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Innovation Powered by Talent

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This report is published with financial support from the European Commission through its Representation in Bulgaria. The present publication reflects only the views of its authors and the European Commission is not liable for any use that may be made of the information contained therein.

DESIGN
FOR
EUROPE

ISSN: 1313-1060

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Applied Research and Communications Fund 2016
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ISBN: 978-92-79-63977-7

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LIST OF ABBREVIATIONS

AA	– Agricultural Academy
ARC Fund	– Applied Research and Communications Fund
BACA	– Bulgarian Association of Communication Agencies
BAS	– Bulgarian Academy of Sciences
BGN	– Bulgarian levs
BSMEPA	– Bulgarian Small and Medium Enterprises Promotion Agency
CEECA	– Central and Eastern Europe and Central Asia
CRM	– Customer relationship management
EC	– European Commission
EIS	– European Innovation Scoreboard
EPO	– European Paten Office
ERP	– Enterprise Resource Planning
EU	– European Union
GEM	– Global Entrepreneurship Monitor
GDP	– Gross Domestic Product
HS	– Higher School
IAB	– Interactive Advertising Bureau
IICT	– Institute of Information and Communication Technologies
ICT	– Information and communication technologies
IMD	– International Institute for Management Development
IPC	– International Patent Classification
IT	– Information technologies
LAN	– local area network
MES	– Ministry of Education and Science
NACE	– Statistical Classification of Economic Activities in the European Community
NSI	– National Statistical Institute
NUTS	– Nomenclature des unités territoriales statistiques
OP	– Operational Programme
PORB	– Patent Office of the Republic of Bulgaria
R&D	– Research and development
RFID	– radio frequency identification
SMEs	– Small and medium-sized enterprises
TRL	– technological readiness level
UK	– United Kingdom
USA	– United States of America
USPTO	– US Patent and Trademark Office

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EXECUTIVE SUMMARY

Six years after the launch of the **Europe 2020 Strategy** of the European Commission in June 2010 and in the middle of its implementation, contradictory results have been achieved both at European and national levels: faster developments against climate change, tentative progress in education and **a pronounced slowdown in employment and investment in research**.[1]

In the remaining four years until 2020 the country has to double R&D expenditure as a share of GDP in order to achieve its goal of 1.5 %. Similar goals and achieved results have Greece (achieved 70 % from the target 1.2 %), Croatia (56 % of the 1.4 % target), Latvia (46 % of the 1.5 % target) and Slovakia (74 % of the 1.2 % target). Romania has the largest gap, reporting only 0.38 % costs for R&D as a share of GDP against the ambitious goal of 2 %.

The 2016 National Reform Programme[2] for Bulgaria provides for the following measures to overcome the delay in achieving the national target for R&D:

- preparation of amendments to the Promotion of Research Act, aiming to improve the functionalities of the **Register of Scientific Activities**;
- implementation of a **policy of open access to scientific results**;
- improving the management and **funding of research** based on scientific results;
- establishing an **Agency for Research Promotion**;
- use of **financial engineering** and ethical rules.

Although the planned measures were adopted at the end of 2015, neither of them has been included in the 2016 agenda of Bulgarian institutions, including MES:

- the policy of open access to scientific results **fully closed the access of the research community in the country to the results of the global research community**;

[1] Eurostat (2016) *Smarter, greener, more inclusive? Indicators to support the Europe 2020 strategy*, http://ec.europa.eu/eurostat/web/products-statistical-books/-/KS-EZ-16-001

[2] Ministry of Finance (2016) *National Reform Programme of the Republic of Bulgaria in implementation of the Europe 2020 strategy. Update 2016*, Sofia, http://ec.europa.eu/europe2020/pdf/csr2016/nrp2016_bulgaria_en.pdf

- improving the funding of research led to **what is expected to be a de facto reduction of public support** for public institutions in this field;[3]
- the ethical rules in science **are still compromised by financial engineering and benefit corruption practices** and patronage.

In addition, the above-mentioned Agency for Research Promotion,[4] together with the declared intentions of the Ministry of the Economy for combining BSMEPA (which administers the National Innovation Fund) and the Invest Bulgaria Agency into a brand new structure titled Economic Growth Agency,[5] are evidence of an even further **disconnect of the centres of responsibility and design of policies in the otherwise connected and converging fields of science, education, technology and innovation**.

The lack of substantiated and consistently implemented policies in these fields, which should equally engage the public and private sectors, causes pronounced imbalances and fluctuations of the indicators of innovation potential, thereby leading to the unenviable positions of the country in the comparative analysis of European countries.

According to the methodology of the Global Innovation Index, **Bulgaria's advantages are mainly associated with results from low technological intensity innovation**, which is also a finding of the Innovation Union Scoreboard ranking:

- patent activity

Patent activity of Bulgarian patent holders remains at very low levels. The highest drop (43 %) occurred in 2015, when the Patent Office registered merely 34 patents of Bulgarian patent holders.[6] Over the last 15 years, the higher education sector has had 24 patents. There are eight (out of 51) higher schools with patent activity.

- publication activity

Bulgarian scientists are performing best in the fields of physics and astronomy, medicine, materials science, chemistry, biochemistry, genetics and biology. However, the analysis of the dynamics shows that **in the recent years the performance is weaker in terms of number of articles and share in publication activity for each of the thematic areas** within EU-28 and the region of Eastern Europe.

[3] МОН, Проект на национална стратегия за развитие на научните изследвания 2025, http://www.mon.bg/?go=page&pageId=381&subpageId=63#science

[4] Also referred to as Agency for Scientific Research Finance, which is to established after restructuring the National Science Fund. See further MES (2016) *Better Science for a Better Bulgaria 2025: A Vision for a research policy strategy in support of society and economy*, National Strategy for Research Development in the Republic of Bulgaria 2016 – 2025 and Operational Implementation Plan, https://era.gv.at/object/document/2763/attach/BG_Better_ScienceBetter-final_en.pdf

[5] Министерство на икономиката (2016) Проект на Закон за иновациите, http://www.mi.government.bg/bg/discussion-news/zakon-za-inovaciite-2586-m0-a0-1.html

[6] And in 2016 the certificates of useful models will be the highest achievement of innovation activity in Bulgaria. In November 2016, the deputy minister of economy Lyuben Petrov presented the award Innovative Firm 2016 at the ceremony Inventor of the Year 2016. Two companies received the awards: EL Stomana, which in the last three years has filed three applications for registration of useful models, and Atra Export, which was awarded for its seven useful models for LED lighting fittings for street lighting, searchlights, etc. There are no patents for inventions.

