive protection documents nevertheless. This leads to problems for both patent holders and users of technological products – mostly to litigation.

The existing system which holds the danger of multiple patent litigations (infringement of rights, annulment because of illegal issuance and so on), weakens the patent system in Europe and makes patents less attractive, particularly for SMEs. In the first place, the system for resolution of disputes is costly – maybe not for large business but definitely for SMEs and individual inventers. If a patent cannot be protected from violations this can strip it of any practical value. In addition, there are considerable differences between the various national judicial systems and the manner in which courts consider patent cases.

The lack of comparable statistical data is a difficulty in estimating patent litigation at EU member-country level. The existing data for 2003 – 2006 show that annually an average of 1,500 to 2,000 claims of violations and for revocation of patents are filed with first instance patent courts, 60 to 70 % of which concern European patents. According to calculations of the European Commission on the basis of its own research, 20 to 25 % of the judgments of first-instance patent courts are appealed.[14]

At the same time, the overall costs for parallel litigation in the four member-states that are most frequently mentioned in applications for a European patent (Germany, France, the Netherlands and the United Kingdom) vary between €310,000 and €1,950,000 at first instance and between €320,000 and €1,390,000 at second instance.[15] According to a study by the European Commission, cases related to patents in Bulgaria are under 5 per year.[16] There are no data on patent litigation in Bulgaria.

Patent economic value

A low degree of activity at licensing inventions in Bulgaria was registered for the 2000-2009 period – a total of 63 inventions were licensed, which means that an average of 6 inventions are licensed a year. Although utility models as a form of protection of technological products is preferred by Bulgarian persons, the licenses for the period under review were exceptionally few (a total of 11 for 10 years, with 4 of the licenses being actually utility model applications). This could be due to the fact that the technological solutions which are protected as utility models find application mainly through introduction in the company's own production and additional economic benefit through licensing them is not sought.

The ratio between licensed **Bulgarian and foreign inventions** is definitely in favor of the former – they are 59 against 4 foreign ones (from the Netherlands, Norway, United Kingdom).

It is interesting to note the fact that not only **patented** (33) inventions but also inventions with **applications** for patenting (3) are the subject of licensing. This shows that the individuals, after all, value the significance of new technologies even when not yet holding the exclusive rights on them. Several inventions were licensed in a package with one deal by co-holders – a Bulgarian and a Russian per-

Figure 8. LICENSED INVENTIONS FOR THE PERIOD 2000 – 2009 ON THE TERRITORY OF BULGARIA

* Data for 2009 are for the first 9 months.

Source: Bulgarian Patent Office, 2010

[14] See Communication from the Commission to the European Parliament and the Council "Enhancing the patent system in Europe", COM (2007) 29-03-07

[15] Ibid.

[16] See Harhoff D., Ph.D., Economic Cost-Benefit Analysis of a Unified and Integrated European Patent Litigation System, 26 February 2009, Tender No. MARKT/2008/06/D

son; these were reported as Bulgarian inventions.

Inventions are licensed both **individually** and in a **package.** The numbers of inventions licensed individually and in a package are almost equal (19 against 14). Packages usually consist of 2-4 inventions. There is also a license which ceded the rights for 13 inventions.

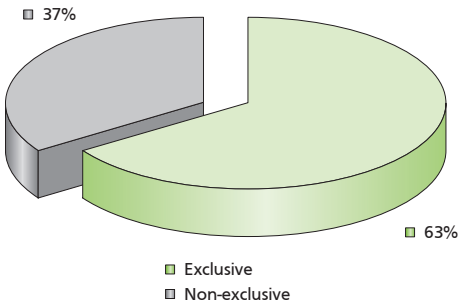
Most of the patented inventions are licensed individually and about 2/3 of the inventions filed for patenting – in a package. The explanation probably lies in the greater risk in the case of the filed applications inasmuch as the exclusive right (and respectively monopoly utilization) is not yet a fact. **Repeated** licensing of inventions is an exception rather than the rule – there is only one such case.

Business licensors are above all **small and medium-sized enterprises** – limited liability companies. Only in 6 of the contracts is the licensor a joint-stock company. The **licensees** are mainly Bulgarian persons – foreign persons are such on only 3 of the contracts (from the USA, Russia and the United Kingdom). Bulgarian licensees are **mostly companies** – chiefly medium-sized and large. The exceptions are a foundation for technological transfer and in seven cases individual holders or proprietorships.

As to the **type of license agreements,** exclusive licenses are more than the non-exclusive ones. Non-exclusive licenses for patented inventions are about twice the number of those filed. It is exceptionally rare to come across specification of anything else involving the type of the license in the registry entries for contracts. In 5 cases it is indicated that the license is full, in 3 that it is limited, and in 9 that sub-licensing is possible.

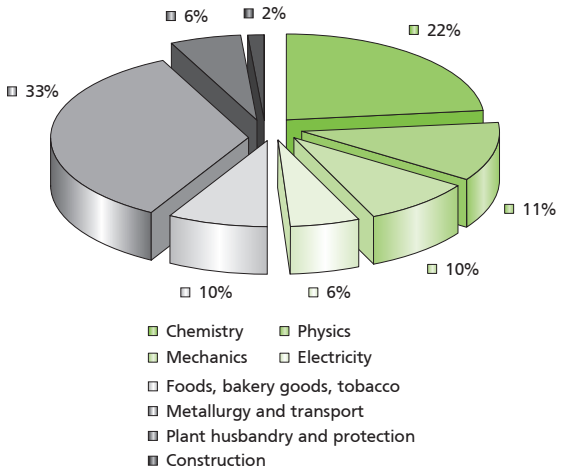
In respect to the technological fields in which the inventions are licensed,

Figure 9. LICENSE TYPES



Source: Bulgarian Patent Office, 2010

Figure 10. TECHNOLOGICAL AREAS OF INVENTIONS LICENSING FOR 2000 – 2009



Source: BPO, 2010

to some extent they reflect the activity by technological field of the applications filed and the protection documents issued. There are many licensed technical solutions in the field of chemistry, foods and mechanics. Unlike patent activity, however, in the case of licensing the most popular fields seem to be metallurgy and transport. The reasons for this can be sought in several directions:

- Technological development in the field of metallurgy and transport is not as fast as in the field of chemistry and foods, which is why the applications filed and the protective documents issued are not so many;
- As a market of technical solutions in this field Bulgaria is attractive, which is why many companies prefer to extract additional benefit from their products by licensing them to other persons;
- The organization of production in this field is related to the investment of a lot of resources (financial, as well as technical and human), which makes this form of economic implementation of technical solutions less attractive than the opportunity to license and get profit in the short term, without the related risks of production failure.

There are numerous problems in the patent system not only in the legislation on the protection of technological products, but also as regards the legislative and economic framework of the introduction, utilization, and sale of technical innovations. Although the costs for acquiring a patent with validity on the territory of the country are not high, the costs for acquiring a European patent under the Patent Cooperation Treaty are quite considerable. These costs are an obstacle before Bulgarian companies entering foreign markets. The long time needed for acquiring a patent is also a deterring factor in patenting technological products – this is a problem for both the Bulgarian and the European patent system.

The motivation of companies generating and introducing technological products is also a grave problem. The patent system does not provide economic incentives for the creation, production and market realization of innovative products. In addition, the award of a patent requires full disclosure of the essence of the technological product filed for protection. This makes it easier for the competition to have access to the information about the product and to work on the creation of products with improved characteristics in much shorter time-limits. The problem of the protection of rights, particularly in the case of rights from infringements on different territories, is another factor reducing the motivation for patenting by companies.

Research Product

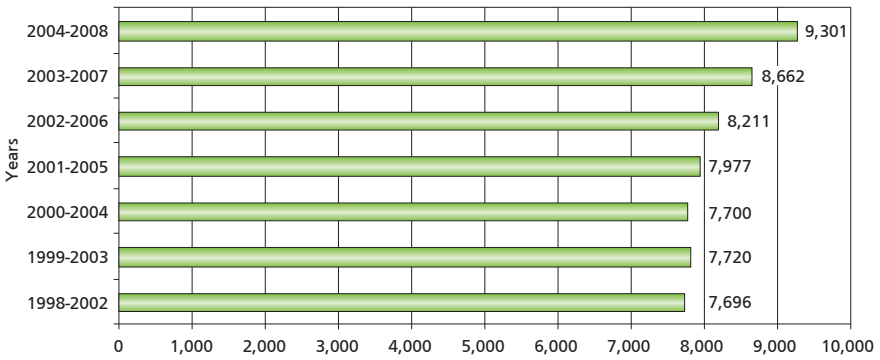
An important precondition for enhancing the country's innovation activity is the new knowledge created by its scientific organizations and scientists. An analysis of the dynamics and structure of this process reveals Bulgaria's potential to enter international research networks, its relative advantages in different spheres of knowledge and its ability to compete on the market of intellectual products. Regional and European comparisons are particularly important with a view to Bulgaria's participation in the European Research Area along with the other EU member states.

Structure and dynamics of scientific publications

The analysis of the structure and dynamics of scientific publications with the participation of Bulgarian scientists, presented in the two most popular global databases today – Essential Science Indicators (1998 – 2008) and SCOPUS (1997 – 2007), allows interesting conclusions about the national policy in respect to science, technological development and innovations.

Bulgarian publications above the citation threshold are registered in all 21 main scientific fields monitored in Essential Science Indicators. In SCOPUS scientific publications are classified in 26 scientific fields, with Bulgarian science being represented with publications in every one of them. Of the 147 countries featured in the Essential Science Indicators, only 42 have scientific publications in all scientific fields. SCOPUS features a total of 233 countries, with only 42 of these having publications in every scientific field.

Figure 11. Number of scientific publications by Bulgarian authors in SCI referenced journals



Source: Essential Science Indicators

Recent years have witnessed a trend of Bulgarian scientists presenting their results more successfully in leading international scientific journals – the number of Bulgarian scientific publi-

cations in the databases[17] increases for the respective periods, growth being particularly notable after 2005.

According to the data from both databases concerning the period 2000-2003 there is a decline of the publication activity of Bulgarian scientists. The decline during the period coincides with a reduction of the share of articles co-authored by Bulgarian and foreign scientists. Regardless of the inevitable fluctuations, however, the percentage of articles co-authored by Bulgarian and foreign scientists increased in the period 1996 – 2007, exceeding 50 % since 2004. One of the reasons is more active participation of Bulgarian scientists in EU scientific programs.

The total number of Bulgarian publications[18] in 2004 – 2008 has risen to 120 % compared to the preceding five-year period. In this respect, Bulgarian science takes a median position compared to countries whose publication activity for the period is high.

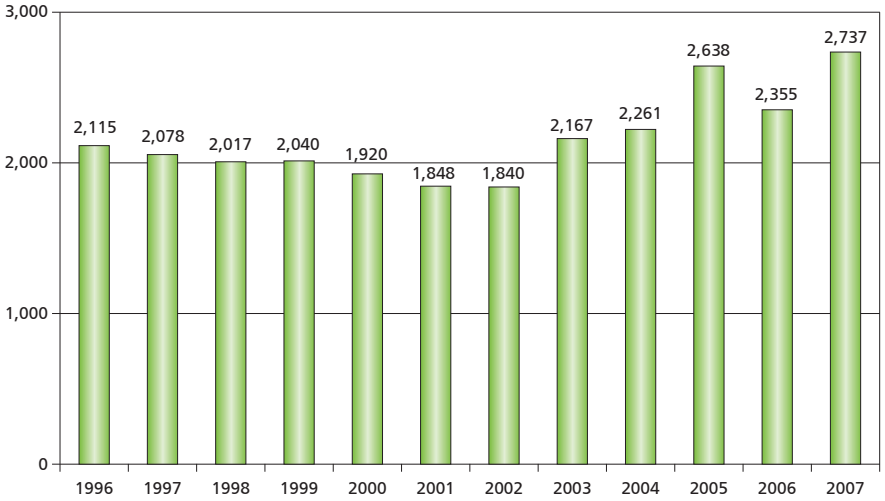
In absolute numbers, articles for the 2004 – 2008 period increased by nearly 1,600, the highest growth being observed in the field of chemistry (306), clinical medicine (240), earth sciences (147), physics (106) and computer sciences (105).

The ranking of scientific fields in Bulgaria according to the number of scientific publications has been changing in recent years. Thus for the period 1999 – 2003 the ranking of the ten leading scientific fields in Bulgaria according to the number of scientific articles was: chemistry, physics, biology and biochemistry, materials sciences, engineering sciences, clinical medicine, botany and zoology, mathematics, pharmacol-

[17] The databases monitor different primary sources (scientific journals), with Essential Science Indicators not monitoring a single Bulgarian scientific journal.

[18] Included in Essential Science Indicators.

Figure 12. TOTAL NUMBER OF CITED DOCUMENTS BY BULGARIAN AUTHORS BY YEAR



Source: SCOPUS

Table 4. SHARE OF ARTICLES BY BULGARIAN SCIENTISTS IN CO-AUTHORSHIP WITH FOREIGN SCIENTISTS (1996 – 2007)

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
%	32.4	37.8	40.3	41.1	37.7	36.4	37.6	49.8	52.3	51	57	53.9

Source: SCImago (2007) SJR – SCImago Journal & Country Rank

Table 5. INCREASE OF THE TOTAL NUMBER OF PUBLICATIONS IN SCI REFERENCED JOURNALS FOR SOME COUNTRIES WITH OVER 9,000 PUBLICATIONS IN 2004 – 2008 AS COMPARED TO 1999 – 2003, %

Country	Increase %	Country	Increase %
China	227	Bulgaria	120
Turkey	213	Austria	120
Portugal	166	Slovakia	118
Ireland	156	Hungary	116
Romania	155	Denmark	115
Greece	154	USA	113
India	150	Finland	112
Croatia	148	Wales	112
Slovenia	140	England	111
Czech Republic	140	Germany	110
Spain	137	Scotland	110
Poland	136	France	109
Norway	135	Sweden	109
Belgium	126	Japan	101
Italy	126	Russia	91
Netherlands	122		

Source: Essential Science Indicators

ogy and toxicology, space sciences. In 2004 – 2008 earth sciences were among the first ten in place of pharmacology and toxicology.

The publication activity of Bulgarian scientists outlines a mixed structure of scientific research, which follows on the one hand the structure of the fundamental subjects of the natural sciences and a number of interdisciplinary fields of a more applied nature originating on their basis, such as earth sciences, materials sciences and space sciences – on the other.

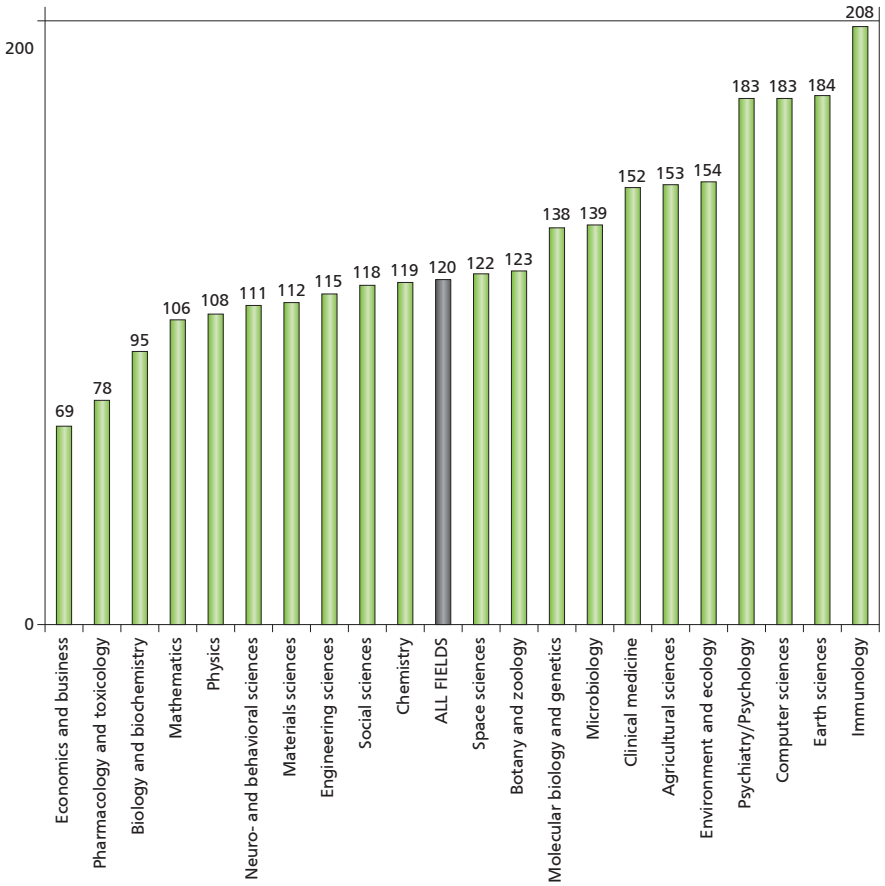
For the period under review, in terms of number of referenced articles reflected in Essential Science Indicators Bulgaria features in the first half of the ranking of countries worldwide in the following eight fields:

1. Biology and biochemistry
2. Chemistry
3. Earth sciences
4. Physics
5. Materials sciences
6. Engineering sciences
7. Botany and zoology
8. Pharmacology and toxicology

The trends and degree of influence of Bulgarian articles on global science can be judged by using a special indicator in Essential Science Indicators. A special section in the information system is dedicated to the so-called "New Hot Papers". These are lists of the articles in each of the scientific fields which have received the largest number of citations in it, the threshold again being specific to each one of them. The list of these articles is dynamic – it changes at every quarterly renewal of the database.

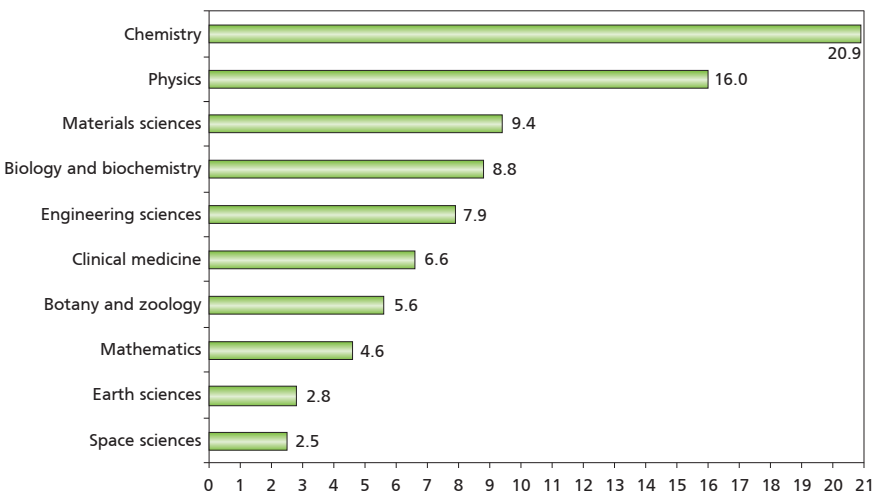
At the end of 2008, there were 73 articles with Bulgarian participation in the "New Hot Papers" and by the beginning of August their number reached 81. They are distributed in 14 of the 22 monitored scientific fields, the largest number of such articles being in the field of physics (23), clinical medicine (14), chemistry (12),

Figure 13. INCREASE OF THE NUMBER OF BULGARIAN SCIENTIFIC ARTICLES BY FIELDS AND TOTAL IN SCI REFERENCED JOURNALS FOR THE PERIOD 2004-2008 AS COMPARED TO 1999-2003, %



Source: Essential Science Indicators

Figure 14. RANKING OF THE FIRST TEN SCIENTIFIC FIELDS IN BULGARIA ACCORDING TO THE SHARE OF REFERENCED ARTICLES IN THEM AS COMPARED TO ALL BULGARIAN PUBLICATIONS (1998 – 2008)



Source: Essential Science Indicators

engineering sciences (11) and botany and zoology (6). Again, the fields of physics, chemistry and engineering sciences come to the fore in Bulgaria, with a confirmation of the place of clinical medicine which is an absolute leader on a world scale in terms of the total number of citations. As it has already been indicated in previous analyses, the prevalent number of the highly quoted articles is a result of international cooperation.

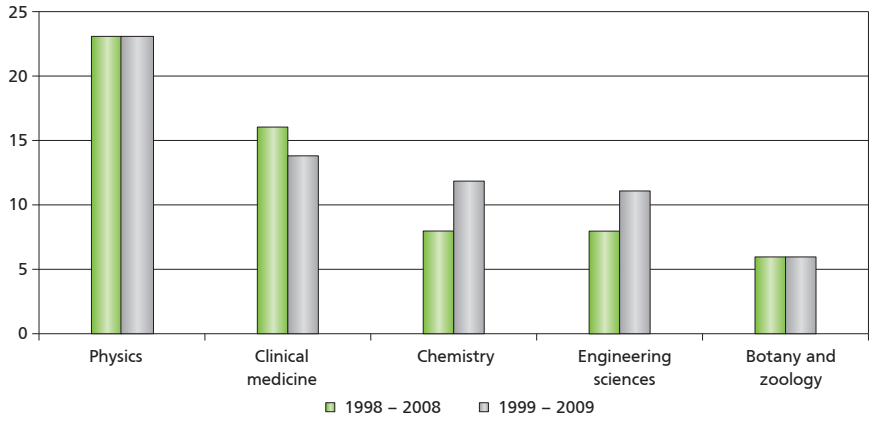
The list of most quoted articles has seen a reduction of those produced exclusively by Bulgarian scientists (from 17.8 % to 12.3 %). These are a total of 10 articles in the fields of: engineering sciences, chemistry, botany and zoology, earth sciences, pharmacology and toxicology, materials sciences. Only two articles are individual – by scientists from BAS. The articles with predominant participation of Bulgarian scientists (only one foreign co-author) total 4 and are in the fields of chemistry, engineering and agricultural sciences.

The institutional picture in respect to the articles which are in the highest citation list for the period shows the following distribution: there are a total of 101 participations, including 53 from BAS, 23 – from Sofia University, 16 – from medical universities and hospitals, 5 from other higher educational establishments and 4 in others (centers, Agricultural Academy institutes, international organizations).

There are two universities among the organizations located outside the capital (a total of 4) – the Medical University in Varna and the Paisii of Chilandar University of Plovdiv, as well as two scientific institutes – the Institute of Oceanology (BAS) and the Institute of Fodder Agriculture in Pavlikeni.

The co-authorship of Bulgarian scientists from the various organizations – an indicator of inter-institutional cooperation in the country in the field of scientific research – is most active between the institutes of BAS and Sofia University faculties, resulting in a total of 7 joint publications. These are mainly in the field of physics and engineering sciences.

Figure 15. DISTRIBUTION OF THE MOST HIGHLY CITED ARTICLES FROM BULGARIA BY SCIENTIFIC FIELD



Source: Essential Science Indicators

Table 6. SIGNIFICANCE OF THE DIFFERENT SCIENTIFIC FIELDS FOR INDUSTRY DEVELOPMENT

Degree of contribution	R&D in engineering (mainly through tacit knowledge)	Fundamental and applied academic sciences (mainly codified, i.e. through publications)
Very high	Computers	Pharmaceutics
High	Aviation Car building Telecommunication and electronics	Petrochemical industry Chemicals Foods
Average	Tools Mechanical machines	Base metals Building materials
Low	Metal products Rubber and plastic products	Textiles Paper
Relevant scientific fields*	Mathematics, computer sciences, machine and electric engineering	Biology, chemistry, engineering chemistry

* Physics is important for both research and development. Statistical analyses did not show a prevalent influence of this science for some of the two groups included in the table.

Source: Salter & Martin (2001), adapted from Marsili (1999)

The link between scientific and technological products

The relations between scientific knowledge, its transformation into innovation and the latter's turn into production are characterized by considerable complexity. Studying them is exceedingly important for scientific policy, inasmuch as they have an essential influence on policy in respect to fundamental research. There are studies that show that the significant technological breakthroughs of the United States in the field of information technologies and biotechnologies are based on university research.

Empirical research and summaries also show that in terms of intensity this relation is not identical for all scientific fields since they contribute differently to the development of the various technological fields. On the other hand, there are also differences in the way in which available knowledge is disseminated and exerts its influence. Last but not least, fundamental, applied or R&D research also reflects on the strength of the relation discussed.

