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.

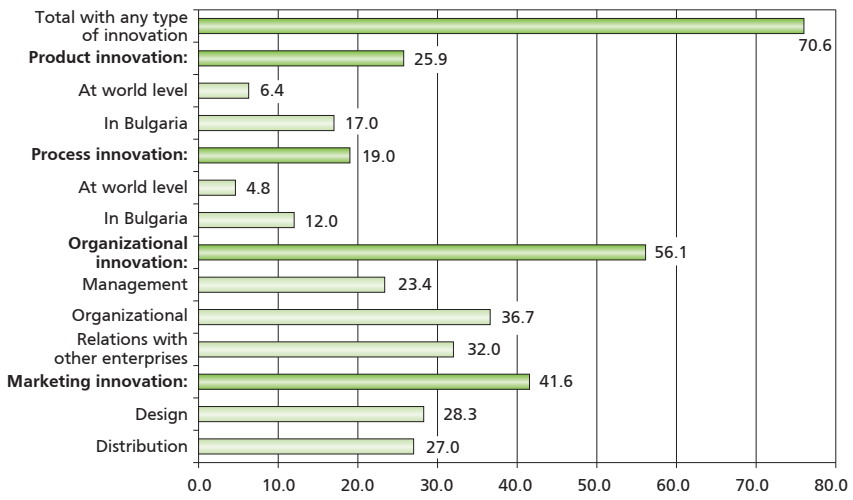
An essential feature of the innovation process is its duration. **Process innovations** require a longer time for implementation and very rarely result from lightning reactions during crisis. Usually enterprises freeze their new projects, with the effect becoming visible to the economy after one to three 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 %.**

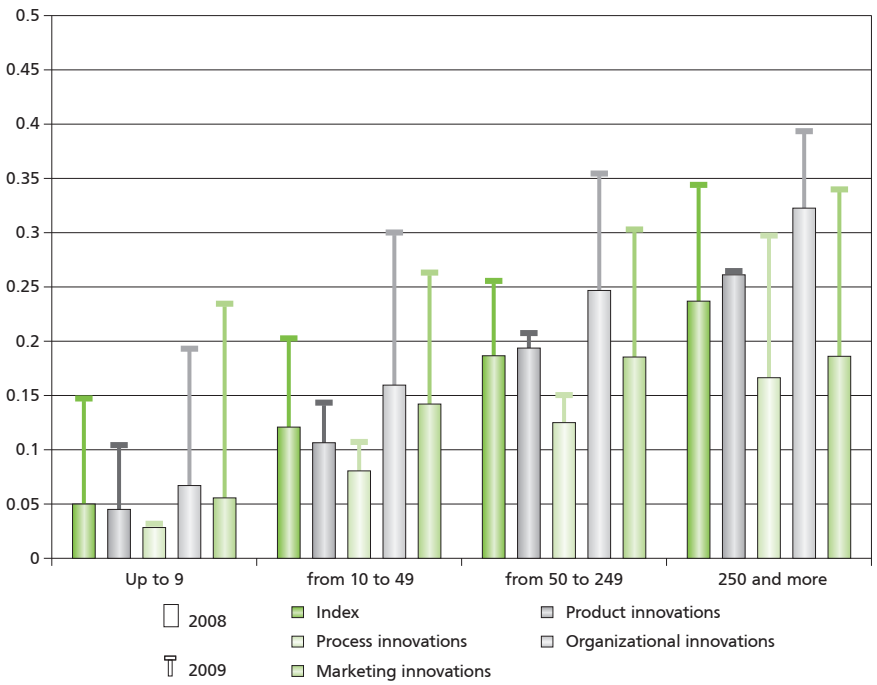
The explanation of the large difference[5] (growth nearly doubled in a year) lies in the so-called "optimizing enterprises", estimated at some 26 %. Their innovation activity is limited mainly to organizational and marketing innovation. Such an approach could be considered as a reaction to the crisis – 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.