- entrepreneurial activity

Bulgaria has the lowest entrepreneurship activity in Europe, which places it at the bottom of the global ranking, too. A comparatively strong driving force for entrepreneurship in the country is necessity (individuals reckoning that there are no other alternatives for employment) which determines a low level of motivational index. The lack of entrepreneurial culture and insufficient readiness for successful start-up of a new business venture at the entry of the entrepreneurship system compromises the positive impact of entrepreneurship on the economic and social development.

- financial resources for innovation

The upward trend in R&D expenditures continued in 2015, both in absolute terms and as a percentage of GDP (by some 30 % from the previous year). Two factors contributed to this: a) **a high level of foreign investments in innovation projects**, including European structured finance allocated directly through the European framework programmes for applied research and development, and indirectly, through the national operational programmes, as well as foreign direct investment in research projects and subsidiaries of foreign companies based in the country; b) a **doubling on the previous year of the funds allocated by enterprises for research and development**. For a sixth consecutive year **the share of public expenditure for R&D decreased**.

- human capital for innovation

The number of researchers rose for another year. Nevertheless, **the country holds one of the last places in EU-28 by the share of researchers in the working age population** – merely 0.48 % in 2013, against an average level for EU-28 of 1.12 %. Innovation leaders in Europe have much more human resources (around and over 2 % of the working age population) engaged in basic and applied research, hence their results constitute a sound basis for further application in practice in the form of product or process innovations. **After 2000, the public sector is the only sector that has been constantly reducing its staff engaged in R&D**.

According to Eurostat data for 2014, the share of graduates in scientific and technological fields of education in Bulgaria amounted to 13.9‰ of the population aged 20-29, versus the EU-28 average of 18.7‰ and is far below the levels of the innovation leader countries. In addition, improvement of the country's positions as regards PhD graduates is necessary.

Over the last 5 years, the admission of mobile students in Bulgaria rose by 15 %. At the same time, **after 2010 the number of students studying at higher schools in the country decreased** – by 9 % for the last academic year, and by 12 % for the whole five-year period. **The adverse effects of the demographic crisis and the continuous brain drain of students studying abroad persisted** in higher education, and hence in the labour market.

The **low rates of participation of adults in lifelong learning** are a worrying trend**.** With a 2 percentage involvement of adults in training programmes, Bulgaria is dwarfed by the innovation leaders in Europe (with over 30 % participation) and almost all European countries. There seem to be no long-term prospects of efforts to bridge the gap.

- information and communication technologies

The ICT sector and its closely related economic activities show a steady long-term growth. The share of revenues of ICT companies as part of total corporate revenues rose from 4 % in 2005 to 6 % in 2014, and the growth in related sectors was from 5 % to 7.3 % respectively. Revenues of the IT sector (NACE 62 and 63) grew by 370 %, compared to a total growth by 50 % of all revenues for the whole economy. The development of e-business in Bulgaria is closely related to the overall development of the Bulgarian ICT sector. There are a number of interactions between the two areas: recently, development of technologies – particularly cloud technologies – have enabled SMEs to address the challenges of managing ICT infrastructure, platforms and services without specialised ICT staff.

Given the unenviable positions of the country on a number of indicators of innovation potential, **the claims of a successful implementation** of the government Programme on Sustainable Development of the Republic of Bulgaria 2014 – 2018[7] do not appear credible.

In Bulgaria, deadlock and failure to act hold back development. Unlike previous years, Bulgaria is the only EU member state which achieved growth based on higher efficiency of the economy. The remaining 21 European economies demonstrate innovation-based growth – innovation potential, quality of research infrastructure, R&D spending, innovation interaction, pre-sale public procurement, number of scientists and engineers, patent activity. The recipes for growth are well known and have been proved in the practice of a number of countries, but the will and capacity to apply them in Bulgaria are still absent.

The new challenges are in fact the well-known ones, which were not addressed for various reasons (lack of understanding and vision, finding excuses instead of taking action). As a result, **they have turned into urgent problems that require more resources for tackling them.**

[7] Отчет на Министерство на икономиката за изпълнение на Програмата на правителството за стабилно развитие на Република България 2014 – 2018 г. (към 07.11.2016 г.). http://www.mi.government.bg/files/useruploads/files/vop/otchet_pravitelstvo_11.2016.pdf

INTRODUCTION

Data about 2015 show that despite various limiting factors **Bulgaria has the potential for positive shifts.** The country reported **GDP growth of 3 %,** which – although being nearly ten times lower than, for example, the growth of the Irish economy (26.3 %)[8] – suggests that further sustainable growth can be expected.

Bulgaria has positioned itself as a leader in the Balkans in the ranking of the Boston Consulting Group on sustainable economic development and well-being based on a set of economic indicators (income, economic stability and employment); investment in education, healthcare and infrastructure, and sustainable development (social inclusion and environment).[9]

Although it is difficult to conceive of a sustainable trend toward change, the above examples **demonstrate some potential**. How this potential will be fulfilled depends on a number of factors.

The annual report ***Innovation.bg*** **provides a reliable assessment of the innovation potential of the Bulgarian economy** and of the status and potential for growth of the Bulgarian innovation system. It makes recommendations for improving the public policies for innovation in Bulgaria and in the EU, building on the most recent theoretical and empirical studies in the world and taking into account the specific economic, political, cultural and institutional framework in which the country's innovation system operates. Over the past 12 years, *Innovation.bg* has made a number of specific proposals for improving the country's innovation policy and practice, which have been supported by business and academia. The lack of specific and sustainable actions by Bulgarian governments on the proposals made – despite their commitment to the process at the

[8] http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tec00115&plugin=1

[9] Boston Consulting Group (2016) *The Private-Sector Opportunity to Improve Well-Being. The 2016 sustainable economic development assessment*, Available at: https://www.bcgperspectives.com/Images/BCG-The-Private-Sector-Opportunity-to-Improve-Well-Being-Jul-2016.pdf

highest political level – reveals a **serious institutional deficit in development and application of relevant policies in the field.**

Innovation.bg 2016 analyses the status and potential for growth of the national innovation system based on five groups of indicators:

- aggregate innovation product;
- entrepreneurship and innovation networks;
- investment and financing for innovations;
- human capital for innovation;
- information and communication technologies.

Innovation.bg changes existing perceptions of the standard system of indicators of innovation measurement. In turn, the shift of focus towards sectoral innovation systems and value added chains is more closely associated with the open innovation concept.

In the focus of *Innovation.bg 2016* are the country's talents and the potential to identify, develop and attract talents; the potential to manage them appropriately and to develop national and regional competences on that basis. Innovation is a function of creativity, out-of-the-box thinking, imagination, passion and perseverance of people who have the potential to generate ideas and have the knowledge to convert them into successful new products and business models.