It is also important that in a number of cases the impact of research in a certain field are not limited to only one technology or industrial branch, and therefore the factoring of the multiplication effect of such fields has an important influence on scientific political orientation and the selection of priorities. The so-called "key technologies", as for example ICT or biotechnology, in turn, reflect on a wide spectrum of industrial sectors, as well as in the field of services.

The existence of differentiated connection, as well as the stronger or weaker influences of research on the branches of the economy is an important element of orientation in terms of scientific policy because of the need to achieve synergy between the national scientific, innovative and industrial policy. On the one hand, the economic priorities and the technological breakthroughs sought are an important determinant of the choice of scientific priorities. On the other, the strong sides of research shape the choice of strategic technological priorities.

Entrepreneurship

Entrepreneurship is a key driver of innovation-based high productivity and economic growth. Successful entrepreneurship produces results along three main lines.[19] First, it can increase a company's productivity by adopting innovative technologies or organizational solutions. Second, entrepreneurship involves the entry into, expansion and sometimes the establishment of new market niches, which raises the company's market share, not least by making it a part of global value chains. Third, entrepreneurship is linked to the elimination of old production forms due to the competition of higher productivity start-ups that replace existing low productivity companies. In all three cases entrepreneurship is as an endeavor based on new combinations and uses of the means and methods of production, the financial and human resources already present in the economy.[20] Product, process, marketing and organizational innovations are precisely such new combinations,[21] while only occasionally being the direct result of introducing a new invention which has not existed before.

A crucial feature of the new combinations is that resources must be withdrawn from the stationary reproduction in the economy, most often in the form of bank credit which the entrepreneur uses to carry out the new combination.

[19] *Evaluation of the Finnish National Innovation System.* Policy Report, Helsinki University Print, 2009.

[20] Schumpeter, J., *The Theory of Economic Development,* Transaction Publishers, New Brunswick, USA & London, UK, 2002.

[21] Oslo Manual. *Guidelines for Collecting and Interpreting Innovation Data 2005*. OECD. Schumpeter himself lists five types of innovation: introduction of new products, introduction of new methods of production, opening of new markets, development of new sources of supply for raw materials or other inputs, creation of new market structures in an industry.

Most often, it is innovative start-up firms that will introduce these combinations. After a certain period, some become firmly established on the market due to their better cost–benefit ratio. This leads to other market actors copying the successful model and thus diffusing the particular innovation. In the case of radical innovations – that is, innovations that cause major changes in previous production methods and/or organization – diffusion can also affect some of the old firms negatively, as they fail to adopt the new combinations. Their market share will gradually shrink and they will be wiped out. On the other hand, the number and market share of the start-ups and the companies that do adopt the respective innovation or modify it with their own innovations will grow. This process of "creative destruction", as Schumpeter terms it, constitutes the basis of long-term economic dynamics.

Science and Entrepreneurship in Europe

As the interaction between science and business in Europe has changed from the mid-1990s on, pressure and incentives have increased to commercialize government funded scientific research, by promoting the so called "academic entrepreneurship", viewed as intrinsically innovative and based on high technologies. This approach is increasingly used in the current financial and economic crisis, as it is considered a possible way to enhance the innovativeness and therefore the competitiveness of national economies. Taking the US *Bayh-Dole Act* as an example,[22] over the past decade a number of west European countries have amended their patent legislation, **granting new rights to the stakeholders under government funded research schemes** – universities and research institutes, and in a few cases, such as Sweden – to individual scientists and researchers. The legislative amendments have permitted these stakeholders to acquire ownership over the patents for the results of publicly funded research and to license private firms to use them.[23]

As a result of these changes the stakeholders have focused mostly on the processes involved in the establishment of **spin-off firms – start-up businesses set up to commercialize results.** There are four major benefits of spin-offs: a strong impact on local economic and technological development; income generation for the respective research institution; commercialization, including further development of technologies which would otherwise remain undeveloped; a strong relation to business and support for research and training at the respective institution.

The majority of publicly funded research organizations in Europe work in an environment where high-technology academic entrepreneurship has emerged fairly recently and is not well developed yet. Because of this, the establishment of spin-off firms follows a pattern rather different from that in the US. In contrast to the US, where they follow the business pull of the innovatively-intensive environment, **in Europe government funded research organizations are compelled to take on a key role in the startup and incubation of new businesses.** In this case research institutions follow the technology push and assume the role of selectors of potentially profitable technologies and, with this in mind, possible innovations. Thus, old-continent academic entrepreneurship creates the so called **European innovation paradox** – the EU is a top-level creator of scientific knowledge, but lags far behind the US and Japan in the ability to translate its scientific advances into wealth-generating innovations. Because R&D in Bulgaria is largely state funded, and non-innovative and micro-enterprises have dominated the structure of businesses, **research organizations became the main actors in the selection and development of new technological innovations** and therefore start-up companies.

European national innovation systems are much less friendly to start-

Table 7. UNIVERSITY SPIN-OFF FIRMS (SELECTED COUNTRIES)

Country	Period	Number of spin-offs
USA	1980 – 2003/2004	4,543*
Canada	1962 – 2003	1,100
France	1984 – 2005	1,230
Netherlands	1980 – 1990	300
UK	1981 – 2003	1,650
Belgium	1980 – 2005	320
Sweden**	До 1990	3,000-5,000
Germany**	1997 – 1999 2001	470-4,000** 900-8,000

* Including 462 in 2004 for USA and Canada;

** Calculations for Sweden and Germany are difficult to make, as intellectual property rights are owned by the researcher rather than the university.

Source: Wright et al., p 2

[22] Enacted by the US Congress on December 12, 1980, the Act is named after the two senators who sponsored it – Birch Bayh and Bob Dole (P.L. 96-517, Patent and Trademark Act Amendments of 1980, codified in 35 U.S. Code § 200-212, implemented by 37 Code of Federal Regulations 401). It set up a unified patent policy for federal agencies funding research and gave small businesses, non-profits, universities and research institutions title to retain control of their intellectual property that resulted from such funding. The Act enables US universities to license and commercialize their inventions by supporting the establishment of spin-off firms interested in the licensing and further development of these inventions. (Wright M., B. Clarysse, Ph. Mustar and A. Lockett, *Academic Entrepreneurship in Europe*, Edward Elgar Publishing, 2007, p. 1).

[23] Wright et al, 2007.

up business than the US. Intellectual property matters are poorly regulated and publicly-funded research organizations must comply with a number of regulations to get permission for starting spin-offs.[24] For instance, Germany had prohibitions on university investments into spin-offs in force up to the late 1990s. Highlighting this fact is important, so that **Bulgaria does not seem to be an exception with its similar bans in the 1990s.** It can be argued, though, that such proscriptions in Bulgaria were supplemented by a number of negative macroeconomic and political factors. In addition, contrary to the pattern in developed capitalist states, the lifting of these bans has been formal rather than ensuing from a policy change in this area complete with all regulatory, financial and organizational incentives to commercialize research.

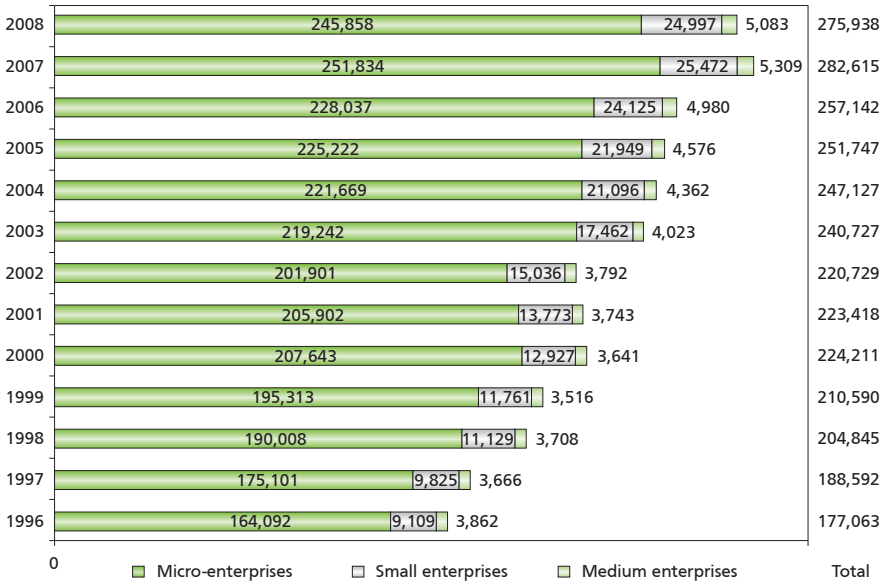
Entrepreneurship Environment in Bulgaria

Setting up a new business does not amount to entrepreneurship if the start-up follows only long-established old combinations contributing to keeping the economy in a stationary state. Therefore, the structure, dynamics or life cycle of start-up firms only point to the context or the particular entrepreneurship environment, solely serving to draw a rough estimate of entrepreneurial activity in the country.[25]

Analysis of the number, structure and dynamics of the legal entities registered in the non-financial sector[26] indicates that micro, small and medium start-up enterprises have steadily increased in the period 1996 – 2008. Their number as a relative share compared to the preceding year dwindled during two periods (2001 – 2002 and 2008), mostly in 2008 when the overall number of micro, small and medium businesses decreased by 2.4 % compared to the year before.

As to their structure, in 2007 there was a rise of 0.4 % in the share of micro-enterprises compared to the previous year, while small companies' share decreased and that of medium ones did not change. A similar ratio was maintained in 2008 against the background of the already noted drop of the total number of companies to 275,938. Compared to the whole post-1996 period this change does not affect the trend of small and medium enterprise growth and micro-enterprise decease, whose shares respectively reached 9.1 %, 1.8 % and

Figure 16. STRUCTURE OF LEGAL ENTITIES (1996 – 2008)



Source: National Statistical Institute, 2009

[24] Wright et al.

[25] *Measuring Entrepreneurship. A Collection of Indicators, 2009* Edition, OECD-Eurostat Entrepreneurship Indicators Programme, 2009, OECD Statistics Directorate.

[26] Despite variations in established international definitions of what constitutes an enterprise, all underline that for a unit of study to be defined as enterprise it must have a certain degree of autonomy in decision making. (Oslo Manual. *Guidelines for Collecting and Interpreting Innovation Data,* 3rd ed., OECD and Eurostat, OECD 2005, p. 64-66, §§ 231-236) The two definitions most referred to – those of the EU and the International Standard Industrial Classification (ISIC), also incorporate this principle. (Council Regulation No 696 / 93 of 15 March 1993 on the statistical units for the observation and analysis of the production system in the Community, OJ No L 76, p.1, section III/A of the annex; ISIC Rev. 3.1., p. 16-17, §§ 49-56; ISIC Rev. 4, p. 16, §§ 77-79, 93-94).

89.1 % in 2008. In terms of innovation potential this looks like a positive trend, as micro-enterprises are generally viewed as less innovative.[27]

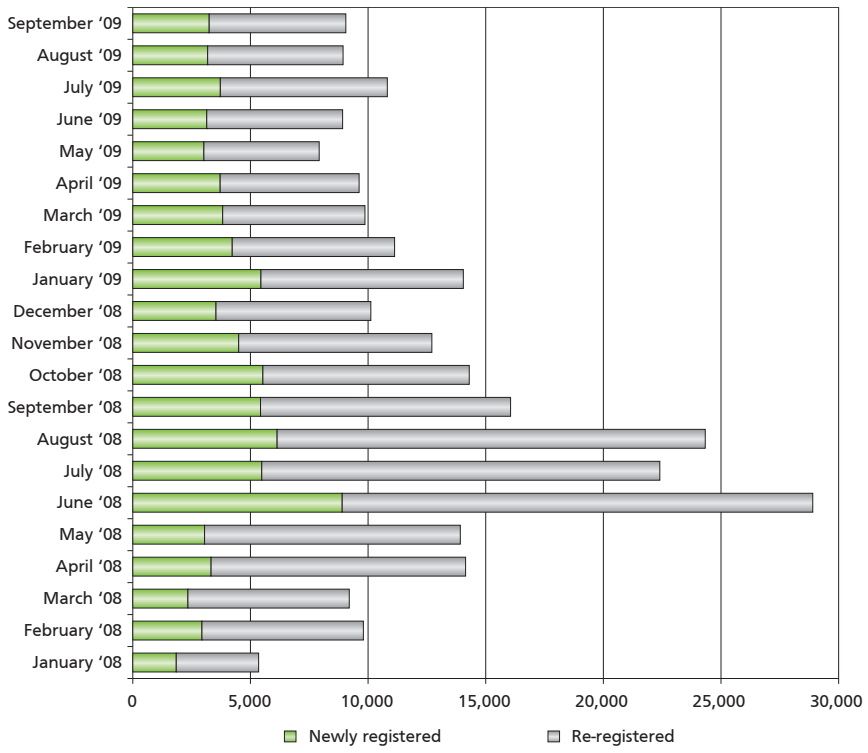
The Registry Agency reports that between January 2008 and September 2009 a total of 271,694 companies were entered in the Central Commercial Register, 184,995 of which were transferred from the old registers and only 86,699 were new companies.[28]

The dynamics of the registration process shows that after a peak in June – August 2008, a downward trend settled, the number of registered firms dwindling more than twice in March 2009 when it reached a monthly 7 – 10,000. Despite the decreasing trend of re-registration and first registration, the number of first registered companies is fairly stable, particularly after March 2009, since when an average of 3,400 have been registered monthly. The dynamics of newly registered companies is one of the indicators of the national economy's level of innovativeness, as it is among entrant businesses where "authentic entrepreneurs" commencing a novel activity in the respective period are to be found. The structure of newly registered companies shows that nearly half of them for each particular month are sole proprietor limited liability companies, while proprietorships and limited liability companies occupy almost equal shares of close to one fourth, while other forms of registration account for a mere 1-3 % of new companies.

The structure of first registered businesses according to their ownership type could be indicative of the firm's size, as it is reasonably expected that proprietorships are basically micro-enterprises. At the same time, for the whole nearly two-year period, the newly registered proprietorships were a mere 24.0 % compared to 76.0 % of those re-registered. **This is a clear downward trend in the number of registering proprietorships compared to the pre-2008 period.** From the perspective of innovative entrepreneurship this trend could be perceived as a positive factor, since the number of the smallest, low-innovative companies, which are often a form of self or family employment, is dropping. It should be remembered, though, that a certain, small proportion of the micro start-ups are authentic entrepreneurs whose numbers will vary among economic sectors.[29]

Taking into account the number of legal entities in the non-financial sector in 2008 (276,715 according to NSI data) as well as the total number of newly registered and re-registered companies in the Central Commercial Register (271,694 by September 2009), it can be concluded with considerable certainty that the economic entities carrying out or de-

Figure 17. NUMBER OF NEWLY-REGISTERED AND RE-REGISTERED LEGAL ENTITIES IN THE CENTRAL COMMERCIAL REGISTER



Source: Registry Agency, 2009

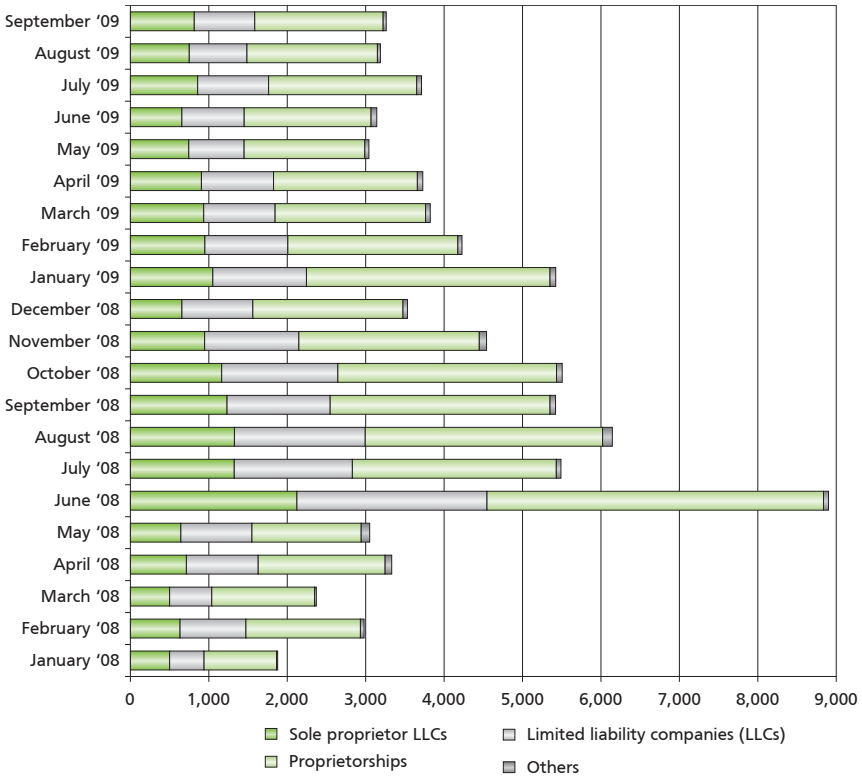
[27] Many studies of European enterprises' innovation activity leave enterprises with less than 9 or even 20 employees out of the analyzed clusters on the grounds of their having no innovative potential. For instance, the survey Innobarometer 2009, commissioned by Directorate General "Enterprise and Industry" of the European Commission, only includes companies with over 20 employees.

[28] According to the Law on the Commercial Register in force as of 1 January 2008, all active companies are subject to re-registration in the Central Commercial Register within the following three years, that is, by December 2010. After the period has expired, those that have not been re-registered will be deleted either directly if they are proprietorships, or, in the case of trade companies, through official liquidation proceedings for the purpose of deletion from the Register.

[29] The dropping number of proprietorships could be due to some other factors as well, such as the decrease of the minimum required amount to register a limited liability company – now, following the latest legal amendments, a mere 2 levs (Commercial Law, Art. 117, Par. 1, amended State Gazette No. 82, 16 October 2009), as well as the abolished provision that a limited company of an annual turnover below 50,000 levs can opt not to register for VAT purposes.

claring to carry out any activity are less than 300,000.[30] This seems to be the corporate context in which Bulgarian and foreign entrepreneurs operate on the legal side, although whether these enterprises are autonomous economic units is a different matter. Some estimates have shown that concerning control over companies' ownership and management, in the various sectors of the Bulgarian economy an average of 2.5 to 3.5 legal entities compose or service a single economic entity.[31] Based on its own estimates the ARC Fund considers the total of economically active enterprises in Bulgaria in 2008 to be around 110,000, of which 10,000 to 15,000 have more than 10 employees and barely 1,000 to 2,500 employ over 50 people. It is among these 100,000 economically active enterprises where entrepreneurs taking up innovative activities with a start-up firm or carrying out the so called corporate entrepreneurship[32] as existing medium or large enterprises should be sought.

Figure 18. TYPE OF OWNERSHIP OF COMPANIES FIRST ENTERED IN THE CENTRAL COMMERCIAL REGISTER



Source: Registry Agency, 2009

As mentioned above, the dynamics and structure of companies in the economy as well as the structure of economically active enterprises can only provide for a rough assessment of some factors determining entrepreneurial activity. From the perspective of the innovative potential of the national economy, of particular economic sectors or of local techno-economic hubs key distinctions of the types of entrepreneurs are made according to the degree of novelty and the intensity of innovations applied by the entrepreneur as well as the innovations' impact on the enterprise productivity, the growth of its market share and the competition-led replacement of dated production forms.[33] Having recognized how important this criterion is, in the last two decades in Europe particular attention has been paid to innovative entrepreneurship and the proliferation of high-technology start-ups in order to promote and speed up the commercialization of results from both publicly and privately funded R&D.

As the analysis in the following chapters of entrepreneurship devel-

[30] According to the Registry Agency, at the end of 2007 there were 1,200,000 registered legal entities. Current legislation requires re-registration if companies are to be allowed to perform certain key activities (such as concluding contracts with other firms or taking part in public procurement procedures), which means that most companies conducting any activities have already re-registered. ("One million companies have to re-register in order to continue operation", interview with Atanas Georgiev, acting Deputy Director of the Registry Agency, *Novinar* daily, November 4, 2009).

[31] This issue was examined at greater length in *Innovation.bg 2009,* pp. 22-23; Data from INA-4 and case studies in various economic sectors, including highly innovative branches, carried out in 2009 confirm the conclusions about the average number of legal entities constituting a single economic enterprise. Apart from the analysis in *Innovation.bg 2009,* there is a growing number of cases where networks of legal entities are created in order to become legitimate participants in the EU structural funds tenders. According to the Acting Director for the Registry Agency, in certain cases 10–15 firms are fictitiously registered, particularly in order to decrease due taxes or to engage in tax fraud ("One Million Hollow Firms in Bulgaria", *Monitor* daily, November 23, 2009).

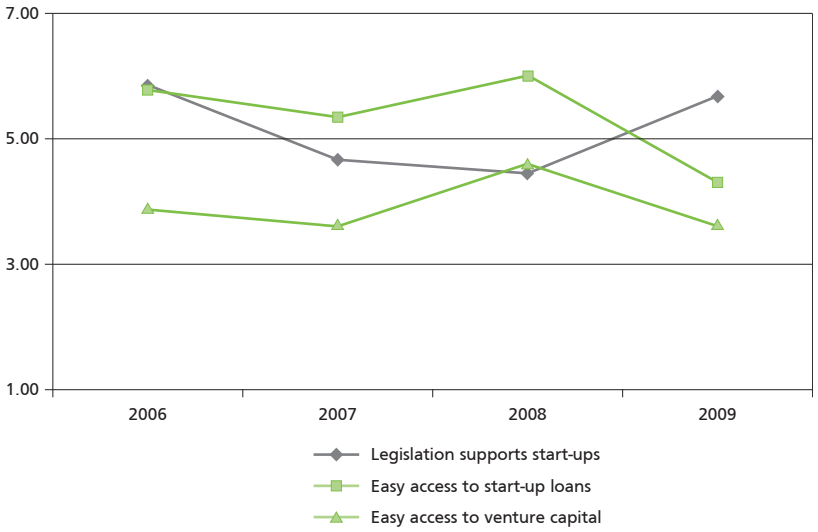
[32] Although the term was coined later on, as early as in 1942 Schumpeter described the process of making entrepreneurship routine within large corporate structures where specially trained expert teams draw mid and long-term plans and strategies of innovative development and entrepreneurial activities (Schumpeter, J., *Capitalism, Socialism, Democracy,* HarperCollins Publishers, New York and London, 2008). As enterprises are going increasingly global in the last two decades, corporate entrepreneurship becomes highly developed. Large multinational companies, mostly in high-technology branches (IT: IBM, Nokia, Microsoft, Panasonic, etc.; automobile industry: Toyota, Volkswagen, General Motors, Ford, Daimler, etc.; pharmaceutical and cosmetic industry: Pfizer, Johnson&Johnson, Novartis; military and space and aircraft industry: Lockheed Martin, Boeing, BAE Systems, etc.) are working on special programs to encourage internal corporate entrepreneurship, also through earmarking financial, organizational and other resources. Several cases of corporate entrepreneurship are also found in Bulgaria, falling into two basic groups – either local branches of multinational corporations where the relevant corporate policies are supported, or Bulgarian companies that have planned and are following a long-term innovation strategy for the company (mostly firms in the ICT and defense sectors).

[33] *Evaluation of the Finnish National Innovation System,* Policy Report, 2009, Helsinki University Print.

opment in Bulgaria in the last two decades reveals, certain economic sectors (e.g. ICT) have advanced basically due to highly innovative entrepreneurship, in particular academic entrepreneurship. Taking into account the global ICT development dynamics as well, this could explain the gap between R&D costs in natural and technical sciences. Data analysis also shows that **innovation and entrepreneurship policies are needed in specific sectors, reflecting the specific ways in which the related science and technology areas and economic branches develop.**

Creating such sectoral policies is hampered by the rather unreliable data on R&D costs in Bulgaria. This has a direct negative impact on the relations between research and business, notably regarding entrepreneurship in government funded research institutions (including universities), but also R&D in strictly business enterprises. There are two interrelated phenomena. On the one hand, a variety of hidden interactions between the research and business spheres is widespread, in which scientists and researchers are engaged in entrepreneurial activities. This could involve spin-off creation, scientists and researchers moonlighting between an institute and a business enterprise or providing consultations and expertise to business enterprises, cooperation in the development of human resources, cooperation in national and international applied research projects, etc. The common feature of all these forms of interaction is that they are informal, sometimes using loopholes in or even breaching the law. Thus, they remain hidden from both official statistics and most surveys in this area. On the other hand, where R&D is independently conducted within business enterprises, including the cases when entrepreneurial activities evolve directly from it, it often remains unreported and is not formally recorded as such. A recent study carried out by the Applied Research and Communications Fund on public and private R&D investment in the ICT sectors of Bulgaria and Romania has revealed that the relevant official Bulgarian statistics contains figures twice as low as the actual R&D costs of enterprises which remain unreported.[34] These two related phenomena have a considerable impact on entrepreneurship in Bulgaria, conditioning the prevailing use of qualitative research methods that can describe the processes underway, but cannot supply any quantitative dimensions. Before presenting such analysis of the development of innovative entrepreneurship in Bulgaria, another group of indicators will be examined which determine the potential for innovative entrepreneurship via the establishment of high-tech start-ups.