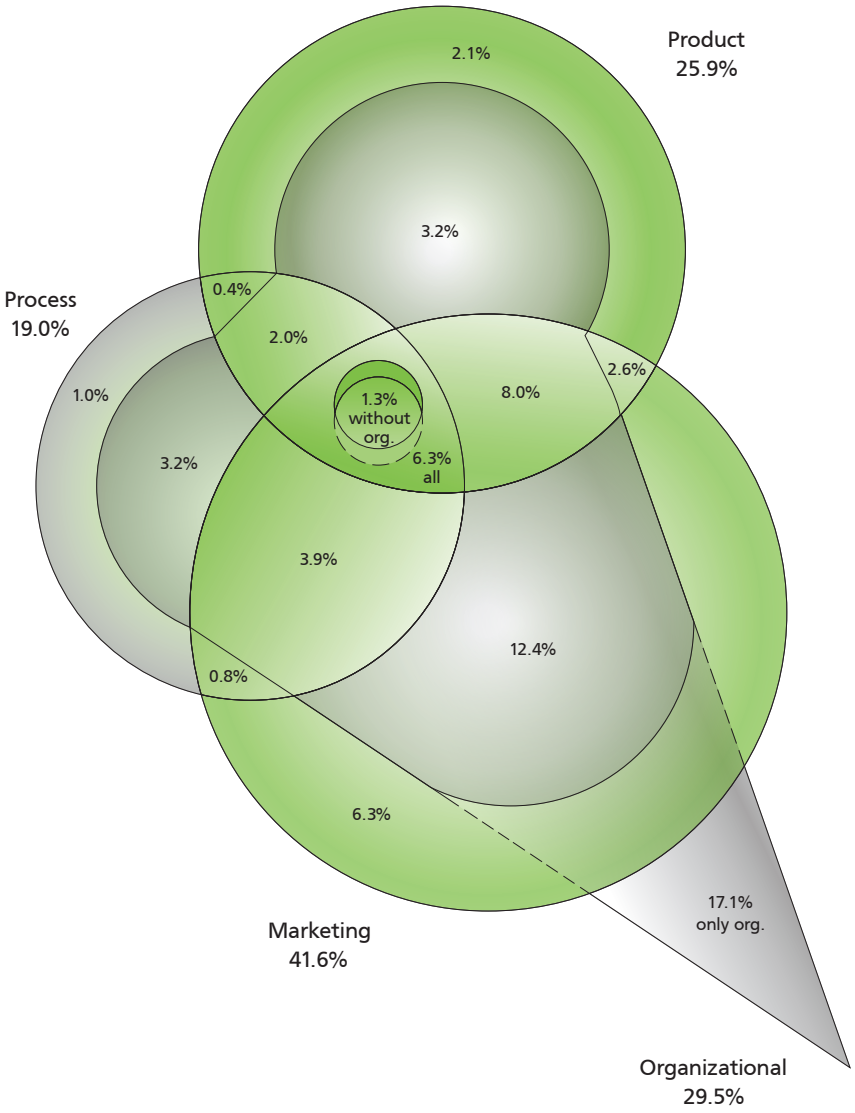
The group of those catching up relies on product diversification and partly on process innovations already made in previous reporting periods. This group constitutes 12 % of all enterprises, demonstrating a higher innovative potential than the "optimizers" – a result of the new products they have already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