Talent Policy of the European Union and Bulgaria

Talent in the 21st century economy

It has become abundantly evident by now that any future growth and prosperity could only come from innovation, and that applies to developed and developing economies alike. While this has been almost universally acknowledged, how to steer the shift to economies driven by knowledge and innovation is less clear. One factor for that transition that is being increasingly appreciated is talent.

The current understanding of the concept of *talent* – including the one adopted by this report – breaks with its traditional meaning which referred to exceptional individuals of extraordinary aptitude, mostly in the sciences and the arts. Rather, by wide acknowledgement its current use in political and economic discourse has been mostly influenced by a seminal study by McKinsey & Company in the 1990s, resulting in their 2001 book "The War for Talent."[10] Although not a strictly defined term, it covers mostly the segment of the workforce of a company or a country with highly developed managerial, scientific, technical, entrepreneurial skills. It thus relates to the notions of educational achievement, knowledge economy and knowledge worker, innovation and technology development.

Policy makers and analysts have since scrambled to highlight the significance of talent for individual businesses and whole economies – it has been called "the world's ultimate capital asset," "the new oil," "21st century wealth," "a special kind of natural resource." In business, its role as a critical driver of corporate performance is evident in the increasing share of knowledge-intensive activities – intangible assets, for example, of which talent is a primary component, now make up to 84 % of the value of the S&P 500 companies.[11] The increased

[10] Michaels, E., Handfield-Jones, H. and Axelrod. B. 2001. *The War for Talent*, Harvard Business School Press: Boston.

[11] Ocean Tomo. March 5, 2015. 'Annual Study of Intangible Asset Market Value from Ocean Tomo, LLC.' *News release.*

importance attributed to talent by both national governments and private corporations has arisen from two sets of considerations – the quest for competitive advantages and the requirements of innovation-driven growth. Consequently, these prompt two different strategies – competing for it ("race for talent," "talent poaching") and supporting its development. The two approaches can be optional and complementary – companies and countries can find it advantageous to procure talent rather than invest in its development or can combine talent attraction with talent promotion.

The former strategy has been, however, much more popular among managers and politicians – they have preferred policies that that cope with the scarcity[12] of talent over those which expand its pool. Advanced economies battle with each other for new sources of talent from emerging economies. One reason is that the "differentiation and affirmation" (McKinsey's term) required for grooming internal talent is fraught with uncertainties – identifying those with the best potential is not an exact science, while the promotion of the best performers needs to be counterbalanced with equally supportive measures for the rest of the workforce. Many, therefore, find it easier to provide incentives to entice outside skilled workers than invest in the development of their own.

Talent has, furthermore, contradictory effects – while it gives birth to ideas, solutions, inventions, it is also disruptive of established truths and hierarchies; it is the primary agent of the proverbial "creative destruction." Its promotion may also have adverse social effects because "while maximising the talents of the whole population matters more than ever in creating economic and social success, the danger is that skills formation becomes a source of greater polarisation rather than an antidote to it."[13]

Thus, managing its power of innovation for desirable social and economic goals requires that corporate and national policies are based on adequate understanding of its drivers and its effects. At the national level, policy makers need to distinguish and balance the interests of individual businesses and the needs of the economy and broader society. Greater government effort and money to promote the incorporation of creativity and innovation at all levels of education and training should be matched by incentives for individuals and corporations to spend time and money taking up learning opportunities.

At the EU level, however, things are a bit more complicated. Although the competitiveness and innovation implications of talent are well appreciated and member states are expected to share goals in terms of competitiveness, most talent promotion policies fall outside the Union's core competences. One aspect of it, though, is relevant to a policy area of increasing significance for the Union – migration. EU level measures in this area are fairly recent and led to the adoption of the so called Blue Card – a measure allowing high-skilled non-EU citizens to work and live in most member states.[14] The Directive (2009/50/EC) was intended to make the admission and mobility of highly-qualified third-country nationals easier in order to make the Union more attractive and boost its competitiveness and economic growth. It is, of course, far from being a common policy – the EU Blue Card Directive states that it is to be without prejudice to the right of the member states to determine the volumes of admission

[12] Here, the risk of taking the "resource" metaphor too far is evident – governments and companies are driven into a zero-sum mentality, competing for a share of a supposedly finite good (as resources are supposed to be).

[13] Knell, J., Oakley, K. and O'Leary, D. 2007. *Confronting the Skills Paradox*. Demos, p. 4.

[14] Save for Denmark, Ireland and the United Kingdom.

of third-country nationals entering their territory for the purposes of highly qualified employment. Indicative of the initial lack of enthusiasm among the countries is the fact that few member states had transposed it into national law within the two year deadline in 2011. Although by 2016 all have done so, the reality in the member states is still one of "fragmented and complex landscape of many different regimes for admitting highly qualified third-country nationals."[15] As a result, the effect of the policy has been limited – by 2015, of the total pool of highly-educated third-country migrants residing in EU and OECD countries, the EU hosted one-third (33 %), while more than half (57 %) were in North America.[16]

More generally with respect to talent development, there has been the odd initiative – a 2008 EU Council conclusions on promoting creativity and innovation through education and training or a short European Parliament declaration on the support of talents in the European Union – but these have been conspicuous in their isolation.

In Bulgaria, governments have pursued neither policies of attraction, nor of development of talent. In education, there has been the effect of the encouragement – although never explicit – of selective schooling, mostly by allowing foreign language high schools to become disproportionately more competitive than other public schools. Tournaments in various school subjects – known as "olympiads" – which allow talented students to reveal their potential have been quite popular but there has been no visible effort by business to reach out to that pool.

This absence of policies promoting domestic talent is all the more inexcusable given that the country is hardly a talent magnet. It has little to offer high end knowledge workers – it is among the lowest income countries in Europe, the labour market is not particularly flexible, the lead times for company development are long, IP rights are hardly respected; its overall ability ecosystem is rudimentary.

Bulgarian business seems to appreciate the significance of talent: in a corporate survey, the consideration "Discovering talents" scored highest (51 %) among the priorities for remaining competitive and on the market.[17]

Given the growing global preoccupation with talent, it is hardly surprising that there have emerged a number of measurement models seeking to capture its dynamics. Most of the "talent indexes" rank countries according to a set of indicators. The range of these indicators, however, is often based on such an expanded notion of talent as to make it synonymous with "the entire workforce, a definition so broad as to be meaningless."[18]

A much more policy oriented approach to assessing the potential of a country to attract and promote talent needs to focus on a limited range of intended effects. One of these effects is innovation, especially as it affects and is produced by the private sector.

[15] European Commission. 2015. 'Inception Impact Assessment. Review of Directive 2009/50/EC of 25 May 2009 on the conditions of entry and residence of third-country nationals for the purposes of highly qualified employment, p. 3.

[16] OECD. 2016. *Recruiting Immigrant Workers: Europe*. OECD/European Union, p. 97.