Figure 19. Factors affecting entrepreneurial activity in Bulgaria



Source: IMD, 2009

Box 2. Recommendations for an innovation and entrepreneurship promotion policy

1. Drafting sectoral policies reflecting the specificities of the science and technology fields and the related economic branches with respect to R&D funding.
2. Providing tax incentives to enterprises involved in R&D in order to encourage the performance of R&D and its financial reporting.
3. Creating long-term incentives to encourage technology transfer from publicly and privately funded research organizations to business enterprises, including academic entrepreneurship.
4. Promoting entrepreneurship training in secondary and higher schools through support of public-private partnership programs involving the business sector and universities.

[34] The findings of this study are presented in greater detail in the present report's chapter "Information and Communication Technologies." Study on the Trends in Public and Private Investments in ICT R&D in Romania and Bulgaria and the Competitiveness of their Innovation Systems in ICT, DG JRC-IPTS, Contract No 151095-2008 A08-BG.

These are several key factors influencing the environment in which innovative entrepreneurship develops in Bulgaria. A nationally representative survey conducted in October 2009 by NSI, showed that the enterprises having 90 % of the annual turnover in industry anticipated that total investments in 2009 would be 37.2 % less compared to 2008.[35] In addition, it predicted an 11.2 % decrease of investments in industry for 2010 compared to 2009. Enterprise managers from the sectors of industry, trade and services considered the most negative factors on their activity to be the unstable economic environment, (over 55 % of enterprises), insufficient demand and financial difficulties.[36]

According to IMD World Competitiveness Yearbook, in 2009 legislative support to establishing start-ups in Bulgaria is stronger in comparison to 2008.[37] The same ranking, however, shows that access to credit – which according to the neo-Schumpeterian model of economic development it is the ultimate factor determining an entrepreneur's success – has become more difficult both regarding bank loans and venture capital specifically targeted at high-tech entrepreneurship.

[35] *Investment Activity in Industry,* NSI Business Surveys, October 2009.

[36] Business Conjuncture, NSI Business Surveys, November 2009.

[37] IMD World Competitiveness Online 1995-2009 (Updated: May 2009).

Investment and Financing of Innovation

The financing of science, technology and innovation in Bulgaria is an example of being unique in an area where uniqueness is of no use. Governments in other countries have been investing vast resources in the faltering world economy and making large investments in new research and innovation projects (in the past year a number of European states, the US, Asian states and Russia increased both public and private R&D spending). Bulgaria, though, has chosen a different solution:

- budget cutbacks in all areas with no clear idea about the state and development perspectives of each specific sphere and withholding of mandatory state payments, resulting in growth of the domestic debt and compromising of the **short-term** performance of business;
- investment cuts in science, technology and innovation in addition to failure of the government to make their development a priority – another way to handicap the Bulgarian economy in the **long term.**

Research and innovations are high-risk and costly endeavors, but they are the definitive factor that ensures the growth and competitiveness of modern economies. Moreover, forgoing innovations is still costlier and is bound to deepen a country's lag and cause a loss of valuable human resources, a dependence on foreign investors and a mere low-tech survival.

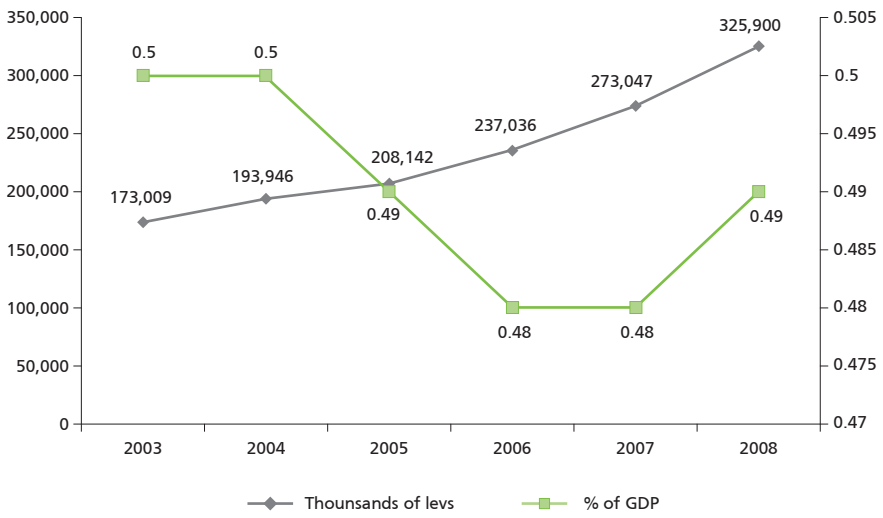
Public Financing of Science and Innovation

R&D spending measures the investment in the creation, use and dissemination of new knowledge in the public and business sectors. They are viewed as an indirect indicator of the innovation capacity of national economies. High R&D intensity (R&D funding as proportion of the GDP) is a factor fostering dynamic economic growth and competitiveness.

Most governments have undertaken similar measures to counter the effects of the recent crisis on the world economy – such as to support domestic competitive advantages and national champions (sectors, technologies, companies) that create them. In exchange for this support, governments insisted on picking the priority areas in which to invest the released financial resources – namely, innovation and new technologies. Taking on the private sector's liabilities has led to considerable increase in long-term indebtedness in most developed countries, so governments have tried to direct the funds to long-term projects with potentially high returns, such as financial support to firms which earmark sizeable resources for R&D, promotion of fundamental and applied research and investment in strategic technologies (e.g. renewable energy resources).

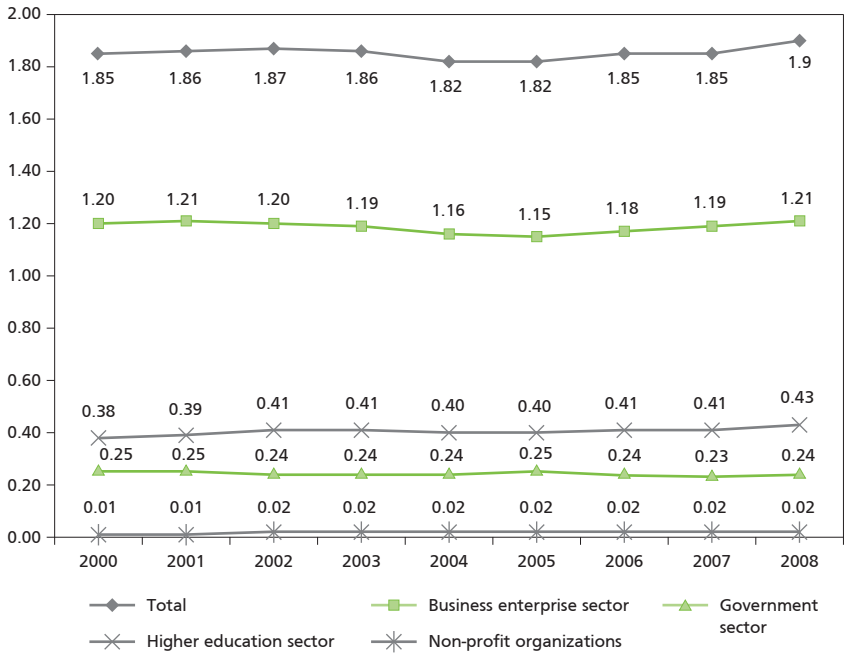
The alternative path taken by Bulgaria was to reduce as early as 2009 state funding for R&D (including innovation financing facilities like the National Innovation Fund with the Ministry of Economy, Energy and Tourism (MEET), which did not commence any new projects in 2009, and the National Science Fund) in order to preserve the macroeconomic balance. It was promised, though, to pursue reforms improving performance in the public sector (the Bulgarian Academy of Science, universities and budget expenditures). Despite the declared increase of funds for education, general university budgets for 2010 are lowered and their scientific research and artistic spending is also to dwindle. In 2009, the costs reported in research project

Figure 20. R&D EXPENDITURES IN BULGARIA



Source: NSI, 2010

Figure 21. R&D INTENSITY IN EU–27, %



Source: Eurostat, 2009

budgets at universities were 40 % as low as those initially approved.

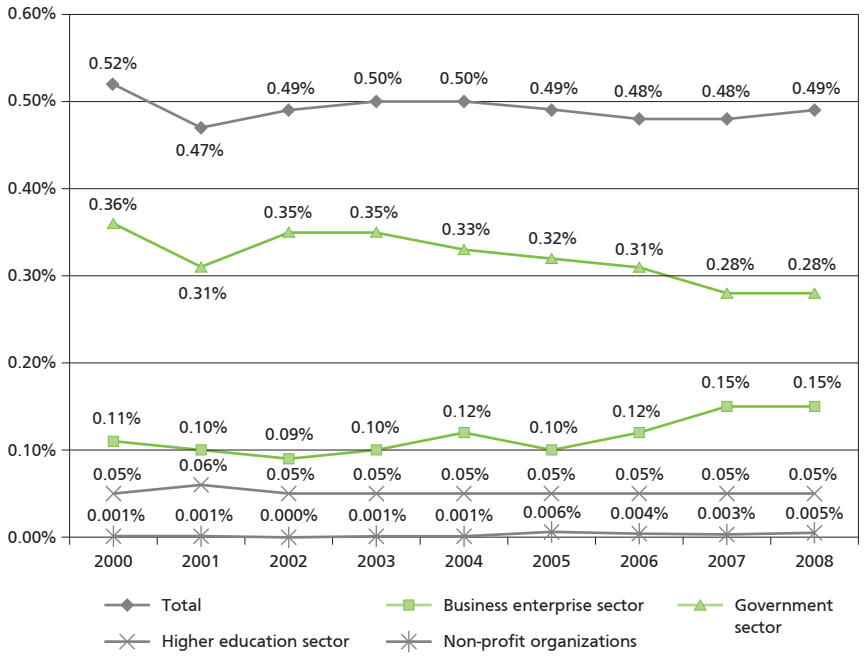
So far Bulgaria has reported highest R&D intensity in 2000 – 0.52 %. Economic growth in the last decade has failed to entail restructuring to more science-intensive activities and so the share of R&D spending in the GDP has remained unchanged. Preliminary NSI data for 2008 puts the share at 0.49 %, which is less than one fourth of the EU–27 level. For 2010 prognostic data indicate a drop down to 0.35 % of the GDP, which will be the lowest value since 2000.[38] Like most countries in EU–27, since 2005 enterprises' R&D spending in Bulgaria has been rising at the expense of public sector R&D costs. Nevertheless, in real terms both private and public R&D expenditures remain rather low and government funding for R&D as proportion of the GDP has consistently been cut since 2000 – from 0.36 % in 2000 down to 0.28 % in 2008. However, it is quite probable that part of R&D spending in private sector enterprises is hidden due to the lack of both adequate statistical coverage and appropriate tax incentives.

The structure of R&D spending by field of science is indicative of the field's innovative potential. NSI data for the period 2000 – 2007 shows that R&D spending in real and in growth terms has been highest in technical sciences followed by natural and agricultural sciences.

A breakdown of these expenditures by sectors, however, shows essential differences between natural and technical sciences regarding both the sectoral balance of R&D spending and expenditures in real terms. Government spending dominates the natural sciences and is therefore of primary consequence in R&D spending growth. In contrast, R&D expenditures of the business enterprise sector in technical sciences are greater than those in the public sector both in real and in growth terms. This trend corroborates the lack of strategic vision on the development of science, technology and innovation in the public sector, as it makes investments in knowledge fields of

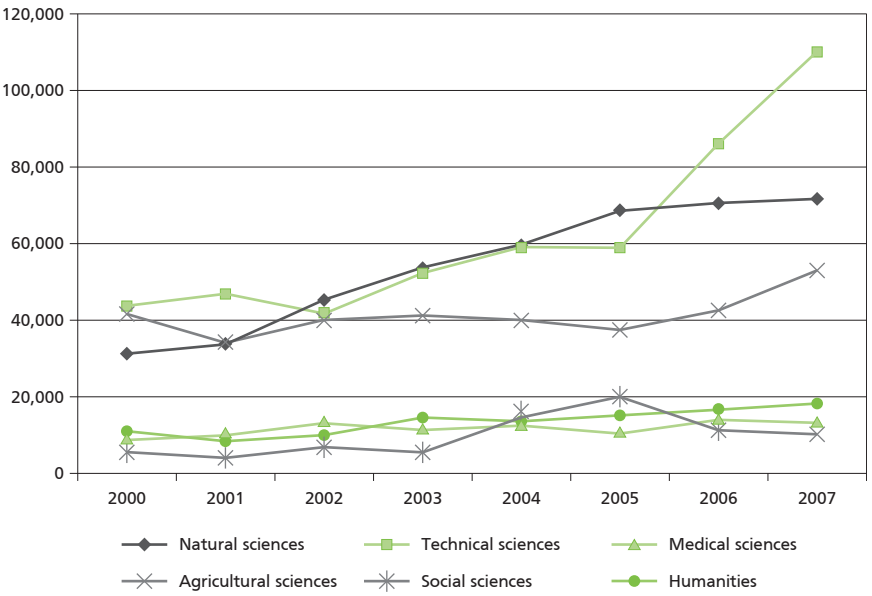
[38] Report to the Draft Law on the State Budget of the Republic of Bulgaria for 2010, Ministry of Finance.

Figure 22. R&D INTENSITY IN BULGARIA, %



Source: Statistical Yearbook 2008, own calculations

Figure 23. R&D EXPENDITURES BY FIELD OF SCIENCE, THOUSANDS OF LEVS



Source: NSI, 2009

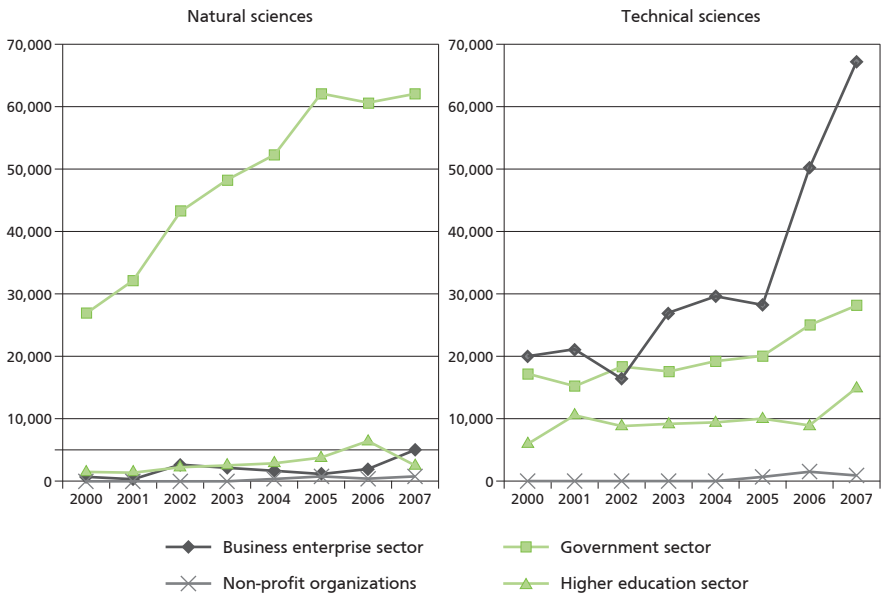
small practical value. Although the state naturally has a priority role in the fundamental sciences, the scarcity of available financial resources requires rethinking of this strategy or a radical restructuring of R&D expenditures across institutions and scientific fields as well as binding these to EU and private sector programs. For instance, the ongoing neglect of social sciences, particularly applied social sciences, drastically narrows the opportunities for developing national policies.

Disparities between R&D spending in natural and technical sciences are not due to increase of personnel – that remains rather steady over the years, but to the growth of average R&D expenditures per individual (measured through FTE). This growth (more than double) is most clear-cut and stable for natural and technical sciences, although in real terms it is agricultural sciences that have the highest R&D expenditures per person.

The relative share of R&D expenditures in the overall budget expenditures measures the degree of importance the government attaches to R&D and its role in providing resources for the production of scientific knowledge. In 2010, expenditures on science will amount to 221 mln levs or 1 % of all budget expenditures. The bulk of them (nearly 97 %) will be spent on running costs (mainly salaries) and barely 3.2 % are distributed for capital expenses, including means for developing the research infrastructure.

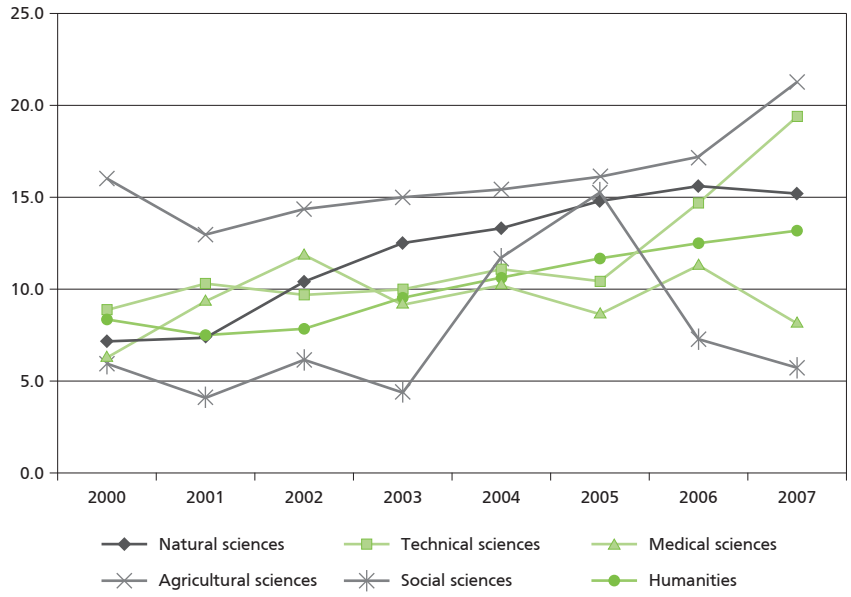
Bulgaria remains the only EU member state that has not set an R&D intensity target for 2010 as part of the process of building the European Research Area.[39]

Figure 24. R&D EXPENDITURES BY FIELD OF SCIENCE AND SECTOR, THOUSANDS OF LEVS



Source: NSI, 2009

Figure 25. AVERAGE R&D EXPENDITURES PER PERSON, THOUSAND OF LEVS PER YEAR/FTE EQUIVALENT



Source: NSI, 2009

[39] *A More Research-Intensive and Integrated European Research Area,* Science, Technology and Competitiveness key figures report 2008/2009, European Communities, 2009, p. 27.

There are several alternative public sources of funding of key importance to the research and innovation activities of Bulgarian business: **EU programs,** such as the Seventh Framework Program for Research and Technological Development (FP7) and the Competitiveness and Innovation Framework Program; resources from the **European structural funds and the Cohesion Fund** for the development of science and innovations distributed through the Operational Programs Competitiveness and Human Resource Development; **national programs for indirect public funding** within the National Innovation Fund and the National Science Fund. As sources of private funding are extremely insufficient, these programs could be defined as fundamental for the development of the Bulgarian economy's innovation potential. Since there is no adequate administrative capacity for the management of government-funded projects, though, this could be a rather challenging task that calls for innovative solutions to combine resources from national as well as European, public as well as private sources.

Each R&D and innovation financing source is available at specific conditions and a specific price, which may often involve extra efforts on the part of beneficiaries to overcome administrative delays and incompetence and thus influence the decision whether to innovate or not.

COMMUNITY PROGRAMS

The EU has a number of programs supporting the activities of enterprises. Strongest priority is placed on enterprises' technological development, the introduction of new products and technologies, the development of an innovation-oriented business culture (new knowledge, products and technologies designed to enhance business performance and contribute to its success).

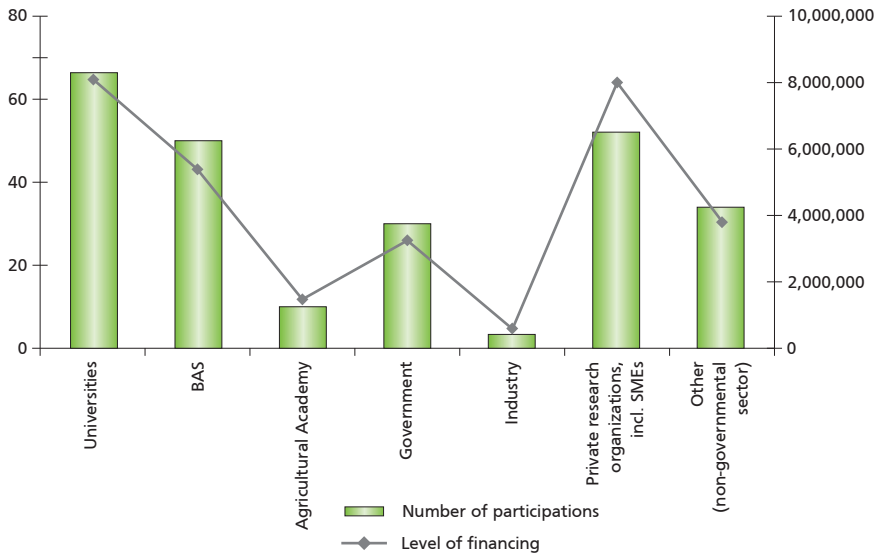
Seventh Framework Program

So far Bulgaria has taken part in 181 projects funded under FP7, with 248 Bulgarian teams participating, the total value of the contracts of Bulgarian participants amounting to €28,649,011. Universities have had the broadest participation.[40]

FP7 applicant teams from universities and the Bulgarian Academy of Sciences have already won grants and accumulated project experience under FP5 and FP6. There are two BAS institutes that stand out, each having successfully completed five projects – the Institute of Oceanology and the Institute for Parallel Processing, also successful under the Sixth Framework Program. Many BAS institutes have not been involved in any projects, while over 30 % have not even applied. Biological and technical sciences are the areas that attract the greatest number of tender participants.

Similarly, project participation is not balanced across universities in regional terms. The ones with highest approval rate are Sofia University and the Technical University in Sofia, followed by Plovidv and Varna. In terms of awarded amounts universities rank at the top of all FP7 beneficiary organizations. It is also notable that private organizations attract a larger share of the program funds than BAS institutes which rely on a

Figure 26. Bulgarian participation in FP7 by applicant organization



Source: MEYS, 2009

[40] Data submitted by the Ministry of Education, Youth and Science (MEYS).

regular state subsidy. NGOs and government agencies draw comparable financial resources as well. This is why the National Science Fund's scheme for providing national co-financing of the participation of Bulgarian private organizations should be extended to other ministries managing EU programs, such as Competitiveness and Innovation Framework Program (MEET) and the Justice and Home Affairs Program (MoJ and MoI).

According to MEYS data, at the end of 2009 seven institutes of the Agricultural Academy were participating in FP7 with 13 successful projects altogether amounting to €2,178,690. This is way above the Academy's FP6 participation when six of its institutes had won a total of 18 projects (€870,740).

An impressive number of SMEs appear as FP7 beneficiaries. **The European Commission points out the positive balance of Bulgaria's non-state sector participation in the program as an example of good practice.** Moreover, the fact that companies participate in research projects suggests that private business is involved in the pursuit of scientific findings and products.