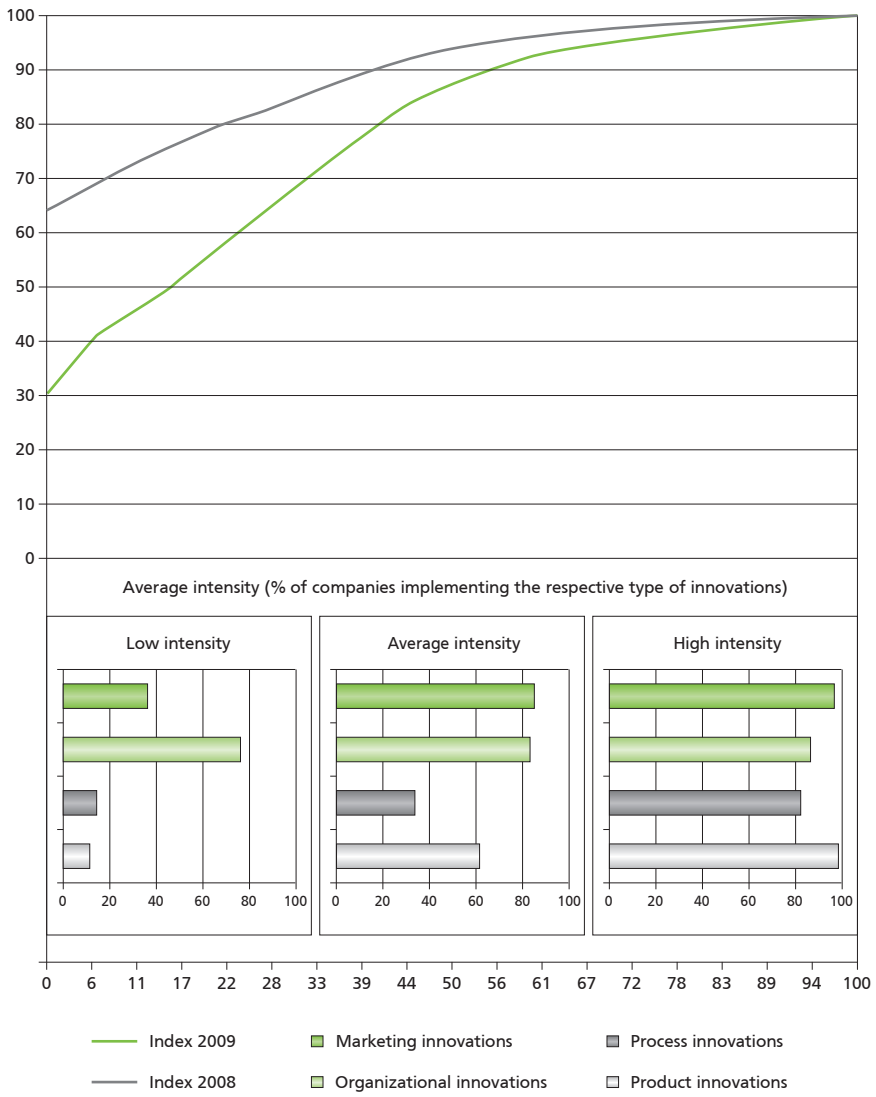
[7] K-means cluster analysis was used. In spite of the instability of the resulting cluster centers, the choice focused on those where the group of the least innovative enterprises showed the lowest dispersion at the lowest mean value of the summary index.

[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.

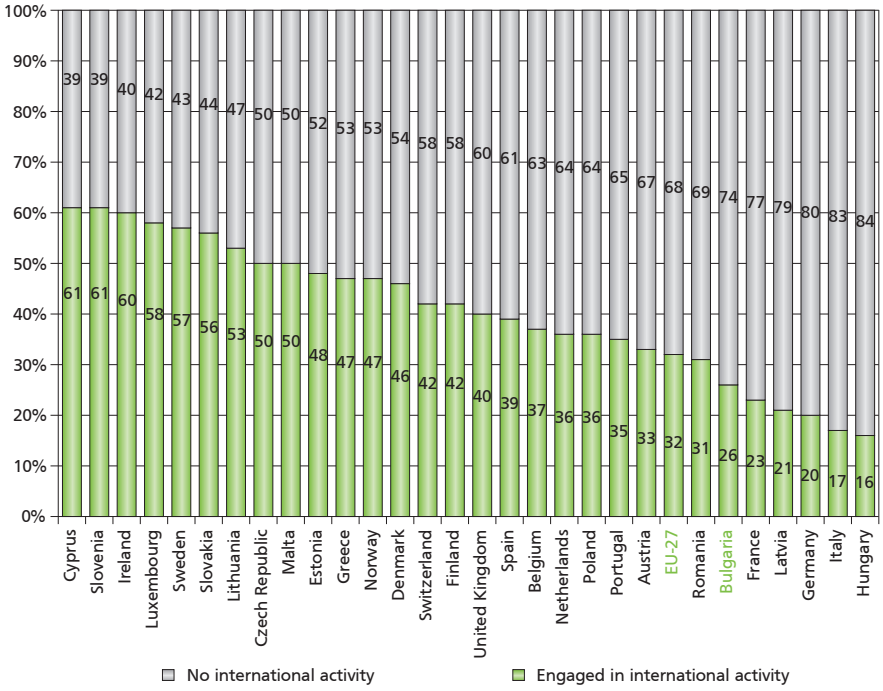
Many of the small open economies in the EU maintain intensive international cooperation in the field of innovation. Slovenia and Cyprus are leaders in this respect (with 61 % each), as well as Ireland (60 %) and Luxembourg (58 %). Three-quarters of the companies with international activities in support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