[17] Stanton Chase Bulgaria. 2015. *CEO Survey* 2015, p. 4.

[18] *The Economist*. 5 October 2006. "A survey of talent: The battle for brainpower".

Assessing the talent component of innovation

The processes of globalisation (taking global actions to solve local problems, and vice versa – increased attention to the local, the niche), increasing mobility (overcoming physical borders) and unprecedented technological advance (overcoming technological barriers) will benefit only the countries that are aware of their impact and that have a vision on the direction of their policies towards long-term prosperity. The countries which lack awareness of this play a catch-up game, as they can only react, most often inadequately and with delay, to the new opportunities and threats. Global practice has proved that the real values of the indicators of physical scale (territory, population, natural resources) are not decisive for the levels of economic welfare and quality of life indicators.

Growth factors are increasingly changing, not randomly, however, but in a foreseeable manner. If until now the goal was to gain unique advantages based on innovation, **the pursuit of higher competitiveness** (both for countries and businesses**) has already been displaced by a search for talents, people with knowledge, competences and skills, who are the core of innovation** and generate creative solutions to address practical problems or even eliminate them.

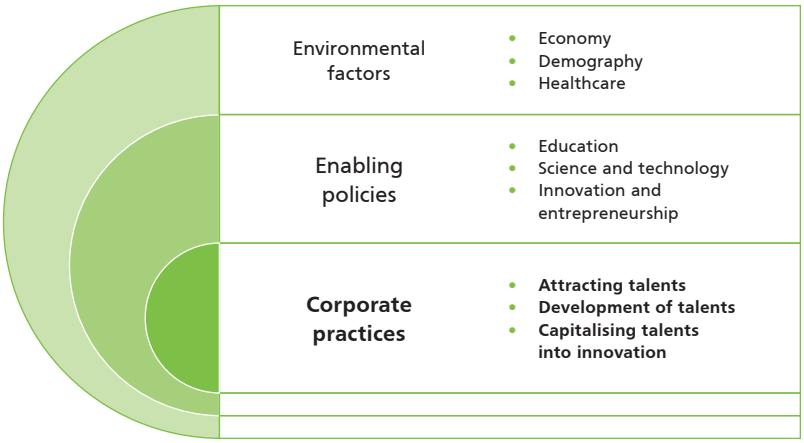
The "talent" challenge is the phenomenon of our time that needs to be addressed at various levels: in social groups, companies, national economies. However, in the conditions of relatively closed and detached national innovation ecosystems – in the framework of which processes are developing on the principle of communicating vessels – it is always better if pillars of the system interact and are mutually supportive instead of becoming barriers or obstacles to the activities of the other participants in the innovation process, or to the development of the system as a whole.

In this sense, when the goal is to create environment which is favourable to talent growth and within the framework of which talents are then motivated to remain and develop, many divergent and interlinked factors need to be made the subject of a targeted and sustainable policy. The policy should focus both on well-developed pillars of the system, which can provide for achieving excellence in one field or another, but also on the periphery and its less developed units, so as to maintain high standards and a reservoir for intellectual capital reproduction.

The policy model will encompass factors which:

- have an indirect impact and create the general conditions for growing, attracting and development of talents;
- enable economic agents to make use of such conditions or, conversely, turn them into an asset that remains unused or is used in the framework of another system;
- and factors internal for businesses, which allow them to make talents the driving force in the innovation process.

Figure 1. A MODEL OF PROMOTING INNOVATION-ORIENTED TALENT-BASED BUSINESS BEHAVIOUR



Source: Applied Research and Communications Fund.

1. Environmental factors

The **first group of factors is labelled "environmental"** and **they include indicators of the status of the economy, demography and healthcare. High levels of these free the individuals from the burden of survival and enable them to fully develop their creativity.**

1.1. Economy

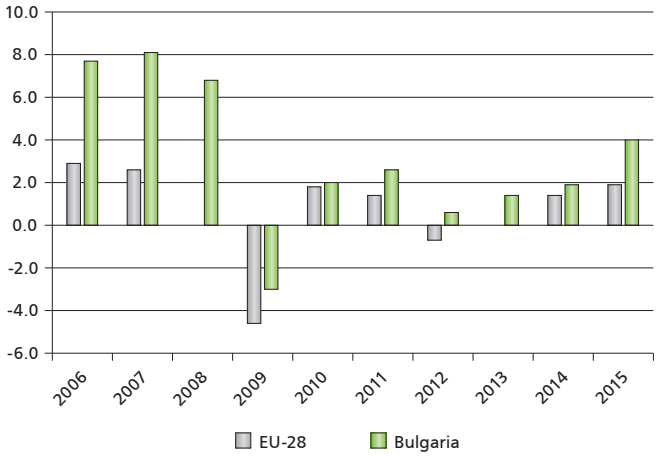
GDP per capita, 2015 (Eurostat)	GDP growth per capita since 2010 (Eurostat)	Foreign direct investment, % of GDP, 2014 (NSI, Eurostat)	Foreign trade (imports+ exports), % of GDP, 2015 (NSI)	Quality of life, 2016 (IMD)
6,300 EUR	21 %	50 %	60 %	4.00 (55th place out of 61)

The economy of **Bulgaria is still recovering from the adverse effects of the economic crisis**. The process is slow and is **influenced by various growth factors**. There are positive trends in terms of business activity, domestic consumption, foreign trade balance, the capital structure of business and intercompany indebtedness (supported by the still cautious banking sector policies) but pre-crisis levels have not been reached yet.

Over the last ten years, **Bulgaria has had economic growth which was above the average EU levels** (66 % and second place after Slovakia). In addition, the country's share in the European economy has increased – by 50 % between 2006 and 2015. Together with Lithuania and Latvia, Bulgaria reported the best structural change on this indicator, against a 33 % fall in the share of the Greek economy and the decrease in countries like Portugal, Spain, France, Italy, the Netherlands.

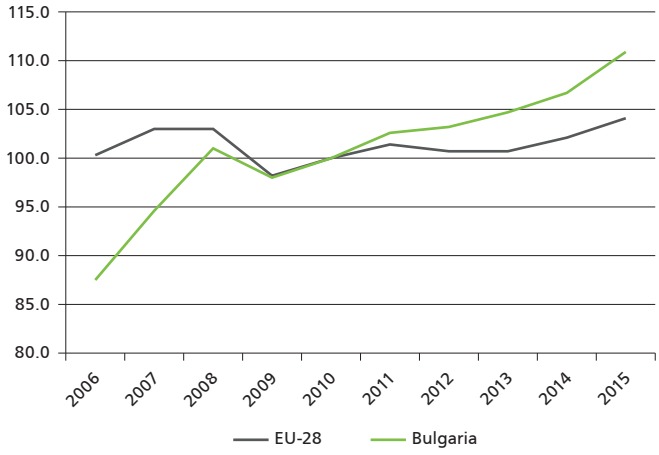
Despite this growth, however, **Bulgaria remained last in the European ranking with EUR 6,300 by the GDP per capita indicator** (the average EU-28 is EUR 28 800), which is decisive for the low comparative purchasing power of households.