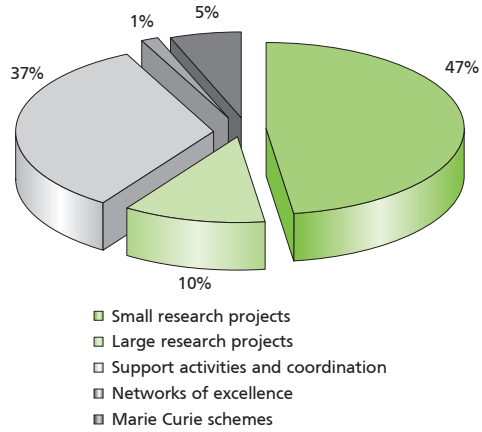
The industry's participation is insufficient (for the purposes of FP7 analysis an industrial enterprise is one that employs over 250 people), but the fact that such enterprises show a growing interest and commitment to co-funding (as the pertinent tender participation rules require) is a positive sign.

The types of instruments where Bulgaria is most often involved are the small research projects followed by horizontal non-research measures. The approval rate of large research project applications is low.

Bulgaria continues to have a high participation rate under the ICT priority theme and, in contrast to FP6, in the Health priority theme area as well. Growing interest is observed in the thematic area new materials and nanotechnologies as well as environment. Bulgaria already has three working research centers under the Research Potential scheme aimed at establishing centers of excellence.

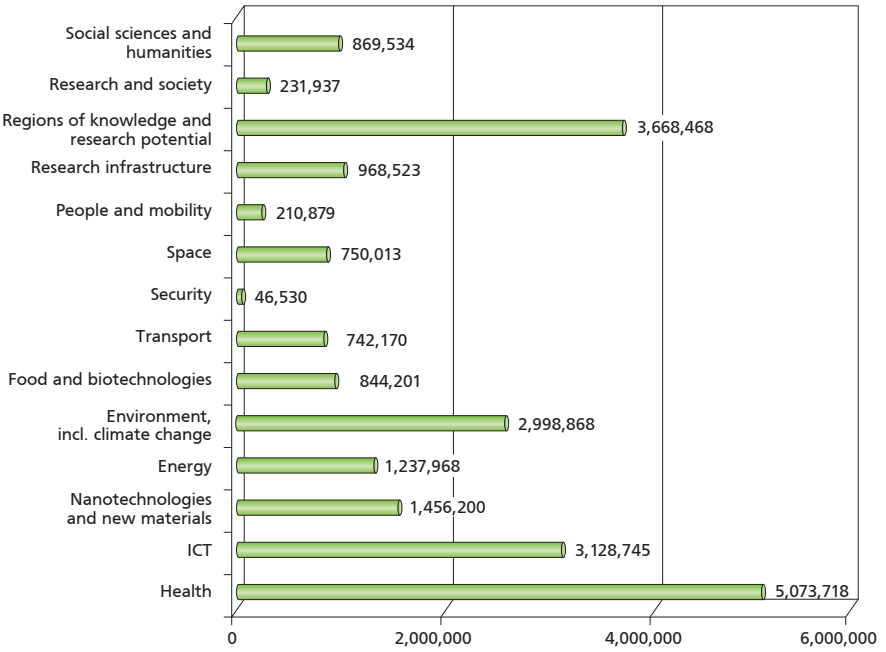
Bulgaria has not scored well in the thematic areas for food and biotechnology as well as energy despite these being considered a declared priority and having established research traditions in these areas. The application rate in the human potential improvement scheme is also very low. FP7 provides varied project opportunities under the scheme – from individual fellowships to young and senior scientists, through reintegration or skills improvement grants, to build-

Figure 27. Distribution of Bulgarian FP7 participation by type of instrument



Source: MEYS, 2009

Figure 28. Project funding by priority area



Source: MEYS, 2009

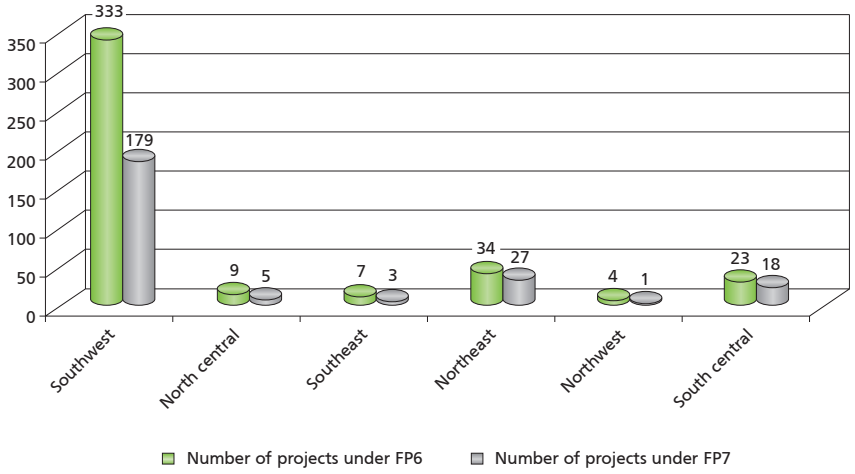
ing research training networks and partnerships with the business. Bulgaria has not submitted any project under most of these facilities, which is in sharp contrast to the great shortage of qualified human resources on the national labor market. The latter is yet another proof that the country lacks an integrated policy on the development of its economy's innovation potential. As a result, the private sector and government remain divided in their efforts thus neither achieving any substantial effect.

The regional distribution of participants is the same as in FP6. The Southwest Planning Region centered round Sofia has the top project approval rate, but the remaining regions are barely active in seeking funding under the two framework programs, which reflects the irregular distribution of Bulgaria's research potential.

Based on experience in recent years, the following groups of factors hamper Bulgarian organizations in their participation in research and innovation funding under Community programs:

- Poor awareness. Despite the efforts of some ministries to raise public awareness about the programs they are administering and those of several organizations conducting information and consultation projects within these programs, the average potential beneficiary is poorly informed about them, not least because the media focus on local instruments (operational programs and national funds) and on topics other than innovation, new technologies and science.
- The administration of responsible ministries does not sufficiently appreciate the opportunities provided under the framework programs and earmarks insufficient resources to inform the public about them. The Competitiveness and Innovation Framework Program (CIP) to be popularized by MEET represents the most alarming case. While MEYS has already developed and is using working mechanisms for the co-financing of R&D projects under FP7, MEET has made no significant move to provide such funds to CIP participants, contrary to some public statements of the minister made back in 2008. This smothers Bulgarian organizations' interest to apply and, through the failure to use fresh financial resources, incurs large opportunity costs to the country's economy.
- Some of the organizations are held back by the framework programs' requirement of forming international consortia, which is a direct consequence of the poor foreign contacts of Bulgarian SMEs (they are narrowly focused on the local and regional market, the geographic range of an enterprise's main activity being no wider than 100 km) and the language barrier (all programs require that the language of communication and of project documents is English).
- The development of a **national mechanism for co-financing of major Community programs,** such as CIP under which several large-scale projects are underway, should be perceived not as an expense but as an investment. Thus, providing national resources to co-finance CIP up to 2013 will attract Community funding of at least the same amount, as well as resources from the EU funds several times as large.

FIGURE 29. PARTICIPATION OF BULGARIA'S REGIONS IN FP6 AND FP7



Source: MEYS, 2009

OPERATIONAL PROGRAMS

The European Regional Development Fund (ERDF) is the largest Community financial instrument for the support of SMEs. It aims to correct the imbalances and to strengthen social and economic cohesion between EU regions.

ERDF differs from all other Community funding sources in that its programs are managed by national and regional authorities rather than by the EU directly. The former play the role of contact points for the calls for

proposal and the project selection procedure. Programs are managed and projects selected at the national and/or regional level. Bulgaria carries out ERDF funding via its operational programs (OP).

Operational programs are replete with cumbersome administrative procedures and the responsible bodies do not have the capacity to implement them. As a result, they barely manage to spend a small share of the resources allocated for Bulgaria under the Fund. Three years after EU accession, the payments made are below 2 % of the total operational programs' value, with the Competitiveness OP, designed to support economic innovation, lagging behind most significantly.

Interest to all OPs is growing as a consequence of the severe economic crisis, but so is disappointment by its actual implementation, as payments in the first three years have either been withheld or considerably delayed. This problem should be tackled via the introduction of more flexible implementation and co-financing mechanism (e.g. in-kind contributions). While in 2007 and 2008 the Bulgarian economy was not in need of financing under the EU funds, in 2009 and 2010 these financial instruments have turned in one of the few possible sources of new capital. Thus, due to the crisis, EU funds – besides their intended use in modernizing and restructuring the economy – have become a possible source of liquid assets for implementing corporate projects. Since national contributions (from the state budget or private entities) are also required but are shrinking as the crisis goes on, the absorption of EU funds should be prioritized as a national strategy; their structure should be streamlined to fit national priorities.

As a comprehensive review of all member states' achievements is pen-

Box 3. BEST PRACTICES IN EU STRUCTURAL FUNDS ABSORPTION

Accomplishing an innovation project from its initial design, through the search of a scientific and technical solution of a specific problem, to its final use in practice involves each of the national innovation system's units. Whether they interact successfully is particularly important in today's global information-dependent society. It is a mandatory condition for being able to work in EU projects and absorb EU structural funds whose main goal it is to disseminate best practices and multiply the effect of innovations across the Community.

Innovation projects depend for their success on the ability to formulate a practice-oriented idea as well as to create organizational and production conditions to implement it. It is the so called "hard" structures of the innovation systems – research bodies and the business – that perform the latter function. "Floating" structures, such as transfer centers and research foundations, however, are ultimately more important for success, as they provide everything else – they form and coordinate the research consortia, draw up project documentation, manage finances, and store and circulate the project know-how.

This is what the PERA innovation centre, located near Leicester, UK, does. It is registered as an applied research foundation, which is the **first indispensable condition** if an organization is to get 100 % financing for EU projects. Among PERA's main functions are project organization and management under the EU operational programs, including preparation of research themes, lobbying, team formation, completing CfP documents, coordination of approved projects, creation of experimental models and reporting of results. PERA has won projects for €180 mln under FP6, all of which are run by several project managers – young engineers of managerial excellence.

Point L-Bulgaria Ltd. is the Bulgarian partner in the PERA's research consortia in the implementation of the following FP6 and FP7 projects:

- A Novel Laser-Inkjet Hybrid Printing Technology for Additive Printed, High Resolution, Mass Customised Conductive Copper Tracks (FLEXTRONIC) 2005 – 2008;
- A Novel Hybrid Regenerating Filter for Improving Air Quality by Safely Destroying Biologically Active Airborne Particulates in AgriFood Production Operations (VOLTAIR) 2005 – 2008;
- Innovative Design for Wind Energy Capture in Urban Environments (ROOF-CAPTURE) 2009 – 2011.

The Foundation has formulated a concise presentation of scientific ideas and the way these would be implemented and benefit the EU (project applicants get more points for cutting-edge research ideas that could be widely applied for the public benefit). Drafting such dossiers is the **second indispensable condition** in securing funding.

It is crucial to attract to the project team a leading research institute from Europe or another country with top scientific achievements in the technology field to be researched (this institute could also get 100 % financing). This is the **third important condition** to make a successful project and enable the transfer of breakthrough technologies to PERA (the terms of CRAFT projects require that the research carried out becomes property of

ding in 2010, cuts in the Structural Funds for Bulgaria are quite possible. It is the practice in the EU to redirect thus freed financial resources to member states achieving better results in their use and management.

The European Parliament is to begin funds planning for the 2014 – 2020 programming period, distributing them among member states on the basis of the preceding period's results in terms of both absorption of the funds and their transparent management in compliance to EU rules.

Box 3. BEST PRACTICES IN EU STRUCTURAL FUNDS ABSORPTION (CONTINUATION)

the SMEs participating in the project consortium, which are obliged to apply the developed idea in their production practice. The project coordinator also has full access to the information and the right to disseminate and elaborate on the technology developed under the project).

Lobbying, the **fourth important condition,** is crucial in how the themes will be formulated and raises a project's chances of approval. It is part of the overall government efforts and policy. In proof of their understanding how important lobbying is PERA have their Brussels office in proximity to the British Council and right next to the European Commission's premises.

Source: Point L-Bulgaria Ltd.

National Funds and Programs for R&D and Innovation Financing

National Innovation Fund

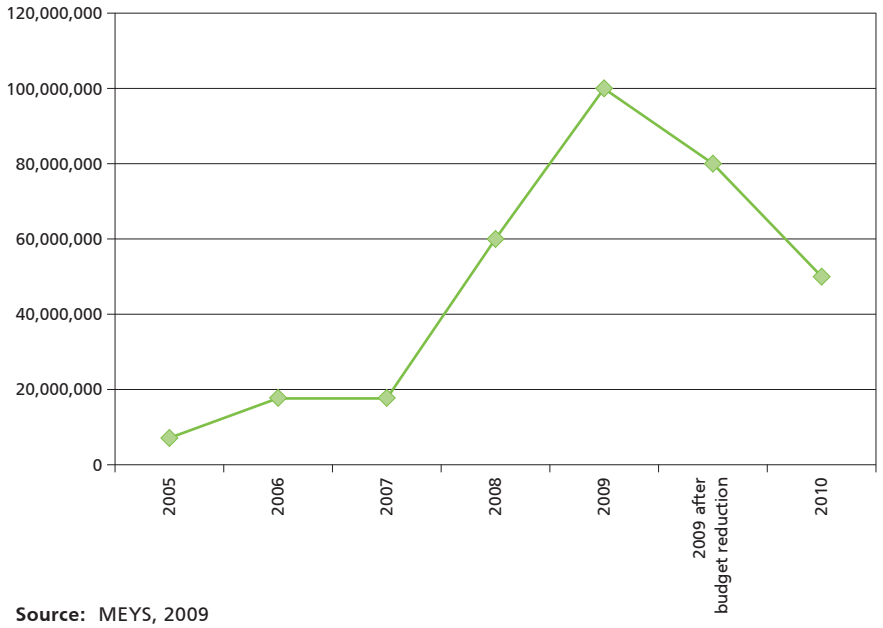
The National Innovation Fund (NIF) was launched in 2005 by a Council of Ministers Decision in implementation of Measure 1 of Bulgaria's National Innovation Strategy. Its resources are intended to promote R&D projects and feasibility studies targeted at the development of new or improved products, processes or services capable of enhancing the economic performance, innovative potential and technological capacity of enterprises.

In the period 2005 – 2007, the number of submitted projects has gradually increased, while in 2008 it sharply dropped. This could partially be explained by the firms' growing interest in selection procedures under the Competitiveness OP and also by the widely shared opinion that project reporting of actual costs is rather challenging, particularly where salaries and social security contributions are concerned.

Although initially it did not run smooth, NIF has managed to attract SMEs to the opportunities it offers for funding their R&D activities. What hinders NIF's operation are the cumbersome administrative project implementation and reporting procedures, and the distrust concerning the transparency of project selection. Solutions could be sought through the following approaches:

- Restructuring and making NIF an autonomous legal entity. Thus, it could flexibly manage its resources, forego cumbersome procedures and become

Figure 30. BUDGET OF THE NATIONAL SCIENCE FUND, LEVS



Source: MEYS, 2009

the major instrument for the co-financing of Community programs (e.g. CIP). The re-structuring could follow the models of the National Science Fund and the instrument for co-financing of approved projects under FP7.

- Improvement of NIF rules. It is not feasible to assess technical and economic (pre-project) studies and applied science research projects using the same methods and criteria.
- The criteria for evaluating business prospects should also be corrected. Although it finances research up to its pre-market stages, the criteria of innovativeness and business prospects currently have equal value.
- The overall management of NIF should be improved by extending the period of planning of the sessions to and over 3 years. It is viable to assess the results of implemented research of concluded projects and perform a comprehensive evaluation of NIF activities.

National Science Fund

The National Science Fund (NSF) finances research activities under projects and programs. It plays an important part in the implementation of scientific research and supports the Bulgarian scientific community in the establishment of multinational research networks and the participation in European consortia and infrastructures. NSF was set up in 1990, but only in the period 2005 – 2009 it was given the resources to contribute sufficiently to the establishment of the Bulgarian research area.

NSF supports both the development of scientific projects and the protection of scientific products. In some of its competitions SMEs can partner with research organizations in applied research and the development

Table 8. INDICATORS FOR ASSESSMENT OF THE ACTIVITY OF THE NATIONAL INNOVATION FUND

Indicators	I session 2005 г.	II session 2005 г.	III session 2006 г.	IV session 2007 г.	V session 2008 г.
Submitted projects, number	118	120	146	168	123
Submitted projects growth compared to base year (I session = 100 %), %	100	101.7	123.7	142.4	104.2
Submitted projects growth compared to previous year, %	100	101.7	121.6	115.1	73.2
Selected projects, number	43	67	108	102	61
Selected/submitted projects ratio, %	36.4	55.8	74	60.3	49.6
Selected projects growth compared to previous year, %	100	155.8	161.2	94.4	59.8
Agreed subsidy (mln levs)	6.7	8.3	16.6	16.9	12.3
Subsidy growth compared to base year (I session = 100 %), %	100	123.9	247.8	252.2	183.6
Subsidy growth compared to previous year (I session = 100 %), %	100	123.9	200	101.8	72.8
Average value of the financed project (thousands of levs)	155.8	123.9	153.7	165.7	201.6
Average subsidy growth compared to base year (I session = 100 %), %	100	79.5	98.6	106.4	129.4
Average subsidy growth compared to previous year, %	100	79.5	124.1	107.8	121.7

Source: Bulgarian Small and Medium Enterprises Promotion Agency (BSMEPA), 2009

Box 4. NEW FINANCIAL SCHEMES OF THE NATIONAL SCIENCE FUND

In 2007 and 2008 several new financial schemes were introduced:

- Schemes to support project preparation under FP7 and COST (starting 2009);
- Schemes to co-finance research and demonstration projects under FP7; since 2009 these also finance the research efforts of teams engaged in ongoing activities under COST;
- Advanced research centers and integrated research units at universities;
- Reintegration grants encouraging the return of Bulgarian scientists working abroad to engage in research at home;
- Fellowships for senior scientists to enhance their skills, experience and knowledge.

Source: MEYS, 2010

of new products. Its instrument for co-financing FP7 projects is a strong incentive for the prospective participation of Bulgarian organizations in the program.

The highest funding was provided by NSF in 2008. In 2009, however, considerable cuts were made which amounts to reducing public resources spent through tendering.

Over the period 2005–2007 international expertise started to be used in evaluating project applications to the NSF without exception. This reduced the approval rate from 45 % in 2005 to 30 % in 2007, but opportunities were provided to increase the average funding of projects and thus enhance the efficiency and quality of research (in 2005 and 2006 the average per-project funding was about 20,000 levs, in 2007 it exceeded 80,000 and in 2008 reached 250,000 levs). In 2008, the selection procedure was changed to include a national-level selection round, which breaches international practices of independent and objective expertise based on scientific quality. This compromised NSF's transparency and effectiveness in 2008 and 2009. It is necessary to restore the good practice of international evaluation and to foreclose the possibility of politically influenced award decisions.

There are several internationally applied principles that Bulgaria should embrace with regard to the public funding of R&D and innovation: project funding should prevail over institutional funding; resources should be distributed according to clearly stated priorities and a mechanism to assess the achieved effects; the various funding sources should complement each other where possible depending on the overall conditions and value of any particular investment; business investment into the introduction of new products and processes should be encouraged through a variety of regulatory mechanisms.

Human Capital for Innovation

Making the most of the potential of modern technology and turning the country into an attractive destination for foreign investment on the basis of an advanced high-tech sector (as would seem to be the declared goal of the Bulgarian government)[41] depend on several factors:

- Culture supporting and fostering innovation;
- Knowledge creating the preconditions for implementation of modern technologies;
- Capacity for mobilization and pursuit of ambitious goals.

All three factors can be regarded as conditional on human capital qualities. Under the conditions of increasing complexity of technologies, blurred geographic boundaries and changing values, it is worth noting the additional need for:

- "broadband" people – sufficiently open-minded and capable of responding quickly even to weak external signals and of achieving what they believe in;
- leaders – either brilliant technocrats or visionary politicians – to put in place the environment that can help form such broadband people.

In times of economic hardship it is worth asking ourselves: Does Bulgaria possess such people? What are the limits of their capacity? Will they manage to take our society into the future? The answers depend on the state of the education system; the quality of the education services; lifelong learning skills;

[41] Government Program for Bulgaria's European Development 2009-2013, http://www.government.bg/cgi-bin/e-cms/vis/vis.pl?s=001&p=0233&n=1&g=

the pool of highly qualified specialists available to the economy; and how well their knowledge is put to use in areas of high added value. The present section considers the progress made under these and other related indicators, the emerging trends in the past few years, as well as the future prospects.

Academic Career, Employment in R&D and High-tech Sectors

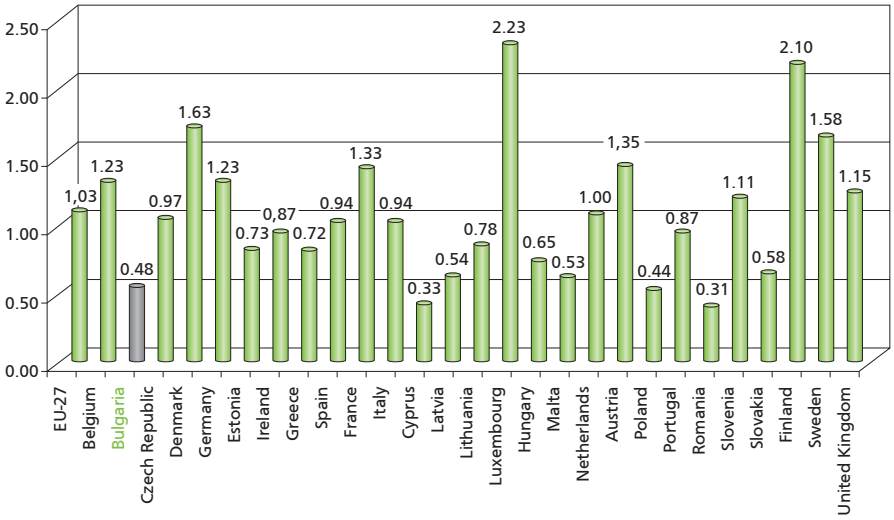
The personnel engaged in academic and technological R&D is indicative of the available human resources directly responsible for the creation, application and dissemination of new knowledge in the field of technologies. The indicator of employment in high-tech and medium high-tech sectors characterizes the country's specialization in areas with a high level of innovation activity. In turn, employment in R&D-intensive services is of great importance for the promotion of innovation particularly in the field of information and communication technologies.

What Are the Available Resources?

Along with increasing investment in R&D and innovation, the advanced countries and the fast-growing Asian economies mark significant growth in the number of researchers and those engaged in technological research and development.[42] In the period since 2000, the number of researchers in China, for example, has doubled. Within EU-27, the rate of growth under the same indicator is twice higher than that achieved in Japan and US and three times as high in terms of the proportion of researchers in the workforce. Nevertheless, employment in Europe essentially remains less research-intensive compared to other leading economies. There are pronounced differences among member countries under this indicator.

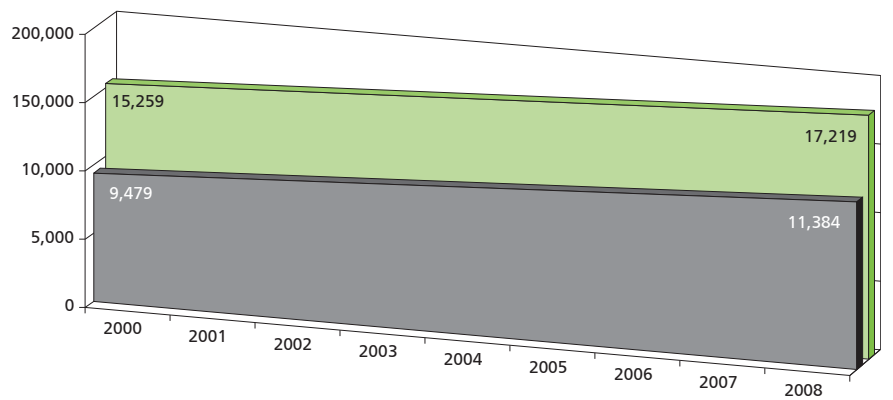
In 2008, the average level of **R&D employment** in EU-27 reached 1.03 % of the workforce, which is nearly 12 % higher compared to 2000. All member countries that passed the 1.5 % threshold continue to mark growth in the share of R&D personnel. It has been most notable in Denmark (18 %), followed by Finland (11 %) and Sweden (6 %). Bulgaria is at the bottom, ahead of only Cyprus, Poland and Romania. However, in terms of the pace of change, Romania marks one of the highest rates, with nearly a 29 % increase in the share of R&D personnel in the workforce. **While Bulgaria marks a positive change, it hardly exceeds 2 %, which shows that the country continues to lag behind.**

Figure 31. Personnel, % of workforce, in FTE equivalent, 2008[43]



Source: Eurostat, 2010

Figure 32. R&D personnel (total and researchers) in Bulgaria in FTE equivalent



Sources: Eurostat, NSI, 2010

[42] *A More Research-Intensive and Integrated European Research Area;* Science, Technology and Competitiveness key figures report 2008/2009, Directorate-General for Research, European Commission, 2009. http://ec.europa.eu/research/era/pdf/key-figures-report2008-2009_en.pdf

[43] The data on Greece and France are for 2007.