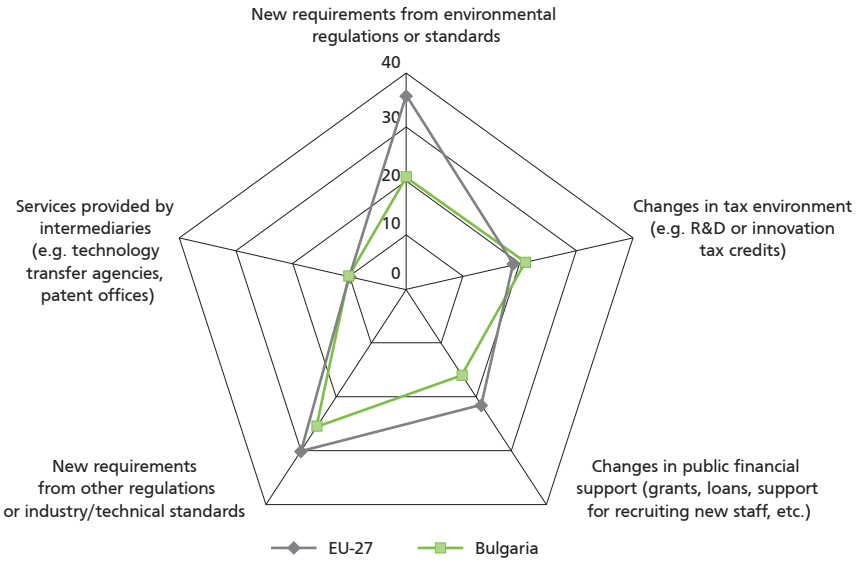
Innovation-supporting environment

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.

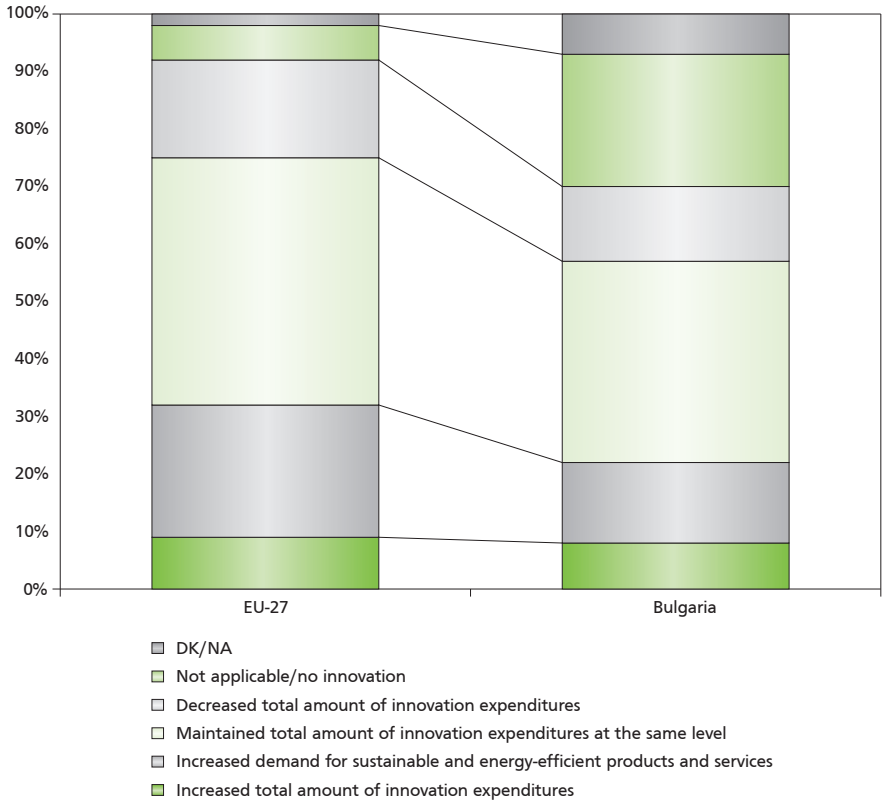
According to Innobarometer 2009, one-third of EU enterprises have increased their innovation expenditure in the last three years, with only 12 % of these expecting this trend to continue. About 28 % of the managers plan to reduce investments in innovation projects. In spite of that, most of the enterprises 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.