Figure 2. ANNUAL GDP GROWTH PER CAPITA, %



Source: Eurostat, 2016.

Figure 3. GDP PER CAPITA, INDEX 2010 = 100



Source: Eurostat, 2016.

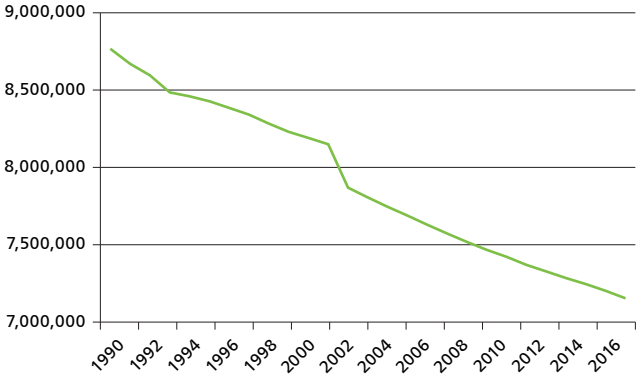
There was minimum growth in foreign direct investment (12 % between 2008 and 2014), accompanied by a decrease in its share (2 % for the same period) in GDP. **Bulgaria remains an open economy** (in terms of the share of foreign trade in GDP), strongly interlinked with the rest of the world and hence subject to global market trends. A major trading partner is the European Union (mainly Germany, Italy and Romania), which means a similar economic cycle and a risk of multiplying the adverse effects of market fluctuations. Outside the EU and in search of external markets for diversification the country maintains intensive trade with Turkey and China.

1.2. Demography

Population, 01.01.2016, number (NSI)	Natural growth, 2015 (NSI)	Migration balance, 2015 (NSI)	Working age population, 2015 (NSI)	Employees aged 15-64 (NSI)
7,153,784	-6.2‰	-0.1‰	4,693,792 (66 %)	2,973,500 (62.9 %)

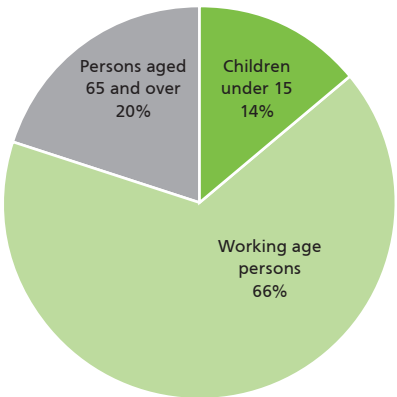
The demographic indicator levels are the general limiting factor determining the basis for creation of new talents and formation of the environment for their further development.

Figure 4. POPULATION AS OF 1 JANUARY, BULGARIA, 1990 – 2015, NUMBER



Source: Eurostat, 2016.

Figure 5. POPULATION STRUCTURE, BULGARIA, 2015, %

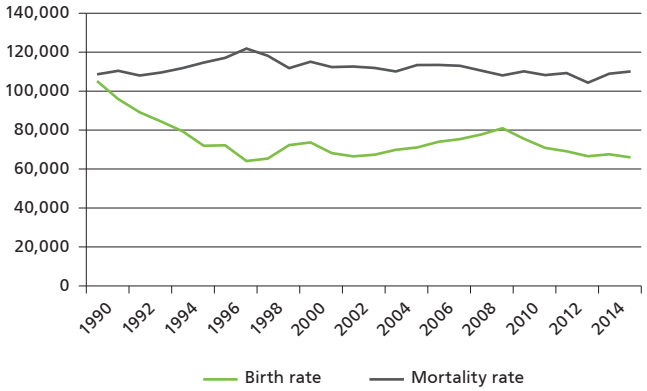


Source: NSI, 2016.

In the period 1990 – 2016, Bulgaria's population numbers have been continuously declining to reach a total fall of some 19 %. Though with some fluctuations over the past 26 years, the gap between birth rate and mortality rate has been widening and in 2016 the natural growth rate reached – 6.2‰ against a birth rate of 9.2‰ (average EU-28 for 2014 – 10.1‰), and a mortality rate of 15.3‰ (average EU-28 for 2014 – 9.7‰).

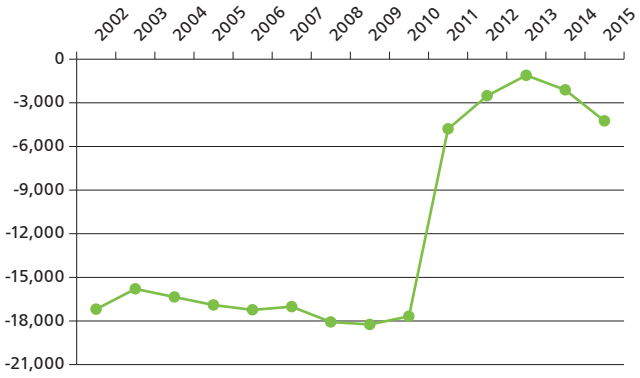
Within the EU, Ireland has the highest birth rate – 14.6‰, followed by France – 12.4‰ and the United Kingdom – 12.0‰, while Portugal has the lowest birth rate – 7.9‰. **Bulgaria has the highest level of general mortality in the EU and increasing population ageing** (including as a result of diseases curable by proper and timely prevention).

Figure 6. BIRTH AND MORTALITY RATES, BULGARIA, 1990 – 2015, NUMBER



Source: Eurostat, 2016.

Figure 7. NET MIGRATION, BULGARIA, 2002 – 2015, NUMBER



Source: Eurostat, 2016.

After the start of the economic crisis in 2008, the labour market contraction in West European countries resulted in a lower migration flow from Bulgaria. After 2013, however, the trend reversed and the number of economic migrants increased. The fastest increase (over 5 times compared with 2012) occurred in the 15-19 age group – the age at which most high school graduates decide whether to continue their education abroad.

At the beginning of 2016, **the general age dependency ratio was 52.4** %, or to any person in dependency ages (under 15 and over 65) corresponded fewer than two economically active age persons, marking **a serious deterioration for the past ten-year period** (44.5 % in 2005).

In 2015, the employment rate of the labour force was 62.9 %. For the period after 2003 its values were higher (64 %) only in the pre-crisis 2008.