By preliminary NSI data for 2008, R&D personnel in Bulgaria amounts to 17,219 people in full employment equivalent, marking a nearly 13 % increase from 2000. The number of researchers, who constitute the highest-qualified category of R&D personnel, reached 11,834 in full employment equivalent (or 66.1 % of total R&D personnel). This category displays the highest rate of growth (20 %) accompanied by a relative drop in the share of technical (decrease by more than 5 % from 2000) and support (increase of barely 6 % from 2000) staff.

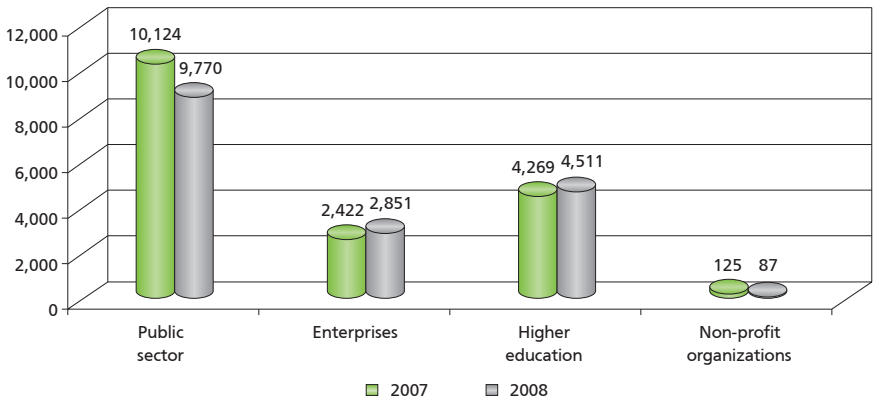
In 2008, the R&D personnel distribution by sector remained unfavorable in terms of the desired shortening of the innovation process, more pronounced practical orientation of R&D, and stepping up the adoption of the newly developed or improved products/processes in business. Compared to earlier periods, the distribution of R&D personnel by sectors still runs contrary to European and world trends of a relative increase in their share in business compared to the public sector.

The indicator **R&D human resources** measures how well supplied the economy is with highly qualified personnel with the capacity to further the development of science and technology. By latest available data,[44] all member countries mark an increase in the share of those engaged in R&D out of all those included in this category (the general indicator comprises even those who possess the necessary qualification but were registered as unemployed in the respective period of time). **There are two exceptions – Lithuania with a decrease of close to 18 % and Bulgaria**

[44] Eurostat for the 2000 – 2007 period.

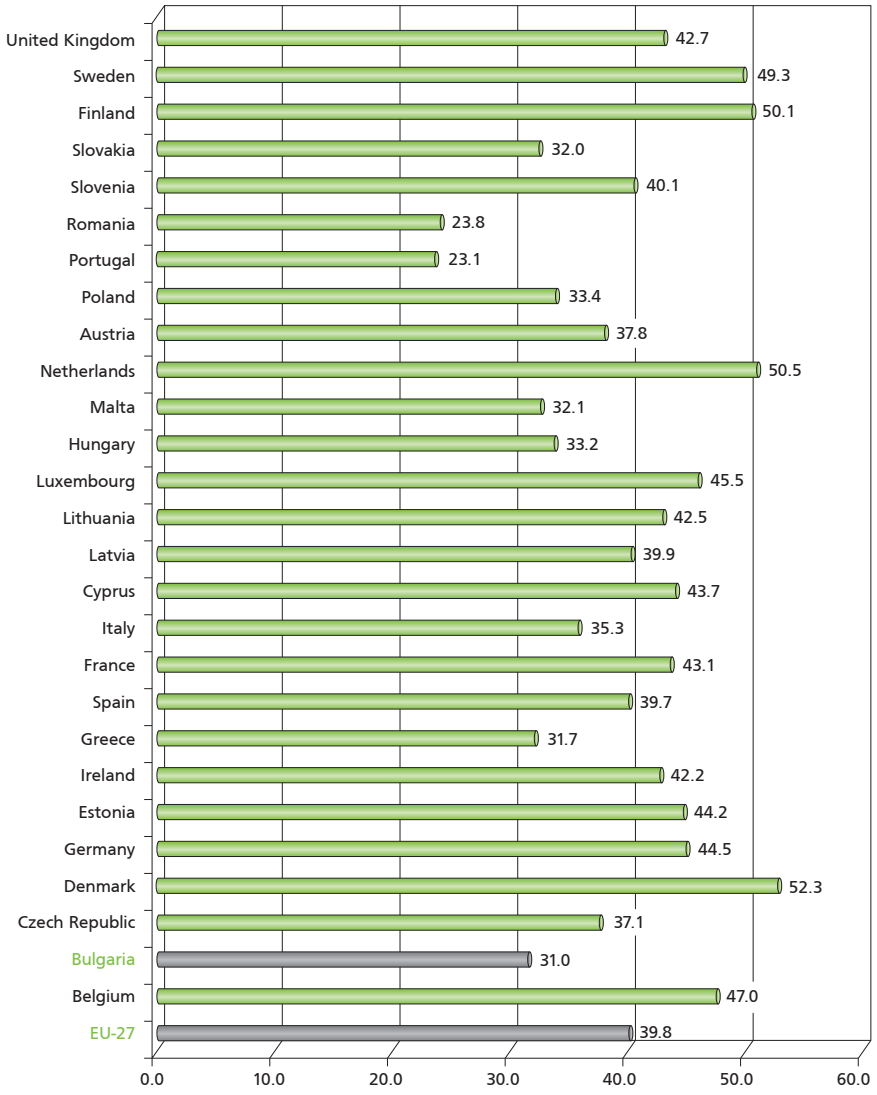
[45] The human resources engaged in scientific and technological work are measured in accordance with the definition laid down in the Canberra Manual and include both the population with successfully completed higher education in science and technology areas and those who do not possess such formal education yet perform work requiring it.

Figure 33. R&D personnel by sector in FTE equivalent, Bulgaria



Source: NSI, 2010

Figure 34. Persons engaged in R&D[45], % of workforce in the 25-64 age group, 2008



Source: Eurostat, 2010

with a decrease of nearly 3 %. For the remaining countries the positive change ranges from 33 % for Ireland to 2 % for Finland. The increase of 31 % in the case of Romania comes close to the highest registered value for Ireland.

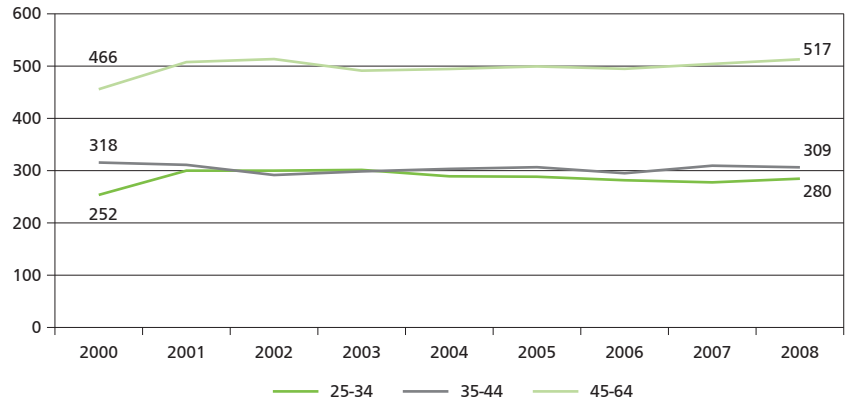
In Bulgaria, in 2008, **those engaged in R&D in the high-tech industrial sectors and knowledge-intensive** services as a proportion of total R&D personnel amounted to nearly 6 %, which is close to the EU-27 average (6.84 %).

The increase by nearly 102 thousand in the number of R&D staff over the period 2000 – 2008 has been accompanied by considerably more effective use of the potential of this personnel category. Whereas in 2000 the unemployed in this group amounted to 5.5 %, in 2008 their share dropped to 2.2 %. **However, there has been a persistent alarming tendency (equally confirmed by the data on researchers) of declining share of young people choosing science and technology as their preferred career path.**

Further insight as to the potential of the country's human resources to create new technological knowledge, to facilitate its implementation and foster active demand for new/improved products can be gained through the **researchers** indicator.

In the 2002 – 2008 period, the number of researchers in Bulgaria fell by nearly 5 % from 21,952 to 20,829 people. Over the same period, academic staff on average in EU-27 (a category close in meaning

Figure 35. Persons engaged in R&D in Bulgaria, by age group, thousands



Source: Eurostat, 2010

but not fully overlapping with the researchers category) marked an increase by close to 13 %. The decline in the number of researchers in this country has been accompanied by another two unfavorable trends.

To begin with, the present relatively balanced distribution of researchers by scientific field may be disrupted over the coming years in favor of social sciences and the humanities. Without underestimating the latter's role as a field of application and implementation of social innovations, it should be noted that the declining relative share of scientists at university and government research units and laboratories in the areas of technical, medical, and natural sciences may put at risk the country's potential to create new technological knowledge and to train specialists in the fields of activity where it is most readily applied. **The decline is most significant as regards the number of scientists in the technical fields (nearly 12 %), followed by medical sciences (slightly more than 8 %) and natural sciences (3 %).** The same trend is present in agricultural sciences where by NSI data the number of scientists dropped by 3.6 %. These findings are confirmed by the data on the Agricultural Academy (AA) and the Bulgarian Academy of Sciences (BAS).

Secondly, there is a process of aging of the scientific community, which is the outcome both of the low appeal of a career in science to young people and of their deficient performance (protracting the duration of doctoral study, working on dissertations of little scientific and/or practical contribution, dropping out of research programs and academia to pursue other career paths, mostly out of financial considerations) in the process of planning and pursuing a professional career in science.

Box 5. HUMAN RESOURCES IN SCIENCE AND TECHNOLOGY: AGRICULTURAL ACADEMY

The Agricultural Academy (AA) conducts scientific and applied research, service and support activities in the fields of agriculture, animal farming and the food-processing industry. The AA comprises 48 units, of which 25 research institutes, 22 experimental stations, and the National Museum of Agriculture.

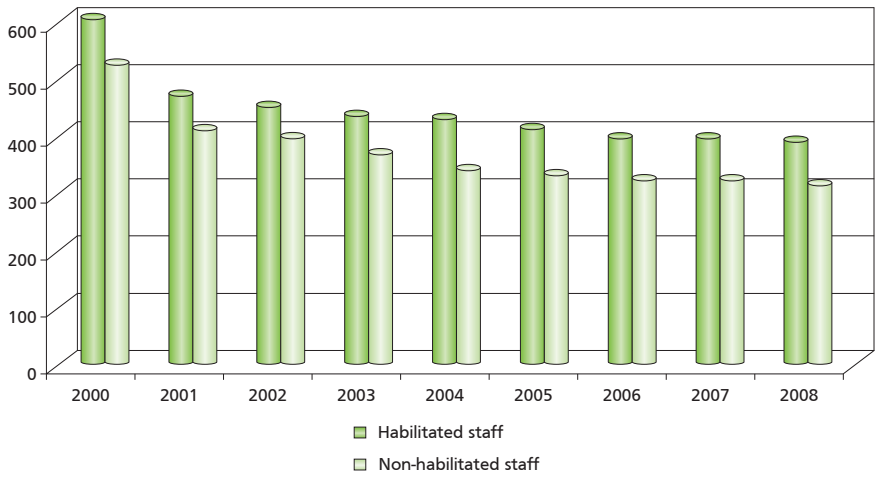
Potential:

The decentralization of research activity at AA into 25 regional units allows scientific coverage of the whole country.

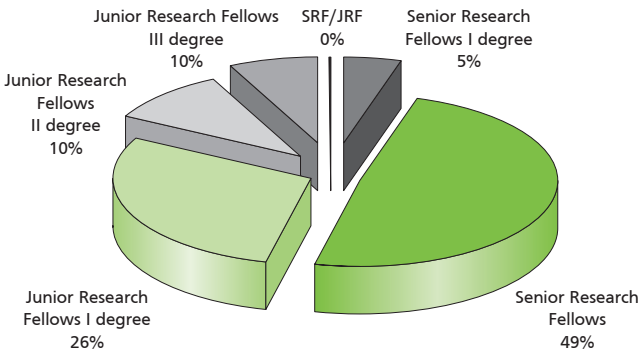
The applied focus of the AA research projects and support activities bring the results of scientific activity as close as possible to the very problems of agricultural farms they aim to address.

More than two-thirds of the copyright protected technological knowledge in this country in the field of agricultural sciences is owned by AA (more than 316 certificates for new plant and animal species issued by the BPO by the end of 2008).

AA RESEARCH STAFF QUALIFICATION STRUCTURE BY ACADEMIC DEGREE AND TITLE IN 2000 – 2008



AA RESEARCH STAFF QUALIFICATION STRUCTURE BY ACADEMIC DEGREE AND TITLE IN 2008



Challenges

Plummeting number of scientists at the Academy – over the 2000 – 2008 period, the decline has been in the range of 40 %.

Marked imbalance in staff qualification structure at the research institute level – the ratio of habilitated to non-habilitated staff members ranges from 10.0 (Institute of Agricultural Economics, Sofia) to 0.1 (Institute of Fishing Resources, Varna).

In excess of 54 % of the AA staff members are aged over 50 years, of whom one-third are over 60.

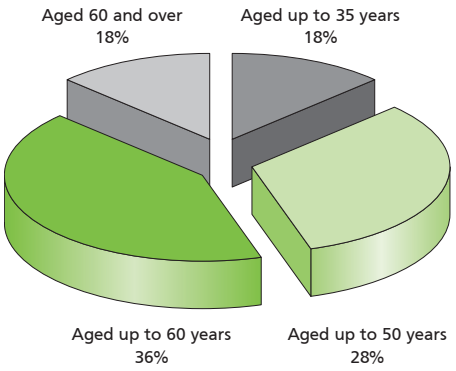
Effective mechanisms have not been put in place for speedy practical implementation of scientific findings – high-yield plant varieties and new animal breeds, complex soil cultivation and agricultural production technologies. Medium-sized and small farms are unaware of opportunities for collaboration with AA institutes.

Scientific works and publications, 2008

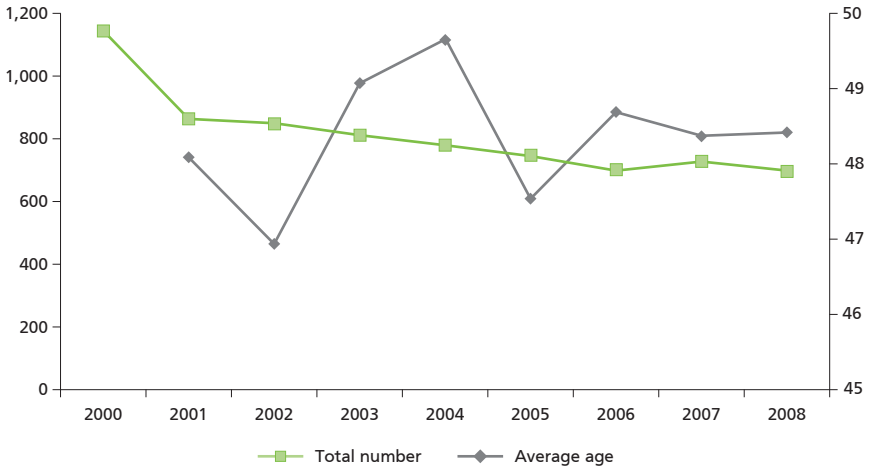
International journals with impact factor	International journals without impact factor	Collections of papers from international events	Bulgarian journals, works of higher education institutes	Collections of papers from national conferences	Monographs and books	Popular science articles
40	118	462	522	226	82	443

Box 5. HUMAN RESOURCES IN SCIENCE AND TECHNOLOGY: AGRICULTURAL ACADEMY (CONTINUATION)

AGE STRUCTURE OF AA ACADEMIC STAFF, 2008



TOTAL NUMBER AND AVERAGE AGE OF AA ACADEMIC STAFF



Source: Annual Report 2008, AA, 2009

Box 6. HUMAN RESOURCES IN SCIENCE AND TECHNOLOGY: BULGARIAN ACADEMY OF SCIENCES

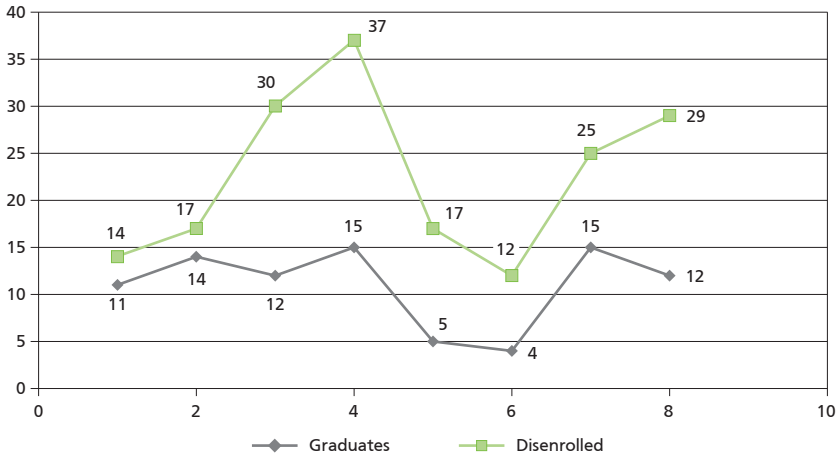
The Bulgarian Academy of Sciences (BAS) was founded 140 years ago. At present its activity falls into four main areas: fundamental research, applied research, education, scientific services to the Bulgarian government and public. BAS comprises 74 research units distributed as follows by scientific field: mathematical sciences (5), physical sciences (9), chemical sciences (8), biological sciences (16), earth sciences (11), engineering sciences (7), humanities (11), social sciences (7), as well as 11 specialized units, for the most part based in the city of Sofia. The staff of BAS numbered 7,641 in 2008, of whom 47.6 % (or 3,638 people) researchers.

Potential:

BAS has an impressive record of international collaboration – it maintains relations with 35 countries across the world and more than 40 foreign academies of sciences and other scientific institutions; takes part in EU framework programs, COST, EUREKA, PHARE; is a member of a number of international governmental and non-governmental research organizations; takes part in the NATO research programs.

Employing 17 % of the academic staff in this country, BAS accounts for about 60 % of the annotated scientific publications and successful project applications under international EU and NATO research programs.

BAS GRADUATES AND DISENROLLED DOCTORAL STUDENTS, NUMBER, 2008



Box 6. HUMAN RESOURCES IN SCIENCE AND TECHNOLOGY: BULGARIAN ACADEMY OF SCIENCES (CONTINUATION)

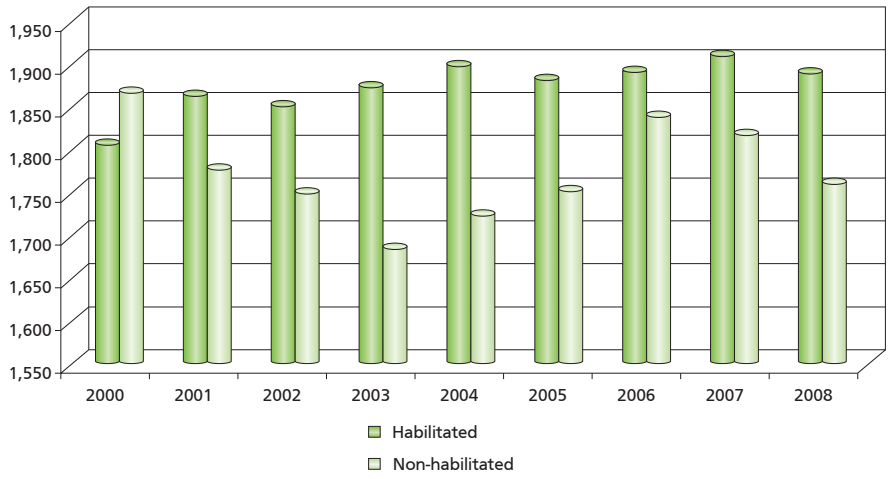
Additional project financing has been increasing consistently and the amount of 55 million levs reached in 2008 constitutes a nearly 11-fold increase from 2002.

Challenges:

BAS constitutes a mega structure with the ambition to conduct the bulk of fundamental and applied research in this country, with strong geographic concentration and a complicated management structure.

The spending of public funds on scientific, research, and innovation activities is not managed by the principal body administering government funds (Ministry of Education, Youth and Science), which is a precondition for their ineffective spending.

SCIENTISTS AT BAS, 2000 – 2008



As regards patent and licensing activity, the pattern for the country as a whole is applicable to BAS as well – the bulk of the applications and patents maintained are in the name of the inventor rather than the scientific unit in which the respective invention was developed

Human resources and outcomes of research at BAS by field of science, 2008

Field of science, Institute*	Number of scientists	Number of doctoral students 31.12.	Scientific publications in international journals and periodicals per scientist	Total publications per scientist	Patents**	
					Patents maintained	Patents applied for
BAS – total	3638***	616	0.55	2.36	54/84	74/95
Mathematical sciences	313	63	0.92	2.61	2/1	3/0
Physical sciences	509	44	0.81	1.67	10/5	12/15
Chemical sciences	443	57	0.82	1.70	6/45	10/50
Biological sciences	684	121	0.66	1.98	5/21	3/22
Earth sciences	517	70	0.36	2.09	3/11	10/7
Engineering sciences	359	46	0.16	1.35	28/1	36/1
Humanitarian sciences	508	119	0.35	4.47	-	-
Social sciences	264	96	0.17	3.34	-	-

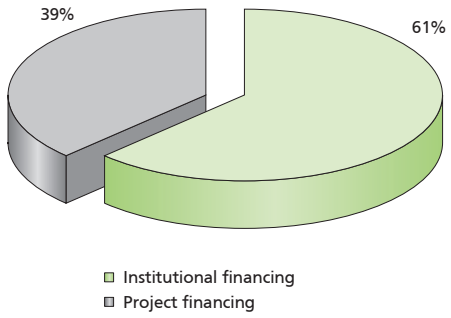
* Noted in parenthesis: Standard scientific assessment/Modified overall assessment on average for the units in the particular field on a 5-grade scale.

** Patents are recorded according to the name of the applicant – BAS Permanent Research Unit/Author or other.

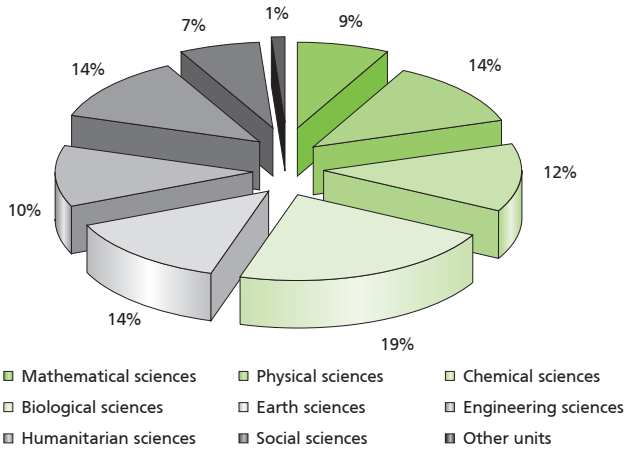
*** The total number includes 41 scientists from other BAS units.