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

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).

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.

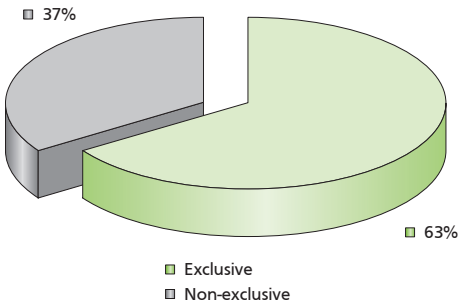
Most of the patented inventions are licensed individually and about 2/3 of the inventions filed for patenting – in a package. The explanation probably lies in the greater risk in the case of the filed applications inasmuch as the exclusive right (and respectively monopoly utilization) is not yet a fact. **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.

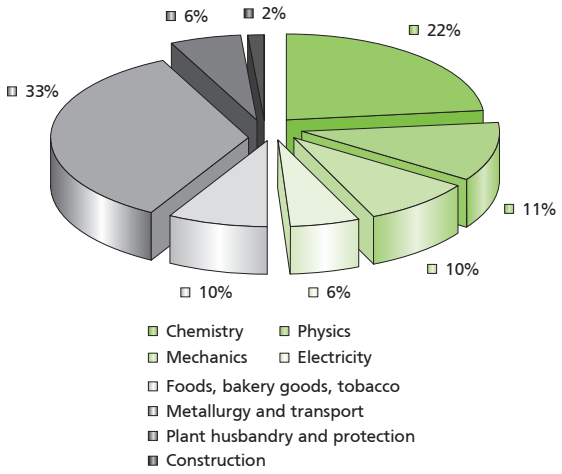
In respect to the technological fields in which the inventions are licensed,

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

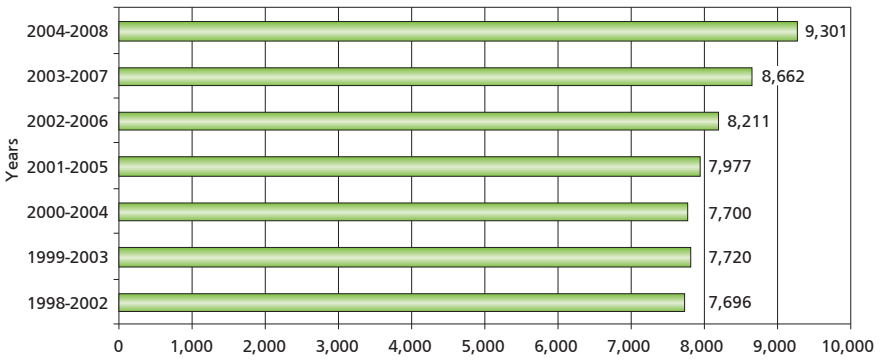
An important precondition for enhancing the country's innovation activity is the new knowledge created by its scientific organizations and scientists. An analysis of the dynamics and structure of this process reveals Bulgaria's potential to enter international research networks, its relative advantages 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.