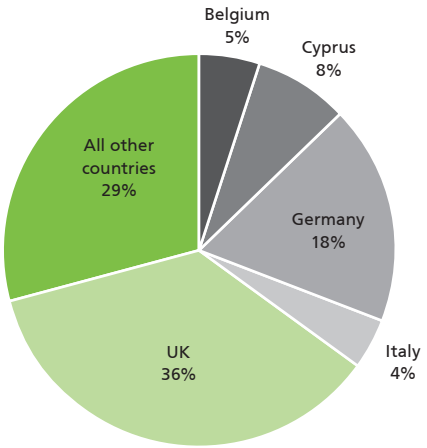
After 26 years of democratic changes **Bulgaria is still a donor to Europe and worldwide in terms of highly qualified staff.** The migration channels are changing over time, but the dramatically increasing adverse effect on the competitiveness of the national economy persists.

According to official EC data[19] for regulated professions, in the period 2007 – 2015 a total of 7,948 professionals who had obtained their education in Bul-

[19] The EU Single Market, Regulated professions database, http://ec.europa.eu/growth/tools-databases/regprof/index.cfm

garia sought recognition of their professional qualification in search of permanent jobs in another European country. Their number before the country' full membership was 95. The main migration flow is directed towards the United Kingdom and the labour markets of Germany, Cyprus, Italy and Belgium are also of interest to migrants.

Figure 8. TOP 5 COUNTRIES TO WHICH PROFESSIONALS HAVING OBTAINED EDUCATION IN BULGARIA MIGRATE, 2007 – 2015



Source: EC database of regulated professions.[20]

Medicine is one of the fields in which Bulgaria has good positions in terms of publication and patent activity, and the healthy life industry is one of the priorities of the Innovation Strategy for Smart Specialisation. However, most of the intellectual capital in this field in the country outflows to other European countries. **The professions with reported highest mobility from Bulgaria to the rest of EU member states since 2007 are in the field of medicine (over 87 %, 6,950 persons)**, including doctors (2,797), nurses (2,091), dentists (744), psychotherapists (358), midwives (182), veterinarians (178), pharmacists (156) and other professionals from the same field (444).

Such a decision seems substantiated against the background of Bulgaria's lagging behind in respect of a number of fair living standard indicators, including the minimum wage. The minimum monthly pay of EUR 214.75 for the second half of 2016[21] ranks Bulgaria last within the EU, and also after Serbia, Macedonia and Montenegro. Only Albania reports a lower level of that indicator.

1.3. Healthcare

Healthcare costs, % of GDP, 2013 (NSI)	Public spending for healthcare, % of all costs, 2013 (NSI)	Health infrastructure, 2016 (IMD)
7.6 %	59.3 %	3.13 (out of 10)

Healthcare is one of the social systems in Bulgaria that has been subject to a series of reforms, which failed to ensure high efficiency of public spending and desirable value added to end users. Although in terms of healthcare

[20] http://ec.europa.eu/internal_market/qualifications/regprof/index.cfm?action=homepage

[21] http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=earn_mw_cur&lang=en

costs as a share of GDP the country holds a middle position in the ranking of European countries, Bulgaria holds the last position in terms of the following indicators:

- per capita healthcare expenditure – USD 583 in 2013. Within EU, only Romania has a lower result of USD 508. Norway holds leading positions on the old continent with USD 9,849, and also remarkable for us is the amount of USD 2,130 in Slovenia.
- public spending for healthcare as a share in total spending – 59.3 %, which is definitely the lowest level for Europe against 85.5 % in Norway (again ranking first) and the very close values of 83.3 % in the Czech Republic, which is leading among the new member states.

The adverse impact of a series of factors – short-sighted reforms, insufficient funding of health services, inefficient spending of public resources, outflow of most highly qualified medical specialists from the country – creates an environment for high general mortality rate of the population in Bulgaria, which has the lowest spending power in Europe and is one of the unhappiest in the world (index of 109 from among 140 countries).[22]

2. Enabling policies

The second group of factors – enabling policies – have a direct impact on converting demography into human capital and include investments (not only financial) in education, science and technologies, innovation and entrepreneurship. The development of these areas creates favourable environment in which talents can thrive. Although the process is slow and needs patience and time, the outcomes pay off.

2.1. Education

Expenditure on education, % of GDP, 2013 (NSI)	Net enrolment ratios, %, 2015/16, secondary education	Graduates in technical and natural sciences, %, 2015 (NSI)	Key digital skills/ use of internet %, 2015 (Eurostat)	Participation in lifelong training, 2014 (Eurostat)
4.52	81.5	20	31/55	1.8 % (EU-28 10.7 %)

Education is an integrated system which models various aspects of available human resources, thereby affecting the state of the economy and the quality of life in general. The analysis of the correlation between the educational degree obtained and the "employment level-incomes-quality of life-sense of satisfaction and happiness" chain shows that the mechanisms for effective elimination of poverty and the low standard of living should be sought only in the area of education policies.[23] Otherwise, social policies aimed at raising income levels and increase social inclusion are doomed to failure.

Like healthcare, education in Bulgaria is a **complex and socially sensitive system with manifold implications,** which similarly **fell victim to diverging and inadequate interventions** (called reforms), the results of which do not leave much room for optimism.

[22] The Happy Planet Index 2016, A global index of sustainable wellbeing, http://happyplanetindex.org/

[23] Институт за пазарна икономика (2016) *Разрези на бедността: Образованието и заетостта като фактори за кривата на доходите и щастието в България*, http://ime.bg/var/images/PovertyBG_IME16.pdf

- **The number of persons enrolled in the education system decreases** (in dynamics and by next educational degree).

The small growth in the number of students up to 4th grade cannot offset the drop in the next two stages: up to 8th grade (a 2 % drop) and up to 13th grade (a 12 % drop). In the 2015/2016 school year the number of children leaving the education system increased by 8 % compared with the 2009/2010 school year. The main factors for this are "going abroad" (with decreasing importance for each next educational degree) and "family reasons".

- **Higher education at any cost**

The ratio of enrolled higher education students rose from 35.4 % to 40 % among those aged 19-23. The country is about to meet the targets of Strategy Bulgaria 2010 by this indicator. At the same time, the country ranks among the first in Europe by number of employees with completed higher education employed in a job that does not require such qualification.

- **The gap between the acquired knowledge and the portfolio of skills and competences needed for successful employment on the labour market widened**.

In 2016, the assessment of businesses in Bulgaria about the extent to which the education system as a whole and university education in particular meet the needs of the competitive environment was lowest in the survey of IMD[24] – 58th and 61st positions respectively among 61 countries.

Nevertheless, **most adults in the country do not feel a need to update the knowledge acquired during their formal education**, nor do they believe they need to obtain new skills and competences to match modern trends in the development of the economy and technologies and in line with the changing requirements of the labour market (see further the Human Capital for Innovation section below).