Box 6. HUMAN RESOURCES IN SCIENCE AND TECHNOLOGY: BULGARIAN ACADEMY OF SCIENCES (CONTINUATION)

BAS FINANCING, 2008



BAS SCIENTISTS BY FIELD, 2008



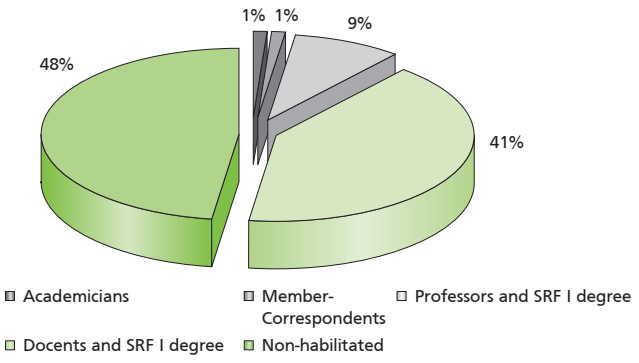
BAS research financing by field of science, 2008

Field of science, Institute*	Number of scientists	Additional financing from projects and contracts				Innovative research projects	
		National Science Fund, number of projects	Bulgarian ministries, institutions and companies, number of projects	International companies and organizations, number of projects	Total funds received	Total projects	Additional financing, in thousands of levs
BAS – total	3638**	725	703	1234	55,152,949	2907	48,047
Mathematical sciences	313	30	108	127	5,384,689	332	2,386
Physical sciences	509	93	61	176	14,117,119	418	13,926
Chemical sciences	443	147	36	157	8,528,791	435	8,599
Biological sciences	684	243	137	280	6,595,887	691	6,596
Earth sciences	517	96	157	208	7,591,667	472	7,591
Engineering sciences	359	48	53	72	7,593,972	257	7,594
Humanitarian sciences	508	47	120	146	3,426,726	93	234
Social sciences	264	21	30	56	1,621,127	209	1,121

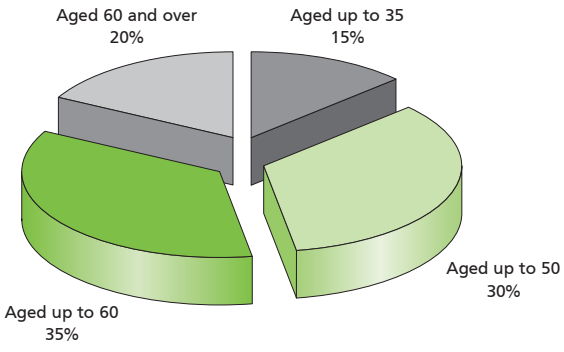
* Noted in parenthesis: Standard scientific assessment/Modified overall assessment on average for the units in the particular field.

** The total number includes 41 scientists from other BAS units.

STRUCTURE OF BAS SCIENTISTS BY ACADEMIC DEGREE AND TITLE, 2008



AGE STRUCTURE OF BAS SCIENTISTS, 2006



Box 6. HUMAN RESOURCES IN SCIENCE AND TECHNOLOGY: BULGARIAN ACADEMY OF SCIENCES (CONTINUATION)

The assessment conducted by European experts at the end of last year of the scientific level of BAS units confirmed that some BAS institutes have the potential for international competitiveness but fell short of providing most of the answers as to the future directions of development of the organization. The more notable reasons included the following: the experts (scientists themselves) applied criteria of assessment of the outcomes of research that did not take into account their potential for practical implementation; there were certain limitations on the supply of information for the purposes of the analysis and assessment; the analysis did not examine the compliance of publicly funded research with the established national priorities for the country's economic development.

The reform is still pending at BAS and, while it needs to be supported from without, it would be doomed unless the committed involvement is ensured of the researchers from within.

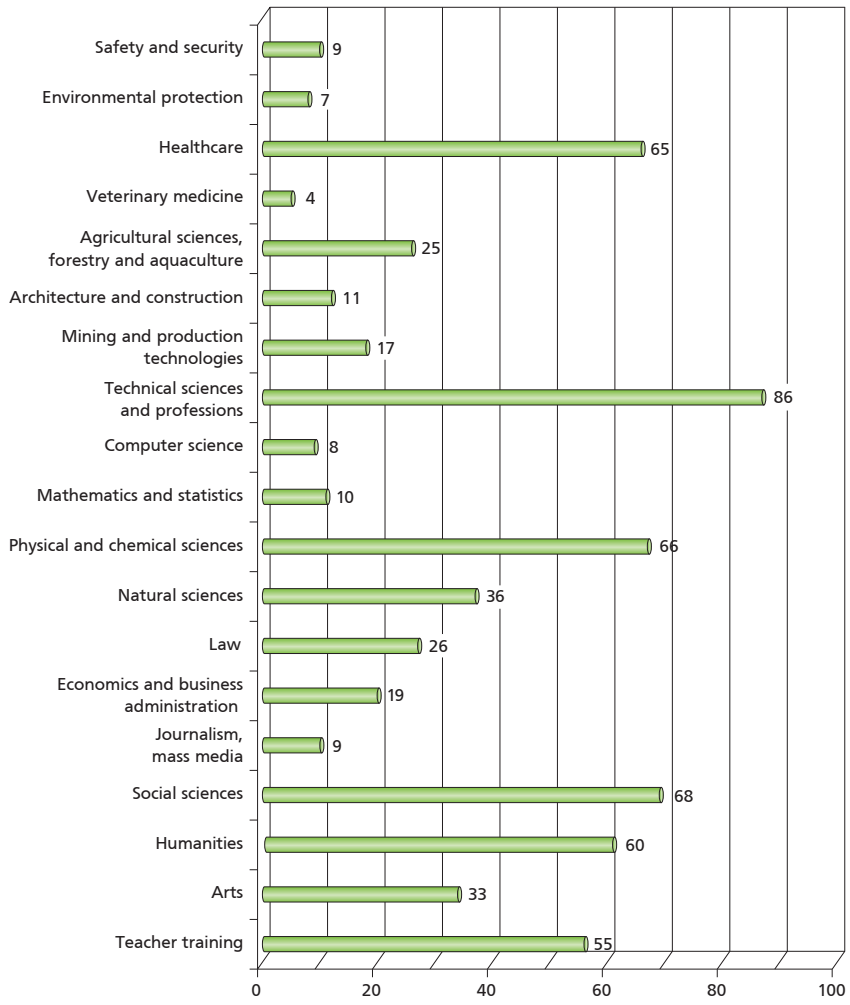
Sources: BAS Report, 2006 and 2008; Report of the Committee for the Scientific Assessment of BAS Institutes, November 30, 2009

Development Potential

The noted trend for EU-27 to surpass the US and Japan in terms of increase in the number of R&D staff applies equally as regards the growing number of **doctoral graduates.** By Eurostat data, as of late 2005, their number in EU-27 reached 100,000, which constituted an increase of 4.8 % on an annual basis, versus 53,000 doctoral theses accepted in the US (+3.3 %) and 15,000 in Japan (+4.6 %). Two of the largest economies in EU-27 account for 40 % of the doctoral graduates – Germany, with more than 24,000 people, and United Kingdom, with approximately 16,000. In excess of 5,000 doctoral students successfully complete their studies in the science-and-technology fields of education[46] in Germany, United Kingdom and France as a whole.

Since 2005, Bulgaria too has registered an increase in the number of doctoral graduates with an all-time high on an annual basis reached in

Figure 36. NUMBER OF HIGHER-EDUCATION AND DOCTORAL DEGREES AWARDED, BY FIELD OF SCIENCE, 2008[47]



Source: NSI, 2010

[46] According to ISCED97, the science-and-technology fields of education are: life sciences (ISCED42); physical sciences (ISCED44); mathematical sciences and statistics (ISCED46); computer science (ISCED48); technical and engineering sciences (ISCED52); production and processing sciences; (ISCED54); architecture and construction (ISCED58).

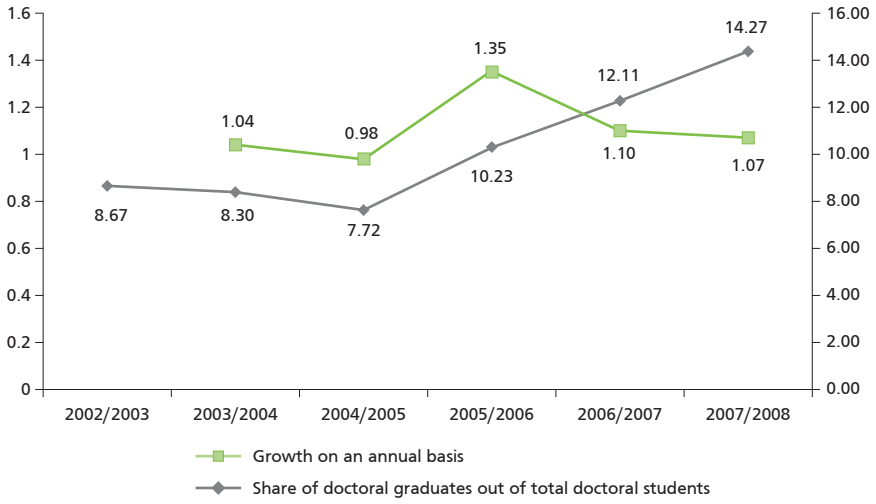
[47] The data concerning the fields mining and production technologies and veterinary medicine are for 2007.

the academic 2005/06, when the increase amounted to 34.7 %.

The number of graduate students in the academic 2007/2008 was 453 less than the previous year and this drop of nearly 10 % was registered for the second consecutive year. The shrinking number of graduate students is the outcome of two opposite trends – increasing number of doctoral graduates and decreasing number of newly enrolled doctoral students, which finds confirmation in the continually increasing share of graduates in the total number of doctoral students.

In 2008, the latest year for which NSI has released official data, 36 % of the doctoral students were in science-and-technology fields. Their share in the population in the 20-29 age group in 2006 (0.22 %) was twice as large as their share in 2000. The leaders in this respect are Finland (1.36 %) and Sweden (0.83 %) and among the new member countries, the Czech Republic (0.68 %). Austria is the only country that appears to be losing ground compared to 2000, with a decrease amounting to more than 30 %.

Figure 37. DOCTORAL GRADUATES: INCREASE ON AN ANNUAL BASIS AND SHARE OUT OF TOTAL NUMBER OF DOCTORAL STUDENTS IN THE PERIOD 2002-2008, %



Sources: Eurostat, 2010; NSI, 2010

Education Level, Quality of the Education Product, and Lifelong Learning

The indicators concerning the level of education and the share of higher-education graduates, particularly in science and technology show the availability and changes in the pool of qualified human resources as an essential precondition for successful implementation of innovation. An important characteristic of the human capital to modern economies is the skill to acquire new knowledge and improve one's education and qualification – an immediate result of involvement in formal and informal lifelong learning.

Has Bulgaria been training more researchers?

Since 2000, EU-27 has registered a marked upward trend as regards the number of **university graduates** both in absolute terms and as share in the population in the 20-29 age group. Europe encourages enrollment in bachelor and master degree programs through the measures to develop the European Research Area and the European Higher Education Area, as well as by implementing the goals of the Bologna process (student and teacher mobility, credit acquisition and transfer system).

Fully in line with this trend and regardless of the negative demographic characteristics, the number of newly enrolled university students in Bulgaria continues to grow. In the past five academic years, their number has increased by 31 %, with the largest growth registered among part-time university students (more than 3.5 times). The situation differs as regards full-time students – the 30 % increase in the number of new-

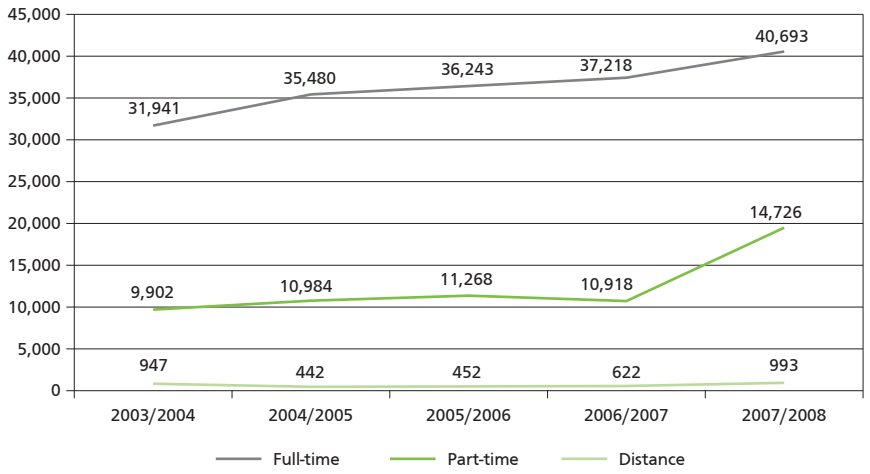
ly enrolled students in baccalaureate programs comes close to the overall trend while professional baccalaureate programs barely register an 8 % increase. However, there is still no sufficiently reliable data on the quality of the education obtained both academically and in terms of practical value (relevance and business realization potential).

By Eurostat data, in the past nearly 10 years in the EU-27 there has been a steady decline in the number of university graduates in science-and-technology fields – an indicator that measures the pool of qualified workforce available to the economy in areas of importance to the development of technologically innovative products and processes. A similar, though more pronounced, trend is observable in Bulgaria. After an increase up to 2002, there has been a decline of nearly 9 % (compared to 6 % decrease in EU-27 since 1998).

Structurally, the distribution of higher-education graduates by field within EU-27 has not undergone any significant changes in the past ten years. The increase in relative share amounts to 10 % for social science, law and economics graduates and 5 % in the field of healthcare, while there has been a drop in the relative share of graduates in the fields of education, humanities, natural, technical and agricultural sciences ranging from 2 to 17 %. In Bulgaria, the changes have been more conspicuous – from a 61 % drop in the field of education to a 51 % increase in natural sciences.

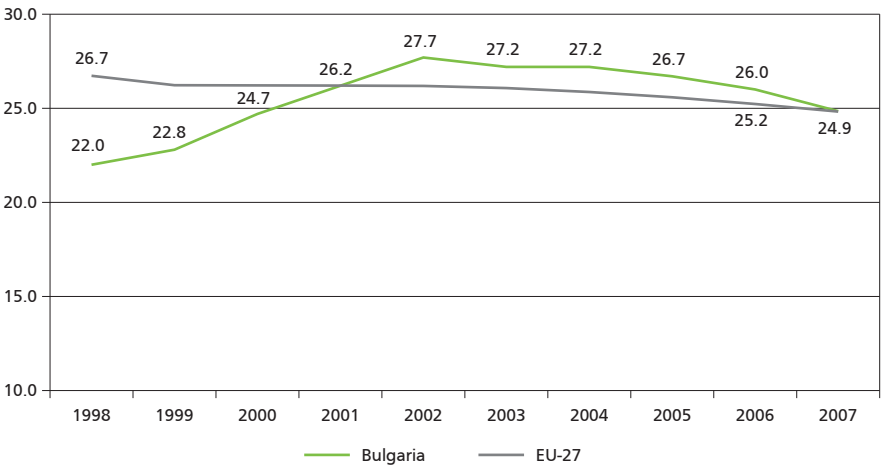
The most alarming tendency is to be found in the fields of healthcare and social sciences. The withdrawal of students from these specialties contravenes the modern priorities of advancement of science and technology (nano- and biotechnologies, adopting ICT-solutions in medicine) and the demographic trends in Bulgarian and European society (aging

Figure 38. Number of newly enrolled students – Bulgarian citizens, by form of education



Source: NSI, 2010

Figure 39. Higher education graduates in science-and-technology fields, % of all students[48]



Source: Eurostat, 2010

population and increasing burden on the social systems of the member countries).

Lifelong Learning

The acquisition of new knowledge and skills is a precondition for the speedier dissemination of technological innovations in the various areas of public life and as the only way of counteracting the trend of the level of qualification of those in employment falling short of the dynamic development of science and technology and the new knowledge with a multidisciplinary pur-

[48] Includes all students who have been awarded a baccalaureate (ISCED 5a) or higher degree according to the Classification of Fields of Education and Training (KOO-2008): natural sciences (KOO42), physical and chemical sciences (KOO44), mathematics and statistics (KOO46), computer science (KOO48), technical sciences and technical professions (KOO52), mining and production technologies (KOO54), architecture and construction (KOO58).

pose. The advancement of the so-called horizontal technologies (ICT, nano- and biotechnologies) and the solutions they offer in all other sectors of the economy, as well as the now mandatory energy efficiency requirements necessitated by the deepening climate changes impose new requirements for the human capital – to possess in-depth knowledge in specific professional areas as well as the skill to combine and use know-how developed in different fields and for different purposes.

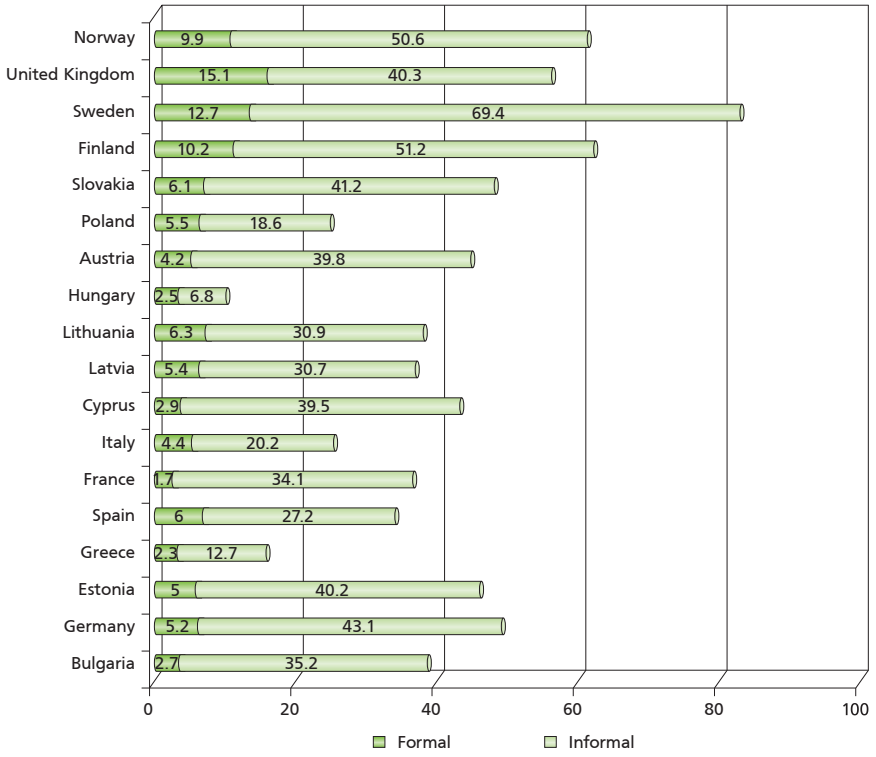
The 2007 Adult Education Survey by Eurostat showed that one-third of the EU-27 population aged 25-64 years participated in formal and informal learning.[49] About 80 % were involved in informal learning, which is less expensive and time consuming. Another 6 % were engaged in formal learning.[50]

Bulgaria's poor record in this respect (only France, Greece, and Hungary out of the countries surveyed had lower indicators regarding participation in formal training) is indicative of lasting and difficult problems in the education system (the focus is more on providing knowledge than teaching the skills to acquire new knowledge) and in business (spending on staff training is still not viewed as a long-term investment and ways have not been found to retain the anticipated positive effect within the company).

In a time of economic crisis (as is to be expected for the Bulgarian economy for at least another year), the measures to encourage participation in continuing education are not among the priorities on the agenda. Even after 20 years of transition towards establishing market conditions and democracy the list of pending reforms is still applicable: education reform; reform in the field of science and research; overcoming the fragmentation within the national innovation system; enhancing the innovation potential of the economy and increasing business innovation intensity.

Regardless of the abundance of strategic and program documents, Bulgaria still lacks a critical mass of people ready to take risks, to work hard to achieve their goals and to face new challenges. Knowledge could hardly become the new medium of exchange in Bulgaria unless a few but clear-cut priorities are defined even in a time of crisis. It is further indispensable to lay down the conditions and procedures for their implementation and to mobilize the available resources to achieve this goal.

Figure 40. PARTICIPATION IN CONTINUING EDUCATION, %



Source: Eurostat, 2009

[49] Formal learning takes place at schools, colleges, universities, specialized higher education institutions or other education establishments on the basis of a pre-established curriculum and set number of academic hours. An education degree is obtained as a result. Informal learning occurs in the form of courses, conferences, seminars, private lessons or other forms, regardless of whether it is of relevance to the trainee's current or future work or is motivated by personal, family or social reasons. Self-learning takes place in the absence of a tutor, outside the formal education system, and is aimed at improving the individual's knowledge and skills.

[50] Boateng, S.K., *Significant Country Differences in Adult Learning,* Population and Social Conditions, Eurostat, Statistics in focus, 44/2009.

Information and Communication Technologies

The information and communication technologies (ICT) are one of the most important engines for innovation in enterprises and growth of economies. ICT enter enterprises as general purpose technologies (GPT) which are integrated in the new production and management processes. ICT also change the organizational boundaries and transform the models for adding value, competitiveness, and consumption. The effects of their use include decreased relative transaction costs, shortened product life cycles and structural changes in markets (convergence, concentration and bargaining power). The expenditure for Research and Development, patent activity and venture financing in the ICT sector exceed substantially that in the other sectors in the OECD countries.[51] R&D focused on ICT, nanotechnologies and new materials, is among the most important driving forces leading to product innovations. The driving forces are connected to the health and leisure industries (including electronic games). Modern processes and marketing innovations cannot exist without ICT. The internet and web-based services have caused important social innovations, including in the political process and state governance. The ICT infrastructure is already considered an essential element of the critical infrastructure of each country, while the issues of digital security are of primary importance for the policy of each country or corporation.

[51] *Information Technology Outlook 2008,* OECD, p. 144.

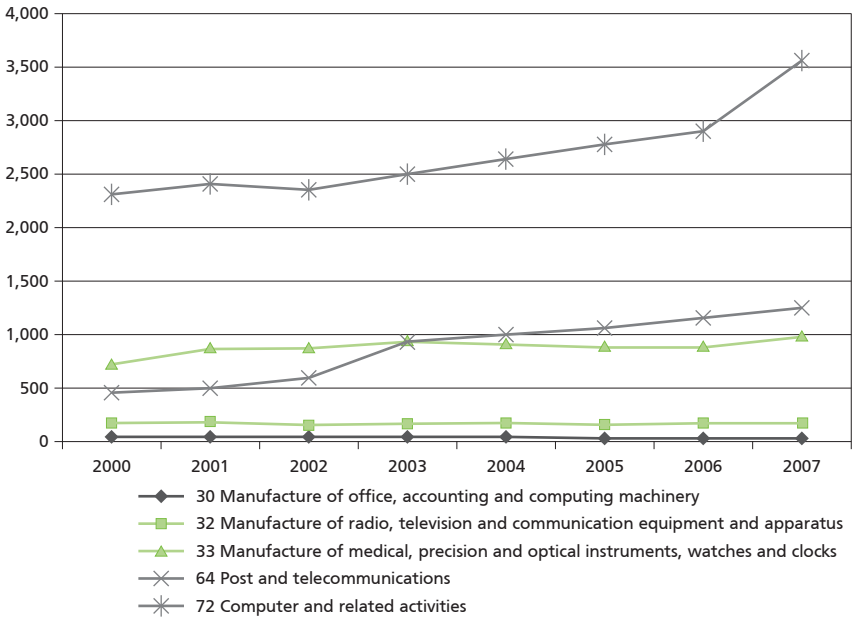
The Information and Communication Technologies Sector

The ICT sector[52] in Bulgaria is distinguished by high levels of entrepreneurship (comparable only to construction and manufacture of furniture as new enterprises, as well as to pharmaceuticals and cosmetics in degree of innovativeness). The majority of telecoms already have their R&D units (laboratories and staff) which mainly work on the convergence and release of triple play services and on the development of new products. Bulgarian telecoms frequently prove to be among the early introducers of new technologies in Europe[53] and thus support Bulgaria's position as an early adopter of new internet technologies[54]. Telecoms commissioned complex systems of payment, thereby causing the emergence of innovations in the sector of "Computer and Related Activities", as well as making it easier for a network of value added SMS companies to appear which, after an initial test period in Bulgaria, entered the European markets. Because of the specific development of broadband access to internet in Bulgaria and the existence of trained users this model of developing and testing new services in Bulgaria and subsequent transfer of technologies or entry into European markets also has substantial potential in other spheres (interactive digital TV, games and broadband networks, among others).