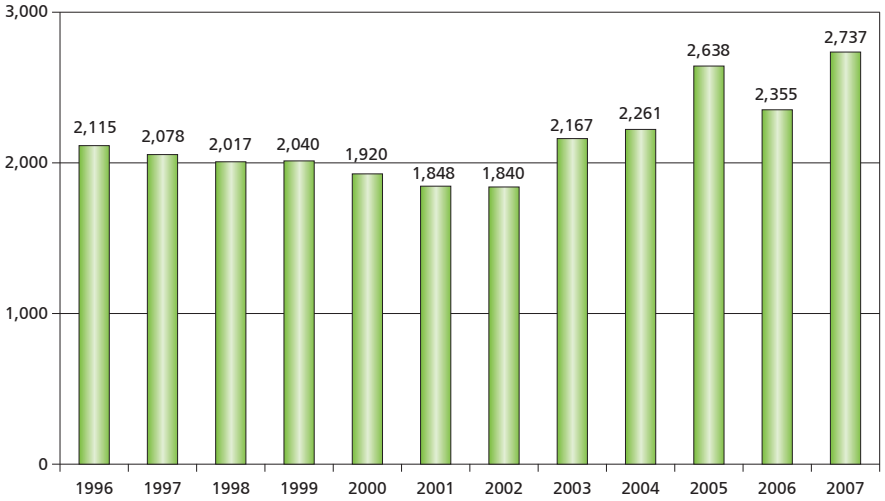
In absolute numbers, articles for the 2004 – 2008 period increased by nearly 1,600, the highest growth being observed in the field of chemistry (306), clinical medicine (240), earth sciences (147), physics (106) and computer sciences (105).

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.

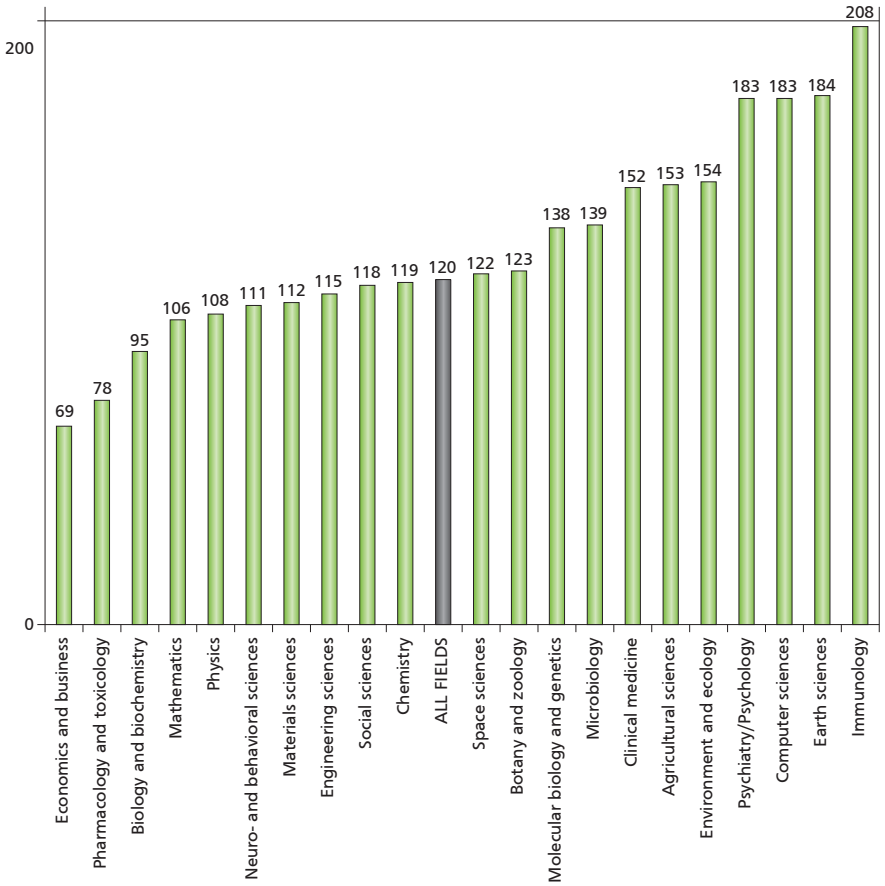
For the period under review, in terms of number of referenced articles reflected in Essential Science Indicators Bulgaria features in the first half of the ranking of countries worldwide in the following eight fields:

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.

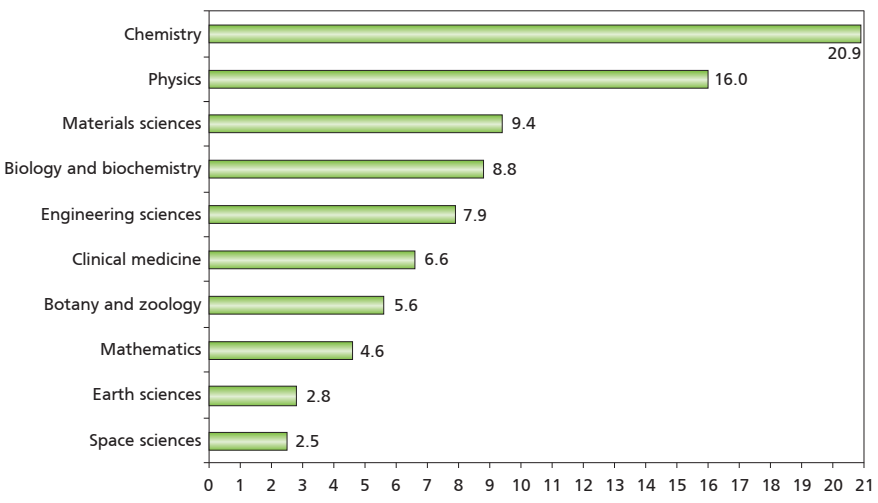
At the end of 2008, there were 73 articles with Bulgarian participation in the "New Hot Papers" and by the beginning of August their number reached 81. They are distributed in 14 of the 22 monitored scientific fields, the largest number of such articles being in the field of physics (23), clinical medicine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

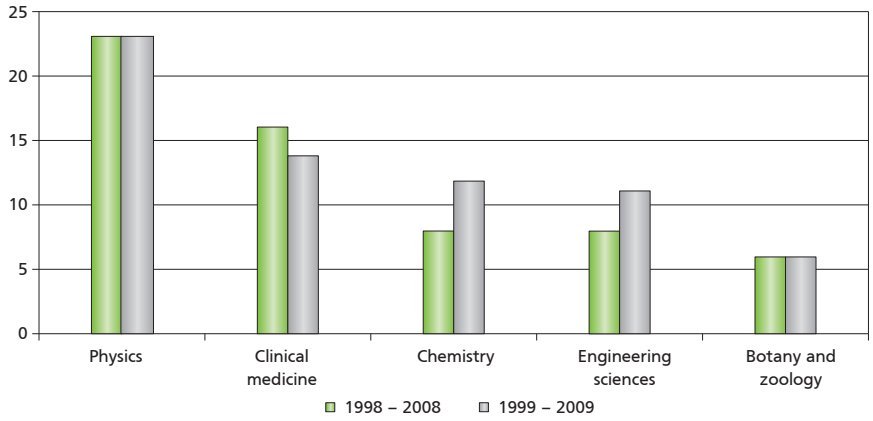
The list of most quoted articles has seen a reduction of those produced exclusively by Bulgarian scientists (from 17.8 % to 12.3 %). These are a total of 10 articles in the fields of: engineering sciences, chemistry, botany and zoology, earth sciences, pharmacology and toxicology, materials sciences. 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.