Furthermore, **only 31 % of the population has basic digital skills** compared to 55 % on average in EU-28. According to Eurostat data, in 2015 the share of regular users of internet in Bulgaria was at the lowest levels in the EU (55 % versus 76 % in EU 28), and **over one third of the population has never used internet** (compared to 16 % on average for EU-28). Given the widening scope of e-government and digitalisation of a greater number of business services, this type of self-restriction is becoming a serious limiting factor for professional and personal accomplishment.

- **Growing regional imbalances**

The downward spiral in which the low economic performance of a given region of the country (Silistra, Montana, Razgrad, Sliven)[25] causes deteriorating problems in the education system (a high share of dropouts, weak performance at school leaving examinations, insufficient number of teachers, lack of qualified staff), in turn exacerbates the adverse effects on the business environment and limits further the potential for growth.

[24] IMD World Competitiveness Yearbook 2016.

[25] Regional profiles. Indicators of Development 2015, Institute of Market Economy, http://www.regionalprofiles.bg/en/

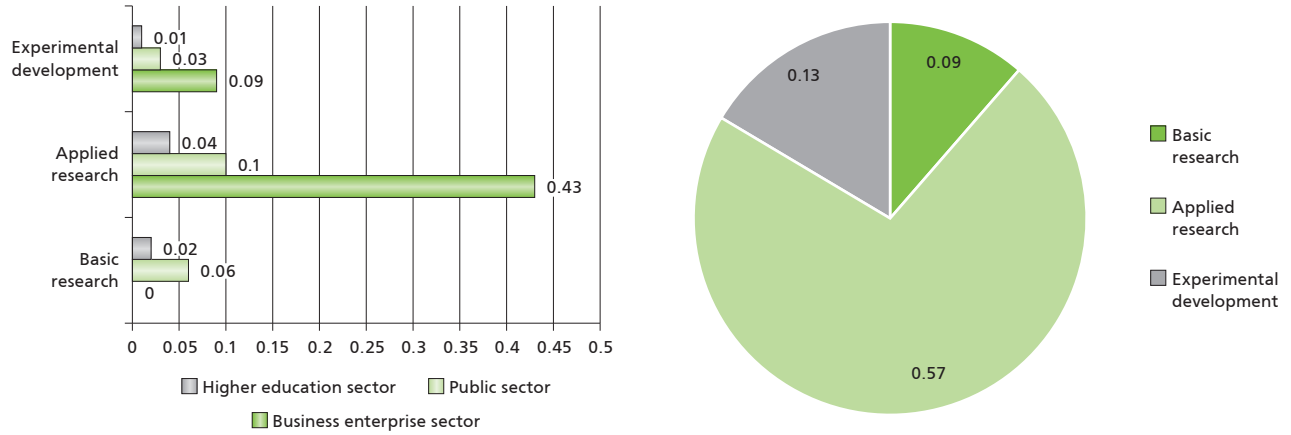
2.2. Science and technology

R&D expenditure, % of GDP, 2015 (NSI)	R&D staff, % of the working age population, 2015 (NSI)	Patent activity, patent applications to EPO (Eurostat)	Transfer of technological knowledge, 2016 (IMD)	Legislation for science and research, 2016 (IMD)
0.96 %	0.48 %	2,494	3.14 (57th place out of 61)	3.42 (54th place out of 61)

In 2015, R&D financing reached 0.96 % of GDP. **Foreign direct investment in research units located in the country's territory is a key factor for growth, combined with co-financing by SMEs of projects financed by national operational programmes.** The share of large companies in total business investment in R&D is equivalent to the aggregate share of all the other enterprises (see further the Investment and Financing for Innovation section below). The contribution of public finance is symbolic.

The bulk of the financing is directed towards applied research in the business sector, and here the impact of EU membership is clearly felt – there has been growth of over 7 times since 2006.

Figure 9. R&D costs by sector and research type, 2015, % of GDP



Source: Eurostat, 2016.

Other factors that need analysis have the opposite impact on the financing of fundamental research, which is mainly concentrated in public institutions. Compared with the pre-accession 2006, the change is negative and is in the range of 50 %.

Patent activity at PORB decreased dramatically in 2015, falling to the symbolic 34 granted patents. The number of patent applications submitted to EPO by Bulgarian patent applicants has been growing after 2007 to reach 6.55 applications per 1 million persons in 2014. Despite the upward trend, however, **Bulgaria remains at one of the last places in EU-28** by this indicator (before Croatia and Romania), far below the average EU level of 111.59 applications and far behind the European innovation leaders which annually submit from 250 to 350 patent applications per 1 million.

Such a great gap is also reported for patent applications to EPO in the high-tech fields (0.059 per million persons for Bulgaria compared to EU-28 average level

of 10.248 in 2013) and ICT patents granted by USPTO (1.267 per million persons versus the EU-28 average level of 19.706 in 2010).

Much better are the positions of the country in regard to trademarks and industrial design – fields in which Bulgaria has clear advantages over the other member states and has made significant progress over recent years.[26]

2.3. Innovation and entrepreneurship

Innovation activity (innovative SMEs, % of all SMEs), 2015 (EIS)	Early-stage entrepreneurship, 2015, % (GEM)	Level of entrepreneurship activity innovation, 2015, % (GEM)	Ease of doing business, 2016 (IMD)	Venture capital, 2016 (IMD)
11.6 %	3.5 % (last place in Europe)	8.6 % (last place in Europe)	4.33 (38th place out of 61)	4.09 (44th place out of 61)

Despite the small improvement by individual indicators, **Bulgaria sustains its position at the bottom of European and global rankings of innovation and entrepreneurship**:

- **The share of innovative SMEs in all SMEs in Bulgaria is among the lowest in Europe** – 11.6 % in 2015 compared to 28.7 % on average for EU-28 and about 40 % for innovation leader countries; furthermore, Bulgaria declined by about one third in the past five years;
- low innovation activity is simultaneously the cause of and effect of the weak interaction within the national innovation ecosystem – **only 2.3 % of all SMEs consider their partners as an asset in the implementation of joint innovation projects** (ahead of Romania only and remaining far behind Serbia and Macedonia);
- **only 13.6 % of SMEs register product and process innovations** (the second lowest place ahead of Romania) compared to 30.6 % on average for EU-28;
- **clearly the weakest performance by marketing and organisation innovation** – 17.6 % compared to 36.2 % on average for EU-28;

Bulgaria's first inclusion in the global survey of entrepreneurship likewise reveals a sad picture of the indicators covered in it – **small number of entrepreneurs who are active mainly in low-tech activities and without a major contribution to the country's economy** in terms of job creation, launch of new products and sales on international markets (see further the Entrepreneurship and Innovation Networks section below).