As a whole, the relative significance of production sub-sections in ICT has dropped from 28 % to 20 % in respect to the number of companies and remains stable – but also low – in respect to the share of added value (9 %) and turnover (13 %) in the ICT sector. For example, companies in the "Manufacture of Office, Accounting and Computing Equipment" sector have declined by 40 %. A number of sector migrations took place in the past ten years. Some of the producer companies (for example, manufacturing radar equipment, controller or computer components) stopped production and replaced it with importing and distribution of such products in the country. In the case of a second group of companies, activities other than production grew gradually and took a larger share. In the third place, formal sector migration was due to incorrect reference to the respective sections at different times.[55] Typical examples are companies from one and the same group when a certain type of service is organized as a separate business (warranty service repairs).

The relative size of ICT companies measured through their turnover practically doubled in eight years – 84 % growth after 2000. The largest companies are in the "Post and Telecommunications" sector and the smallest – in the "Computer and Related Activities" sector. The concentration in the sub-sections is also quite different. Slightly over 100 companies cover nearly 80 % of the entire turnover in the sector, while just 9 companies cover 60 % of the turnover in sub-sec-

Figure 41. DYNAMICS OF COMPANY NUMBER BY ICT SUB-SECTIONS



Source: NSI, 2009

[52] Defined as NACE sections 30, 32, 33, 64 and 72.

[53] For example, the introduction of PON by Spectrum Net.

[54] Although at the beginning many of the large telecoms regarded LAN and small internet suppliers with LAN-like model of growth and technologies with contempt, it was precisely this group of companies which proved to be real-world laboratories for ICT and practically prepared the market and experts for the large companies. At the moment, too, some large suppliers are stretching cables through the air, in violation of requirements – something of which they usually aggressively blame the small ones.

[55] By expert estimation, some 30 % of all classifications at 4-digit NACE code level are wrong, and quite frequently the mistakes are found at 2-digit code level.

tor "Manufacture of Office, Accounting and Computing Machinery."

The fastest growth is observed in sectors "Instruments and Appliances for Measuring, Testing and Navigation" and "Machinery and Other." This growth is largely due to the increase in exports (5- to 10-fold) of the respective groups of products – printed circuit boards, microscopes and measuring equipment. In these two groups of enterprises there are a number of Bulgarian companies which have their own laboratories and staff. Some of the local manufacturers became suppliers of large multinational companies.

The only group with declining turnover per enterprise is in the "Posts and Telecommunication" sector mainly among the new companies, while the old one usually had stable growth.

Added value in the ICT sector remained stable at levels of about half of the turnover over all the years from 2000 through 2009. The most significant drop in added value as a share of turnover is observed in sector „Television and Radio Receivers, Recording and Broadcasting Equipment" – from 41 % in 2000 to 20 %.

At the same time, section "Computer and Related Activities" enjoyed a quick growth from 26 % to 44 %. In this case, the gradual departure of the sector from the grey economy is also an essential factor for growth. Most of the legal information systems have small R&D units aimed at developing value added services based on public data. Some local ERP manufacturers also invested in R&D as a reaction to the demand of their existing clients. Some traditionally outsourcing companies released their own new services on the market. This group of companies also includes innovation hubs (companies which, by providing technologies and services, actually make innovations at their clients), as well as companies specialized in R&D (by participation in framework programs or as a model of growth), at which over half of the staff is constantly or partially engaged in R&D.

According to NSI data, the expenditure for R&D in the ICT sector doubled in 2000 – 2007 and reached some €9 million, with average for the period expenditure for R&D in ICT standing at about 20 % of R&D expenditure in all sectors. On average, this constitutes a mere 0.3 % of the turnover of one company. The

Table 9. SECTOR LEADERS IN EXPORTS, MLN OF EURO

SITC	2000 Import	2000 Export	2003 Export	2003 Износ	2006 Import	2006 Export
Printed circuit boards	2.613	8.876	20.231	22.621	15.753	39.298
Microscopes, diffraction apparata and parts	0.063	0.008	0.051	0.137	0.733	2.757
Control and measuring instruments and apparata	41.022	9.534	70.026	26.798	101.268	103.231
Optical products	3.596	7.123	5.659	7.091	10.359	10.937

Source: National Statistical Institute

Table 10. SELECTED R&D INDICATORS IN THE ICT SECTOR

	2000	2001	2002	2003	2004	2005	2006	2007
Turnover of one company (€, thousands)	277	331	495	380	403	448	489	510
Added value as a share of turnover	47	51	39	53	52	48	47	45
Expenditure for R&D (% of turnover)	0.46	0.30	0.14	0.11	0.14	0.16	0.25	0.29
Expenditure for R&D per company (€)	1,274	1,008	686	416	563	703	1,220	1,467
R&D staff	840	810	714	396	370	305	398	460
Expenditure for R&D per employed in R&D (€)	5,760	5,090	3,944	4,790	7,378	11,639	15,975	19,198

Source: National Statistical Institute and own calculations and estimations of lacking or confidential data, 2009

low level of expenditure for R&D is also demonstrated by the fact that R&D expenditure per employed in the same activity are comparable to the salary of the said employee, which means that either the employed actually engage in R&D in a very small portion of their time, or that nearly no funds are set aside for investment in technologies necessary for R&D. In-depth interviews with representatives of various companies (not only ICT) with R&D show, however, that most of the companies do not report their R&D at the National Statistical Institute or keep special account of it which may help them to constantly have an adequate picture of their own R&D from the point of view of invested resources (including number of staff). If by 2000 tax considerations for preferring accounting direct costs for the respective period to expenditure for R&D for future periods had a considerable role, at the end of the first decade of the 21st century the problem is rather that inertia has settled in, as well as the lack of accounting and organizational capacity to follow and record these indicators. By rough estimates, the real share of R&D in ICT turnover is underestimated 3 to 10-fold, but more detailed research is necessary for a precise evaluation. It is expected that the data for 2009 and the following years will feature many more companies reporting R&D, as well as innovation activity in ICT, because state institutions began to use the statements filed with the National Statistical Institute as source of information for some requirements in cases where companies applied for financing from the structural funds.[56] A problem yet to be resolved[57] in this respect is the application of a methodology for software innovativeness assessment aligned with international definitions in applications to the Operational Program Competitiveness.

The future of R&D in ICT depends on endogenous factors like human capital/university systems (which produce a maximum of 3,500 IT specialists a year[58]), local demand by other industries and public procurement for electronic management systems, as well as on exogenous factors like the decisions of foreign companies about the future of their branches,[59] the EU framework programs and the coordination activities in European Research Area in the field of ICT.

In Bulgaria the patent activity of enterprises in the ICT sector is very low, with an average of some 20 patents a year for the period 2000 – 2007 (with about 10 patents a year registered at the end of the period) or about 2 % of the total registered patents a year. This is largely due to the fact that the greater frequency of innovations in ICT is associated with the production of software which cannot be patented anyway (in Europe). At the same time, nearly all applications and registered patents in the USA in recent years, for which Bulgarians (or foreigners living in Bulgaria) have been entered as inventors, are in the field of ICT. The leader in terms of patents is SAP (for 2009). Another leader is RaiSat (with an equal number of applications along with SAP in 2009). Both companies have sustainable connection with scientific institutions (Sofia University's Faculty of Mathematics and Informatics and the Faculty of Physics, as well as the Technical University in Sofia) in Bulgaria – their leading specialists are established scientists or promising young people (doctoral students).

The leading Bulgarian ICT companies participating in R&D funded under the framework programs of the EU also have a close partnership with academic institutions and laboratories. A case in point is Sirma Solutions in which lecturers in the field of software engineering work and staff (frequently doctoral students) publish in prestigious international journals with a high impact factor (Sirma is the Bulgarian company with the largest number of publications in the field of ICT). More detailed research is needed in respect to the connection of science (publication activity and teaching), patents and innovations with business, but qualitative studies unequivocally demonstrate that recognized scientists in the field of ICT work jointly (and frequently also have their own firms) with leading companies in the sector and vice versa. The situation in other high-tech fields of science and the economy is similar. The ICT sector is in the unique position of balancing interaction between the educational system (even from secondary schools), science and business – there are other sectors (for example, biotechnologies, chemistry and others) that cannot have the existing R&D potential used for developing local production and scientists work for foreign contracting agents. The problems are largely due to the lack of institutional opportunities for this interaction and it remains in most of the cases at personal level, as well as to the fact that the state has not invested in infrastructure for education for years.

[56] In 2009, many companies controlled by famous entrepreneurs in the sector were registered in order to be able to meet the requirements for a start-up company, because they cannot receive funding with those established on the market. This process will also continue in 2010.

[57] For 2009. It is expected that the problem will be overcome in the first half of 2010 with the active intervention of the Ministry of Transport, Information Technologies and Communications.

[58] The total shortage of IT specialists in the economy for 2012 is estimated at some 10-15,000.

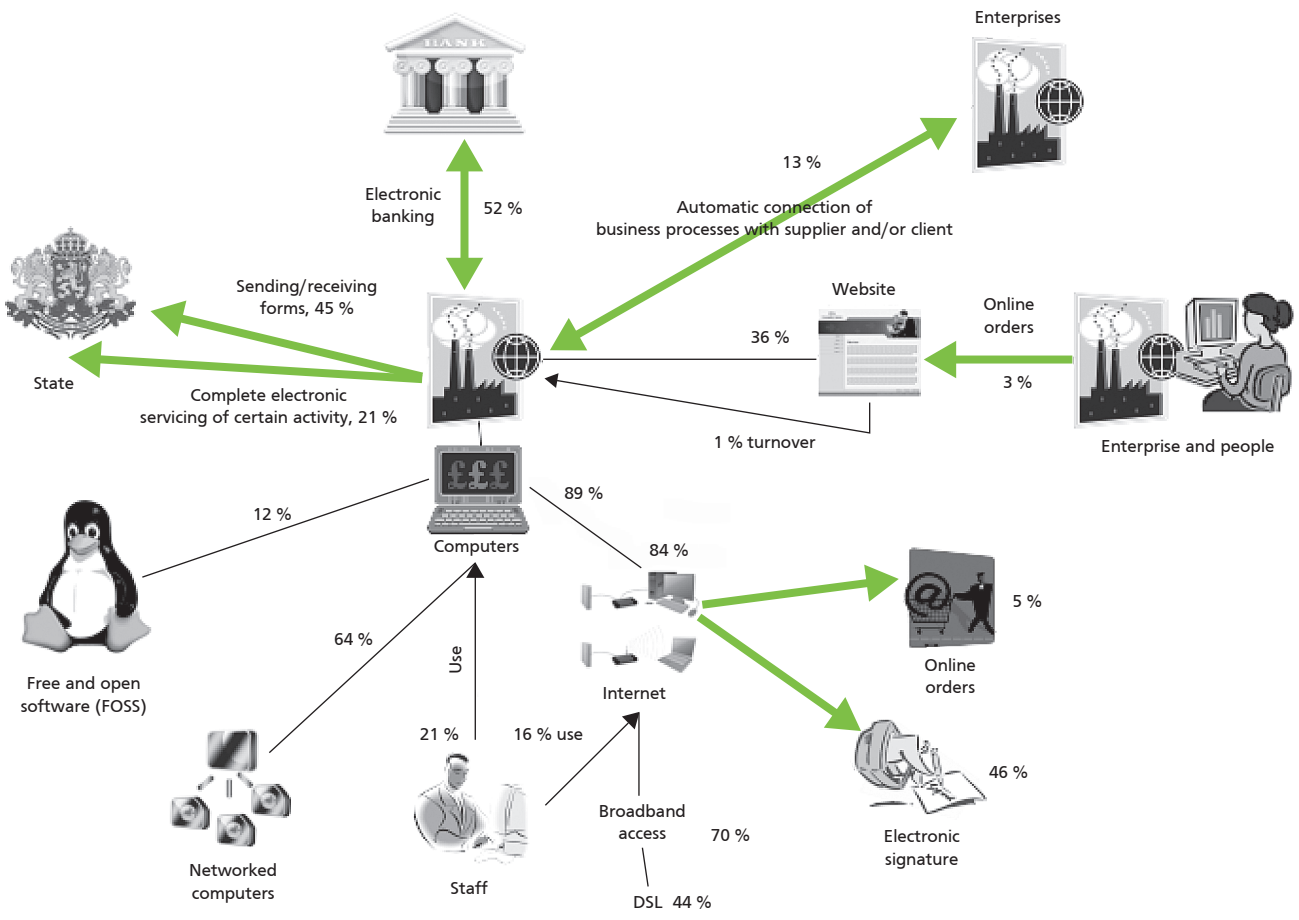
[59] For example, the German Intercomponentware closed its branch in Bulgaria in 2009 as a result of the crisis, while an American company for casino IT systems expanded its staff significantly.

Diffusion of Information and Communication Technologies

The influx of general purpose technologies (mobile phones, PCs, access to internet) has more or less reached its peak (practically no changes were registered in 2009 as compared to 2008). According to NSI, some 90 % of the enterprises have computers and 84 % have access to internet. According to expert estimates of ARC Fund, these data should be interpreted carefully, as the NSI sample covers enterprises with staff of 10 and more and excludes the enterprises from agriculture, forestry and fisheries sector, culture, sports and entertainment, and education. Moreover, according to the survey, there are enterprises with over 250 employees in which there are no computers and 15 % of the companies in the sector of generation and supply of electricity, water and gas do not have computers, while 100 % computer coverage was registered in 2007. The Applied Research and Communications Fund assumes that there are practically no companies with staff of over 10 that do not have computers. Comparison of the survey for Bulgaria and those of other countries reveals numerous mistakes in the survey (possibly resulting from wrong NACE codes, as well as not understanding many of the questions), but they should be analyzed more carefully elsewhere.

According to NSI, 70 % of the enterprises have access to broadband internet. The survey does not measure speed but technologies of access, which means that some 14 % of the enterprises responded that they have dial-up or ISDN access, which in turn does not seem realistic against the backdrop of accessible broadband internet (at least as type of technology and cost). Slightly over half of the enterprises with broadband ac-

Figure 42. USE OF ICT IN AND BY ENTERPRISES IN BULGARIA



Sources: National Statistical Institute/Eurostat, 2010

cess use ADSL. About 15-20 % use more than one access technology as backup.

Nearly all employed (94 %) work at an enterprise with at least one computer but only 21 % of the employed have routine access to a computer a week within their official duties. A total of 16 % of the employed have routine access to computers connected to the web at the workplace. By these two indicators Bulgaria ranks at the bottom among European Union member-states, but there are serious grounds to doubt the reliability of the data. For example, Romania, where 19 % of the enterprises do not have a computer at all, registered that 51 % of the employed routinely use computers at their workplace at least once a week. In Croatia this share is even 65 %, and in Slovakia – 70 % (in comparison, Austria and Germany registered about 40 %).

A total of 36 % of the enterprises have websites (NSI/Eurostat). Here again it can be assumed that the data are significantly underestimated as even in 2006 38 % of the enterprises with over 10 employees had websites *(eBulgaria 2006),* and in 2007 more than half (55.36 %) of all enterprises (including with less than 10 employees) had websites. INA-4 shows that 48 % of the enterprises have a website, and even in the case of the least innovative enterprises those with a website are 37 %. These differences are probably mostly due to the samples, but it is possible that part of the lower values in the latest surveys are due to the fact that the respondent considers that the existing website is not of sufficiently high quality (about 10-15 % of the enterprise websites in INA-4 have errors, are in the process of development and so on). According to INA-4 data, 35 % of the companies have websites which allow online placement of orders, but those where online payment is possible are less than 1 %. The total turnover of enterprises generated by online orders is about 1 %. By all of these indictors Bulgaria (with the exception of Romania where 28 % of the enterprises have websites) ranks at the bottom among other member-countries.

Bulgaria ranks best by broadband access indicators, outstripping more than half of the EU countries in terms of connections alternative to DSL, although it is lagging behind in DSL. Another indicator where Bulgaria traditionally registers high values is the use of electronic signature (46 % of enterprises). The reason for this, as has repeatedly been analyzed in all editions of *Innovation.bg*, is the saving of time, effort and bureaucratic red tape related to accounting of social security, health and tax dues. To a large extent this is precisely what the communication using various forms between enterprises and state institutions is (45 % of enterprises) as well as complete electronic service of an individual activity (21 %).

The use of open code and free software systems is still slow in entering enterprise operation (12 % say they use such), but Bulgaria nevertheless has better results than 7 countries, including Spain which is frequently quoted as an example for using open source and free software.

Impact of Information and Communication Technologies on Innovation

The intensive introduction of technologies into the business environment, the convergence of the various information and communication technologies and the structural changes in consumer demand are the three most significant external forces which determine contemporary product, process, organizational and marketing innovation.[60] **Around half of the product and three-quarters of the process innovations**[61] **in Europe are based on the innovative use of ICT at some of the stages** – from R&D and prototypes, through including ICT components in the new products and production processes to release of the new products and services on the market. The latest empirical data from 2009 for the European Union, which show the influence of ICT on innovations, pertain to section 35 ("Manufacture and Distribution of Electricity, Gas, Steam and Air-Conditioner Gases"), where 71 % of the R&D-based innovations and an equal number of new products and services are based on

[60] *Innovation.bg 2007*.

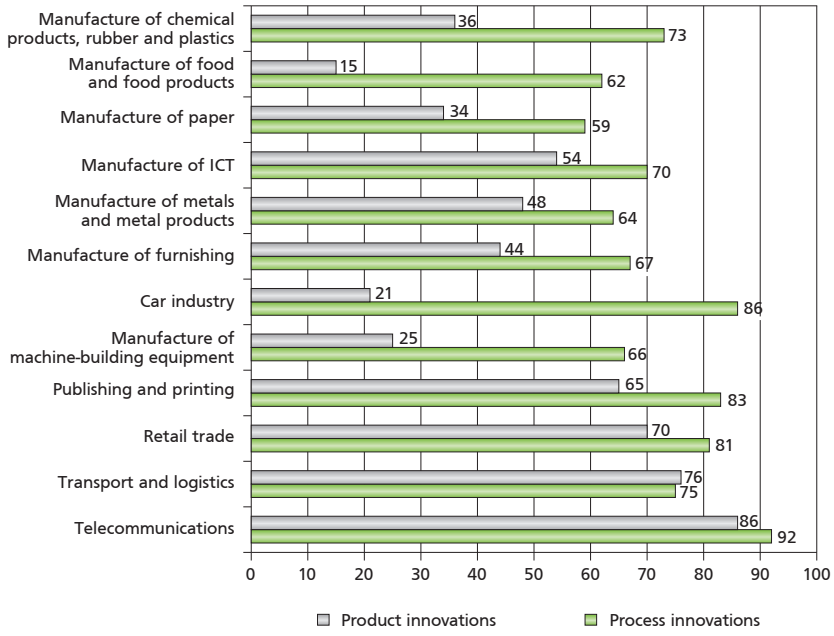
[61] e-Business W@tch, 2007. The data are for the period 2005-2007, resulting from sample surveys for several large or leading EU countries. The USA is also included in some cases. For more information about the surveys visit http://www.ebusiness-watch.org

ICT upon release on the market. The values in section 23 ("Manufacture of Non-Metal Mineral Products – Glass, Ceramics and Cement")[62] are slightly lower (respectively 56 % and 54 %), but they also demonstrate the significant role of ICT. Earlier data (albeit not allowing one to follow where precisely in the life-cycle of innovation ICT have the greatest influence) for sub-sections of the processing industry show that 38 % of the product and 70 % of the process innovations[63] are IT-based.

Although there is no specific survey for Bulgaria, it can be assumed on the basis of expert assessments that these data are close to the values for Bulgaria, particularly in the case of sub-sectors integrated with world markets (manufacture of chemical products, rubber and plastics, glass, ceramics and cement, ICT hardware, car manufacturing, transport and logistics, telecommunications), while the differences should be sought mainly in the less technological and insufficiently clustered branches such as manufacture of furniture/furnishing, retail trade (not the large international chains), manufacture of metals and metal products and paper industry, where there are considerably less ICT-based product innovations, but it is possible to have more process ones because of catching-up development and the introduction of quality control systems in enterprises of the type of small dairies.

Practically the entire technological innovation in all sectors in Bulgaria in 2009 tacitly includes ICT (for example, introduced process innovations and installations in the production of alcoholic drinks, technological lines for the manufacture of foods and food products, wood processing and the manufacture of furniture, etc.). In spite of the crisis, the last year will be remembered with the numerous completed integration projects for enterprise management software, including such for local production

Figure 43. Share of ICT-based innovations compared to the total number, by sector



Source: e-Business W@tch, 2007

Box 7. ICT and innovation diffusion

Technologies increase skills. Computer skills are associated significantly with the increase of skills related to certain jobs.[64] The influence of ICT runs along two lines – as a general-purpose technology of users gradually increase their skills to work with them and the requirements for taking a certain job increase. There was a typical manifestation of this phenomenon over the past few years in the production of soft drinks and beer. On the other hand, some high-tech productions, which traditionally required specialized knowledge from the workers, can already use less qualified workers because of the complete automation of production processes. At the same time, technologies to a certain extent level skills in various sectors and thereby ease migration of employment from sector to sector. Where there is a greater difference in levels of remuneration between two sectors this could lead to grave problems. A case in point was the siphoning of people from the banking sector towards call centers.

Technologies influence structure. The early users of computer information technologies in an organization increase their central role as hubs[65] and, as a consequence, their power.[66] The introduction of complex enterprise management systems (ERP, CRM) and more generally organizational innovations

[62] e-Business W@tch, 2009. A survey conducted in 2009 covering 1,027 enterprises in France, Germany, Italy, Poland, Spain and the United Kingdom.

[63] Average, without weighing the data by significance of sub-sectors.

[64] Francis Green, Alan Felstead and Duncan Gallie, *Computers Are Even More Important Than You Thought: An Analysis of the Changing Skill-Intensity of Jobs,* paper by Centre for Economic Performance, London School of Economics, 1999.

[65] In graph or network theory a measure of the "importance" of a given hub is its connection – both as local, direct connection and in terms of structure (overall connection in the network).

[66] Marlene Bukhardt, Daniel Brass, *Changing Patterns or Patterns of Change: The Effects of a Change in Technology on Social Network Structure and Power,* Administrative Science Quarterly, March, 1990.

developed by foreign companies (not only in their local outlets in Bulgaria). A large portion of these, however, were planned in 2008 and some even in 2007.

In Bulgaria, ICT innovations in the utility sectors[67] "Production and Distribution of Energy," "Supply of Water," "Sewerage Services" and "Waste Management" in 2009 are related to changes in (or the introduction of new) systems for (including mobile, electronic, web) payments and relations with partners who collect payments, consumption accounting systems, the introduction of systems for management of reserves, supplies and business processes, systems for remote consumption accounting, for remote risk surveillance, control and evaluation, the introduction or improvement of centers for work with clients and the introduction of systems or individual elements in the process of management of human resources. All these innovations (and the related changes in business processes) induce and presuppose considerable organizational changes, not only in the energy sector, but in the entire processing industry as well.

In spite of Solow's widely discussed productivity paradox,[68] which generally consists in the apparent contradiction between the measured investments in ICT and the aggregate results (productivity and growth) at national and sector level (particularly with data for the 1980s and the 1990s), at academic and policy level it is accepted as valid (particularly for the future) that ICT are one of the most important motors of innovativeness of enterprises and growth of economies. The effects of their use include reduced relative transaction costs, shortened production cycle, streamlining of production, structural changes in markets. At the same time, a lot of additional risks also appeared (for company security, for example) and threats (in respect to company competitive position).

Box 7. ICT AND INNOVATION DIFFUSION (CONTINUATION)

frequently encounter considerable resistance from employees because they have to change certain business processes or certain employees lose specific power fed by information asymmetry or brokerage.

ICT-intensive sectors grow faster than non-intensive ones. This conclusion was made on the basis of data for the period 1990 – 1999.[69]

ICT boosts competition. ICT boosts competition through a reduction of information asymmetry and the unlimited access of clients to the competitors, including through easier international trade. In turn, **competitive pressure has a retroactive increasing effect of increased ICT use** – for example, a company has a statistically **higher probability of having a website** if its largest direct competitor has a website than if it does not *(Innovation.bg 2008)*. Half of the companies from the sector of manufacture of chemical products, rubber and plastics in Europe think that **ICT have increased competition** in the sector *(e-Business W@tch, 2008)*. The same result was registered a year earlier in retail trade in Europe *(e-Business W@tch, 2007)*. Of course, there are sectors where this influence is practically nonexistent (for example, metallurgy).

ICT increases the probability of innovation, but the power of this influence is greater in the early stages of introduction of the respective type of ICT. When adoptions are made by the late majority or the laggards this connection can be lost. In other words, **the early introducers of ICT are more innovative** *(Innovation.bg 2009)*. For example, the use of software applications for e-business correlates with considerable organizational changes and process innovations, but no correlation is found between the use of internet and the existence of local network infrastructure and organizational changes in several sectors *(e-Business W@tch, 2007, 2008)*. The same surveys register that ICT-based innovations lead to an increase of sales. Enterprises with computers are more innovative than those without, and there is a tangible – albeit weak – correlation between innovativeness of an enterprise and the indicators of number of computers per employed *(Innovation.bg 2009)*. As in the case of computers, the existence of a website, ERP, CRM, joint work and project management systems and open code systems are significant factors which divide enterprises into more innovative and less innovative ones *(Innovation.bg 2009)*.

[67] Although only 325 enterprises with over 10 employees operated there in 2008 and they had only 10 % of the added value in the non-financial sector, they held a considerable portion of the retail electronic payments and were an important factor (maybe second after the state) in the development of local ICT business. Part of these companies in turn own companies in the telecommunications sector, while their problem-free functioning is a condition for the operation of practically the entire economy, which makes them an interesting subject of research about the role of ICT in them.

[68] Brynjolfsson, Erik, *The Productivity Paradox of Information Technology,* Communications of the ACM, December, 1993.

[69] Bart van Ark, Robert Inklaar, Robert McGuckin, "Changing Gear: Productivity, ICT and Service Industries in Europe and United States", in Jens Christensen and Peter Maskell, eds., *The Industrial Dynamics of the New Digital Economy,* Edward Elgar Publishing, 2003.

Bulgarian Innovation Policy: Options for the Next Decade

The political changes in the EU – the entry into force of the Treaty of Lisbon, the new composition of EU institutions, as well as the development of their remit – will influence policy in the field of innovation in Bulgaria and the EU over the next decade. Regardless of the fact that in respect to science and innovation the Treaty of Lisbon preserves the current competencies of the member-states and the complementarity of the measures for encouraging innovations, at EU level there are designs for essential change and promotion of initiatives in support of innovation policy. Should Bulgaria miss 2010 too for drafting a national innovation policy, the country's model of economic development will increasingly resemble those of the most backward in Europe – low competitiveness, long-term low income, a high degree of indebtedness and extreme vulnerability to external economic shocks.

European initiatives in support of innovation

Since 2005, innovation policy has acquired greater significance among EU common policies and was recognized as a key factor for competitiveness, productivity and sustainability. The results and the problems of EU innovation policy can be structured in three fields – framework conditions for innovation, initiatives in support of innovation demand and supply.[70]

Framework conditions include the changes in **the provision of state aid** for research, innovation and development, which include help for young entrepreneurs, centers for providing innovation services, loans for highly qualified staff, support of innovation clusters and so on. The new regulation for exempting

[70] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Reviewing Community innovation policy in a changing world, Brussels, 2.9.2009, COM(2009) 442 final.

from notification state aid to the amount of up to €200,000 per enterprise for a three-year period allows member-states to use a variety of tools in support of innovations and for the development of eco-innovation. **Tax initiatives** for encouraging research and development are embodied mainly in comparative analysis of member-state tax policies and in the distribution of good practices. Access of business to a single patent, keeping talented scientists in the EU, the reform in the structure of educational degrees and the acquisition of e-skills remain unresolved problems.

The supply and demand of innovations in the EU are characterized by **limited access to venture capital** in the first stages of the innovation process and the investment readiness of entrepreneurs. The Commission has undertaken several initiatives to encourage cross-border venture capital investment and to clarify the interests of venture investors, but they cannot replace the measures at the national level. The European Institute of Innovation and Technology has the key task of generating pioneer innovations by stimulating the connection between education, science and business, as well as the development of public-private partnerships. The first knowledge and innovation communities through which it operates are those in the field of climate change, sustainable energy and the future of information and communication technologies. Important initiatives of the European Commission include the drafting of an innovation policy in respect to services and **linking cohesion policy with innovation policy.** The utilization of funds under the operational programs for overcoming the consequences of the economic crisis remains a problem for member states.

The measures for simultaneous support of demand and supply are taken in several main directions:

- Development of **lead markets** in the sectors of e-health, sustainable construction, recycling, bio-products, renewable energy sources, as well as wider access to and better utilization of the technologies ready for commercialization in the field of eco-innovation;
- Information and communication technologies;
- Intelligent transport systems and intelligent energy;
- Using the potential of **public procurement** to encourage innovation;
- Development of active policy in the field of **standardization**;
- Better regulation of new technologies and newly emerging markets and assessment of their impact.

On this basis the European Commission recommends that policies at the level of EU member states define priorities in the following fields:

- A clear understanding of the significance of R&D and innovations to overcome the crisis quickly and create potential for sustainable growth; increasing the regulatory functions of the state towards reconsidering regulatory regimes, overcoming the barriers to entrepreneurship and innovation, and financial support for companies incapable of setting aside the necessary funding for innovation;
- Simultaneous stimulation of the supply and demand of fundamental and applied research results, with a focus on encouraging interaction between innovation system units and shortening the cycle for application of new technological projects;
- Uniting efforts around the so-called national strategic technologies set down as priorities and thus focusing the principal portion of the planned investments in research and technology;
- Orientation of financial schemes towards support for building a green and clean economy and a healthy society.

European innovation policy prospects

The European innovation policy is reflected in the EU 2020 strategy.[71] The strategy focuses on three thematic objectives:

- Creating value by basing growth on knowledge;
- Empowering people in inclusive societies;
- Creating a competitive, connected and greener economy.

Innovations concern all three objectives. The Commission is expected to make a detailed proposal for updating the European innovation policy to the Spring European Council. This is part of the overall European program for reform. The 2010 Spring European Council conclusions will underpin the so-called 'integrated guidelines', confirming the policy priorities which should be pursued by the EU and member states in partnership. The new guidelines will replace those in force under the Lisbon Strategy since 2005. For each of these objectives, member states will be invited to set national objectives for five years corresponding to their specific situations and their starting points.

Bulgaria's innovation policy as EU member

Given Bulgaria's membership in the EU, the modernization and enhanced competitiveness of its economy emerge as a requirement for the improvement of living conditions.

The adoption of a National Innovation Strategy of the Republic of Bulgaria in 2004 and its implementation through concrete projects, such as the establishment of the National Innovation Fund and the development and launch of Operational Program Competitiveness, were the first – albeit quite restricted – measures in support of innovation in the transition to a market economy. Because of the lack of consistent policy and adequate financial support they did not succeed in bringing essential change to the environment for innovation. The surveys of the European Commission – the European Innovation Scoreboard and Innobarometer – classified Bulgaria as a "catching-up country" in the field of innovation, characterized by a downturn of investment in innovation in a time a crisis and increasing innovation deficit in several key problem zones:

1. **The national innovation policy** is implemented on the basis of a strategic document developed more than five years ago, without updating of the objectives set down in it according to the change in the potential of the Bulgarian economy and the conditions of the environment in which the national innovation system units operate. The misbalances which existed at the launch of the National Innovation Strategy and the lack of coordination with the then draft research development strategy and the objectives of the country's economic development continue at present. In practice, the National Innovation Strategy has not been implemented since 2007 – there are no annual plans, part of the few measures undertaken earlier have been terminated or are carried out formally, without a vision, the consultative body established with the Minister of Economy,

[71] The Commission launches consultation on EU 2020: a new strategy to make the EU a smarter, greener social market, http://ec.europa.eu/enterprise/policies/innovation/index_en.htm

Energy and Tourism – the National Council on Innovation – does not fulfill the commitments set down in the Strategy, while the Ministry of Economy, Energy and Tourism does not engage in effective monitoring of its implementation. The national innovation policy (inasmuch as it could be said to exist) is carried out on the basis of sporadic measures which are not subject to an overall logic and are not oriented towards achieving the objectives of national development within the EU.

2. The approaches to **updating the legislative framework in support of innovation** in Bulgaria (lack of transparency and public debate), as well as the mechanisms for the implementation of the legislative documents (lack of control and ineffectively operating judicial system) cannot be considered part of an innovation enabling environment. This is the case with the actions undertaken – or not – for the development of high-tech, human resources (engaged in science and technology), higher education, protection of intellectual property (including by R&D units and universities), and enterprise and innovation activity.
3. **Funding of R&D** is declining as a share of GDP. There is a lack of strategic orientation, responsibility and administrative capacity for more effective utilization of the finances from the European funds in support of R&D. Insufficient financing, combined with the lack of a long-term vision, leads to the establishment of units in support of innovation with questionable sustainability. Cases in point are the technology transfer offices established with some universities and scientific organizations. They were supported financially for a year, with the clear prospect that they would be unable to support themselves and would have to change their functions after this period in order to exist. Such projects can be described as tests of initiatives for encouraging innovation rather than a well designed innovation strategy.
4. The reform of the **national innovation system** is yet to come, both in respect to state-subsidized scientific units and to defining the role of Bulgarian universities in the "science – education – innovation" triangle. Against this backdrop, the number of innovation companies in Bulgaria is growing, regardless of the neutral – and in some cases hostile to innovation – business environment, while among publicly funded research organizations and higher education institutions there are effectively working units whose achievements find practical application. In spite of that, the issues research and innovation remain a *terra incognita* for Bulgarian media.

The need of developing a national program within the EU 2020 Strategy is an appropriate occasion for reconsidering the national innovation policy and for reforming the innovation system so that the strategic foundations for the development of the Bulgarian economy over the next decade would improve.

Recommendations for the establishment of a working national innovation system

The analysis of the innovation potential of the Bulgarian economy presented in this report confirms the need for measures for catching up with the rest of the European economies in respect of innovative development. Support of company and national competitiveness by the introduction of advanced technological achievements in enterprises will help overcome a number of economic and social problems and will permit an improved utilization of the existing innovation

potential. The changes in Bulgaria's innovation policy, which the *Innovation.bg* report summarized for the past six years, should include:

1. **Making innovations a priority of the country's economic and social development.**

    - **Updating the National Innovation Strategy** and its integration with the research strategy and the country's priorities of economic development. Coordination of the main priorities for economic development and the key technological fields in support of their achievement.

The prioritizing of innovation in the economy should be visible in the work of the individual ministries and in the implementation of all operational programs and financial instruments of the state, including the procedures for public procurement, licensing, etc.

It is necessary to draw up an action plan by sectors and scientific and technological fields for the application of the objectives and priorities of the strategy and to determine the financial, legal and institutional instruments for its implementation. The annual and medium-term action plans of the individual ministries and other units disbursing public funds should be linked to the fulfillment of objectives and priorities set down in the action plan, as well as to the assessment of their implementation. Annual updating of the action plan according to the rate of its implementation and external factors, as well as respective updating of the annual action plans of ministries and units operating with budget funds based on it.

    - **Designing a mechanism of accountability, monitoring and control of the execution of measures set down in the national strategy.** The strategy should feature measurable results allowing for impact assessment of scientific research and innovation on boosting the competitiveness of the economy. Financial backing of the implementation of the strategy aiming to ensure consistency and continuity in the long-term application of the national innovation policy.

Modern information and communication technologies permit the establishment of procedures for adequate interaction and exchange of information between the state institutions which create an environment and participate in the implementation of the measures set down in the innovation strategy. Drafting of governance rules for decision-making at national, regional and local level in the conditions of transparency and open interaction with the various units of the innovation system. Following the best practices in the developed countries, the potential of civil society organizations in the country which have considerable experience in carrying out such initiatives should be used to hold a broad debate on the issues of the innovative development of the economy.

    - **Organizational measures on the application of international standards for collection, processing and provision of statistical data** about the operation and innovation activity of enterprises, research and university institutions in the country. The establishment of an updated information database to serve the analytical process and the introduction of measures for an innovation-supportive environment will lead to an improved ranking of Bulgaria's achievements in the European Innovation Scoreboard and will help form a policy adequate to the existing innovation potential.

2. **Drafting legislation encouraging science, research and innovation in their interaction.**

   - **Revision of legislation in the field of science and innovation** with the objective of creating a favorable statutory environment for innovations. Updating existing laws and secondary legislation, including the Promotion of Scientific Research Act and the Public Procurement Act, among others;
   - **Drafting and adoption of legislative acts** which would provide an overall regulation of activity of the units integrated in the innovation process (business, universities, research units), including in terms of protection and transfer of the intellectual property they hold.

The practice of EU countries shows the need of legislation which promotes the development of innovation-related processes such as mobility between research organizations and business, technology transfer, public-private partnerships in R&D, incorporation in the European scientific infrastructure framework. Legislation should support innovation through the procedures for public procurement, state aid and the introduction of international regulations and standards.

3. **Establishment of a center for integrated decision-making which would coordinate the implementation of the country's scientific, technological and innovation policy.**

A unit should be established with the Council of Ministers, headed by the Prime Minister or a Deputy Prime Minister, which would ensure significant changes in the national innovation system on the basis of commitment at the highest political level. The establishment of such a structure should overcome the problems in the work of the existing innovation and research councils in Bulgaria.

4. **Sustainable increase of research and innovation funding.**

   - Formation of a **sustainable financial framework for the implementation of the measures included in the innovation strategy** by setting a national objective for investment in R&D. On the basis of the studies of the sectors of investment in R&D by business it could be concluded that the achievement of 2.1 % of GDP investments in R&D by 2020 is a feasible objective. Participation of the state sector should remain within 0.8 – 0.9 % of GDP.
   - **Integrating the institutional and project approaches to funding research and innovation activity,** including by synchronizing the existing financial instruments – National Innovation Fund and National Science Fund.
   - **Providing a national co-funding instrument for projects funded by European framework programs** in the field of science, technology and innovation, with the objective of encouraging the investment of fresh money in the Bulgarian economy and of improving the management of innovation in the research and industry sectors.
   - **Establishment of mechanisms of transparency and control of public expenditure.** Building the capacity and streamlining the operation of the public administration managing finances under the European Cohesion Fund and the structural funds supporting innovation.

The limited funding for innovation calls for a reconsideration of the measures under Operational Program Competitiveness for 2011 – innovation products,

processes and services, which should be supported under the Program, as well as the processes of technological modernization, development of clusters and technology transfer offices. Changes are also necessary in Operational Program Human Resources Development, which would turn it from a tool applied in areas of low added value and low starting qualifications into an instrument supporting human resources and business in high-tech and R&D-intensive industries. This can be done both by the transfer of more funds and responsibilities under the program from the Ministry of Labor and Social Policy to the Ministry of Education, Youth and Science and the Ministry of Economy, Energy and Tourism, and by raising the caps of costs per trainee adequate to the necessary training courses.

5. **Reform of the national innovation system.**

   - The restructuring of scientific organizations in the country is a must. Regular international evaluations should be introduced for the operation of all state-funded scientific organizations against targets and policy objectives set in advance. The restructuring should establish more flexible structures where mobility of scientists between organizations and companies is possible; attract back Bulgarian scientists working abroad; combine education and research and connect them to business. The establishment of a platform for increasing the quality of the research and educational product is a fundamental problem which should be resolved in this respect.
   - Support for the establishment of intermediary units between research organizations and business in the form of technology transfer offices, innovation and enterprise centers, etc., as well as funding organizations such as venture investment funds. The association of businesses for innovation ends by means of enhancing the functions of trade associations of industry branches or the formation of clusters would support the demand for innovations in the country.

6. **Study, dissemination and introduction of best innovation practices** of Bulgarian and foreign companies and research organizations.

Measures for **popularizing the role of innovation for the development of a knowledge-based economy** should be provided in the updated and integrated innovation strategy of Bulgaria. Best practices should be promoted, for example through annual innovation and enterprise awards and/or by the development of innovative journalism, particularly in national public media.

Appendix: Methodological Notes, Sources of Information and Definitions

Innovation.bg comprises five groups of indicators which describe the national innovation system and its functioning:

1. Gross innovation product.
2. Entrepreneurship and innovation networks.
3. Investments and financing of innovation.
4. Human capital for innovation.
5. Information and communication technologies.

Each group contains several synthetic indicators. Working definitions which could differ from stricter theoretical definitions have been applied to the groups and the indicators. The latter consist of various numbers of statistical values displayed graphically. They are grouped in way providing the most comprehensive view of the respective component of the national innovation system. The graphs representing the values are based on the internationally recognized definitions and concepts.

The report uses innovation in its many forms and meanings. **Innovation** is the adoption of a new or significantly improved idea, product, service, process or practice in order to meet a certain need. The concept is also used in a narrower sense in some parts of the report.

Methodology of the survey of the innovation activity of enterprises in Bulgaria

The Applied Research and Communications Fund has been carrying out regular surveys of the innovation activity of enterprises in Bulgaria (INA) since 2004 based on the methodology of the Innovation Survey of the European Community. In 2009, this methodology was used as a base for drawing up a questionnaire for telephone interviews as a methodology for data registration. The sampling, fieldwork and its quality control has been performed by the Vitosha Research marketing agency. The telephone interviews were conducted the Sofica Group Business Process Outsourcing (BPO) provider of call centre and back office services in the period October 19 – November 16, 2009. The planned sample included 1,000 enterprises (200 micro, 700 SMEs and 100 large ones) in sectors 10 to 74 of the National Classification of Economic Activities (NACE) – 2003. The respondent target group were the owners and senior managers of the enterprises.

The general population on which the sample is based includes the corporate data base of Vitosha Research of about 260,000 legal persons which have been statistically active in the period 2000-2008. On this basis, a random sample of 5,015 enterprises meeting the following criteria for selection was generated: the size of the enterprise, type of ownership, distribution by territorial administrative regions aligned with the type of the relative nucleated settlement. With a view to fulfilling the quotas by region and scope of enterprise, as well as the high share of unsuccessful calls in some of the regions, the initial sample was expanded by the addition of another 232 enterprises from 12 regions.

A total of 1,022 questionnaires with full answers in e-format were received from the 5,247 enterprises called. Following the initial logical review of the information, 31 cases were discarded (5 cases because of doubling the data for one enterprise because of simultaneous telephone interviews conducted by different interviewers and 26 cases because of incompliance in the sector of economic activity). The final sample contains 991 cases.

Table 11. INFORMATION ABOUT THE TELEPHONE INTERVIEWS IN INA-4

	Number
Failed calls (free line but no response or automatic message about a non-existent telephone number)	3,119
Wrong number (the respondent is a natural person or a constantly operating fax machine)	452
Terminated telephone interview	36
Refusal to participate in the survey (including refusal at second call after a terminated telephone interview)	618
Successful calls (filled-in questionnaire)	1,022

Source: Sofica Group, 2009

Following the completion of the telephone interviews, the data about the main economic activity of the enterprises were additionally re-encoded by sectors according to NACE-2008 and the tables for transition from NACE-2003. This was done to achieve compliance of data about the enterprises collected in the fourth survey of the innovation activity of enterprises (INA-4) and the data from official sources (NSI, Eurostat and others), which have been applying NACE-2008 since 2009. With a view to subsequent analysis, the data about the number of employed by the end of 2008 at the enterprises from the final sample were complemented with data about the number of employed in these enterprises in the first 9 months of 2009 using data from the National Social Security Institute. The number of employed has been recalculated as the mean value of the sum of persons with health insurance at the respective enterprise, divided by the number of months.

Table 12. CHARACTERISTICS OF THE ENTERPRISES SURVEYED IN INA-4

Total number	**991**
Distribution by size	
Share of micro enterprises (under 10 staff)	18.7 %
Share of small enterprises (between 10 and 49 staff)	48.2 %
Share of medium sized enterprises (between 50 and 249 staff)	23.8 %
Share of large enterprises (over 250 staff)	6.5 %
Distribution by type of company	
Share of joint stock companies (joint stock and single-member joint-stock company)	22.1 %
Share of limited liability companies (incl. sole owner Ltd)	67.1 %
Share of proprietorships	6.8 %
Other (general partnerships, cooperatives, partnerships limited by shares, companies pursuant to the Contracts and Obligations Act)	3.0 %
Distribution by type of ownership of controlling stake	
Share of enterprises over 50 % of which is owned by private owners	96.2 %
Share of enterprises with over 50 % state/municipal ownership	2.5 %
Lacking data about private/state ownership	1.3 %
Share of enterprises over 50 % of which is owned by local private owners	89.0 %
Share of enterprises with over 50 % ownership of foreign natural or legal persons	10.7 %
Mixed ownership (equal share of local and foreign ownership)	0.3 %
Lacking data about local/foreign ownership	3.5 %

Source: Applied Research and Communications Fund, 2009

Innovation Index of Bulgarian Enterprises

The index summarizes the measurement of innovation activity at company level and aggregates seven types of innovation of the four types applied by enterprises (to products, processes, organization and marketing) and their degree of novelty (to the enterprise, to the market or to the world) as registered by INA-4. Its values range from 0 to 100, with 0 indicating that the enterprise had lacked innovation, while 100 meaning that the enterprise had made all types of innovations at the highest degree of novelty.

Box 8. COMPONENTS OF THE INNOVATION INDEX OF BULGARIAN ENTERPRISES

1. **Product innovations**
   - 1.1. The enterprise has started to make products new to the company
   - 1.2. The enterprise has started to make products new to the Bulgarian market
   - 1.3. The enterprise has started to make products new to the international market

2. **Process innovations**
   - 2.1. The enterprise has adopted production methods/processes new to the company
   - 2.2. The enterprise has adopted production methods/processes new to the sector

3. **Organizational innovations**
   - 3.1. The enterprise has adopted new or considerably improved management methods and systems
   - 3.2. The enterprise has made considerable changes in the organization of work
   - 3.3. The enterprise has established new or considerably changed relations with other companies in the value adding chain

4. **Marketing innovations**
   - 4.1. The enterprise has made considerable changes in the design or the packaging of its products
   - 4.2. The enterprise has applied new or considerably changed methods for the sale and distribution of its products and/or services

Source: *Innovation.bg 2007,* Applied Research and Communications Fund

The index considers three types of innovations, which are equal from the point of view of the positioning of the innovation – **product innovations** (what is being produced), **process and organizational** (how it is being produced) and **marketing** (who it is designed for and how it is sold). In turn, process and organizational innovations have equal weight in the sub-group. Process innovations refer mainly to *technologically* new or improved processes. Purely process innovations usually stand behind a large portion of organizational innovations without having technological innovation as a component (as, for example, application of process or organizational reengineering). This was also the motivation behind their being considered in one group. The various components of the index have equal weights within their groups.

Availability of data, information sources and definitions

Innovation.bg contains secondary statistical and administrative data and data from nationally representative surveys of enterprises conducted by the Applied Research and Communications Fund. The report uses a number of freely accessible Bulgarian and foreign sources, which in some cases has resulted in differences in time horizons, definitions of the used variables and graphically represented indicators. Detailed information about the sources used can be found in the report and systematized information about the data used in *Innovation.bg* is available at www.arcfund.net and www.innovation.bg. The Applied Research and Communications Fund updates the Innovation.bg report annually, aiming at making it a reliable and effective instrument for monitoring the Bulgarian national innovation system.

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APPLIED RESEARCH AND COMMUNICATIONS FUND

The Applied Research and Communications Fund is a Bulgarian research non-profit organization, registered in public benefit, established in 1991. Its mission is to support the development of innovation and the knowledge economy in Bulgaria through:

- advice and advocacy on establishing national, regional and local level policies and strategies for the country's successful integration into the global innovation economy;
- research and analyses of development trends and policy options for supporting innovation as well as information and communication technologies;
- public-private partnerships among businesses, public institutions, the academic community and civil society for addressing specific issues of ICT and innovation based competitiveness.

The Applied Research and Communications Fund has set up two functional units for the provision of IT and consulting services:

- European Innovation Centre – Bulgaria is part of the largest information and consultancy support network in Europe: Enterprise Europe Network, and coordinates its work in Bulgaria. The Network aims to assist small and medium-sized enterprises in their innovation potential development and to raise their awareness about the European Commission's business-oriented policies.
- ARC Consulting EOOD is the consulting arm of the Applied Research and Communications Fund. The company offers consulting services in the fields of innovation and information and communication technologies, as well as advisory services in the design and implementation of national and international projects under the EU Framework Programs, the Cohesion and Structural Funds.

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