3. Corporate practices

The third group of factors are relevant within individual companies and form their corporate practices, by means of which they become a focal point for talents, manage to develop them in line with their strategic views of endogenous growth and capitalise on them, involving them in an innovation process whose output is the visible part of the iceberg – innovative products and processes, completely new technology solutions and solutions combining existing knowledge in a simple and ingenious way.

[26] European Innovation Scoreboard 2016, http://ec.europa.eu/DocsRoom/documents/17822

3.1. Attracting talents

Highly qualified foreign labour force, 2016 (IMD)	Foreign employees, 2016 (IMD)	Traineeship programmes, 2016 (IMD)
2.98 (56th place out of 61)	0.15 (41st place out of 61)	2.83 (59th place out of 61)

Business is the most active sector in the national innovation system, both in terms of innovation activity and as regards a suitable corporate environment to attract young and highly qualified staff and develop talents. Moreover, given the demographic crisis, the brain drain, the decreasing quality of educational services and gaps in the labour market **the business sector takes over some of the functions of the other institutional sectors for training and qualification of staff in fields relevant to business**.

Some of these initiatives go far beyond the needs of individual companies (see Box 1) and aim to build a larger community of highly competent professionals who would be the necessary human resources for the private sector and – as innovation users – would create demand for innovative high-tech products.[27]

3.2. Development of talents

On-the-job training, 2016 (IMD)	Employee motivation, 2016 (IMD)	Workplace interaction, 2016 (IMD)
5.02 (48th place out of 61)	4.53 (56th place out of 61)	5.59 (43rd place out of 61)

Where innovation – and hence the need of talents – are concerned, two major factors are important for defining models for business strategies: **the size of the company** and **the sector of economic activity**. As the data show (see further the Investment and Financing for Innovation section below), **large Bulgarian companies have higher innovation activity**, based on their innovation capacity and the economies of scale. **They are also the biggest employer of highly qualified and research staff.** SMEs rely mostly on external financing, which is mainly project-based and thus limits implementation of long-term strategies for staff recruitment.

The differences between the sectors are mainly due to the characteristics of **the high-tech industries**, where the main sources of growth are from new technological solutions. Therefore, **the need of highly qualified and research staff combines with the requirement for profound knowledge and competences in niche fields of science and technology.**

3.3. Capitalising talents into innovation

Innovation capacity, 2016 (IMD)	Entrepreneurship of managers, 2016 (IMD)	Workforce productivity, 2016 (IMD)
4.71 (45th place out of 61)	5.75 (41st place out of 61)	4.24 (54th place out of 61)

Irrespective of the experience gained in the implementation of innovation projects, including in the second programming period of EU financing, Bulgarian managers still rely more on their intuition rather than on formal in-house procedures for guidance and management of innovation processes.

[27] Good practices of Bulgarian companies in the field of training and development of human resources have been presented many times in the annual reports Innovation.bg.

Opportunities for improvement should be sought in a number of innovation management areas:

- In most of the innovative enterprises **there is no innovation strategy** combining external and internal factors for growth and aiming at a desired competitive and market positioning. There are even cases in which a successful market penetration with a new product or service catches the company unprepared and as a result it responds with delay to the opportunities for development.
- With few exceptions, innovative companies **do not make adequate use of approaches and methods which are well-known in management theory and practice for directing creative thinking** and for boosting the creative potential of their employees.
- There is no established practice for **continuous reporting and monitoring of innovation projects and new product proposals**, which places management in a situation of not having available data and not being able to control the input of individual innovation projects into the results of the operations of the company and the portfolio of innovation projects in general. The result is also visible at the national level – companies do not report correctly (because of lack of information, lack of interest or underestimation of the issue) their innovation activities to NSI. The overall effect of this for the economy is an undervaluation of the innovation potential and last positions in European and international rankings of innovation activity.
- Referring to the confidentiality of information about their technological assets, **companies refrain from any kind of cooperation with external partners** – research and university units, value added chain partners, competitors. In many cases such strategy comes at a high opportunity cost and forfeiting the benefits of new knowledge.

Overcoming internal and external barriers to innovation by businesses is possible through trial and error but takes effort and time. The other option entails pooling the efforts of public institutions, educational structures and companies to boost higher efficiency and innovation results for the innovation ecosystem in general and any of its key units.

Box 1. THE BUSINESS IN SUPPORT OF EMPLOYABILITY: THE SOFTWARE UNIVERSITY EXPERIENCE

The Software University (SoftUni)[28] was established in 2013 by PhD Svetlin Nakov, university teacher and software engineer with over 15 years of professional experience, holder of the John Atanasov Award, and Hristo Tenchev, CEO and founder of XS Software, a Bulgarian company for development of online games, included in the "30 below 30" ranking of the Forbes magazine.

SoftUni was created to address the need of sufficient number of highly qualified professionals for the IT industry in Bulgaria, whose share grows annually by 10-12 % and accounts for some 2 % of GDP in 2015 (BGN 1.6 billion). While the sector needs 40,000 qualified professionals, Bulgaria has only about 17,000.

The aim of the innovation education centre is to educate specialists for the software industry in support of entrepreneurship through the "learning by doing" model (training in programming, IT majors, combined with practical experience). For Svetlin Nakov the aim is to enable Bulgaria to develop its potential of a Silicon Valley in Europe through development and support of talent in the ICT sector.

[28] https://softuni.bg/

Box 1. THE BUSINESS IN SUPPORT OF EMPLOYABILITY: THE SOFTWARE UNIVERSITY EXPERIENCE (CONTINUED)

The educational programmes of SoftUni are a combination of programming courses and IT technology in conjunction with most recent trends in the subjects, so as to obtain fundamental knowledge and develop logical and algorithmic thinking of students. The university has a faculty of own teachers and visiting lecturers.

Two forms of study are available – attendance and online. The places in the attendance form of education are limited and are allocated based on performance. The best students in the attendance form are exempt from payment of a fee for the next module with a scholarship for excellent performance.

All students of SoftUni receive a package of licenses for software products, provided by the university's partners. It offers an opportunity to its best students to become part of a paid internship programme.

The students receive a diploma for software engineer-practitioner. The diploma is not recognised by the state but is valued highly by employer software companies. The software university has built successful partnerships with several accredited Bulgarian universities – MTM College, the Varna Free University, the Bourgas Free University, the Higher School of Telecommunications and Posts. After successful graduation from a SoftUni partner university the students obtain a state recognized diploma of higher education.

For the period 2014 – 2015, 28,000 students of the Software University made their first steps in the programming basics courses and over 4,000 candidates passed successfully admission tests in programming for 4 majors. The number of alumni in the SoftUni network reached over 120,000 persons, and those starting a career after obtaining a profession exceed 1,000. Most of the students are male, 44 % of the students are Bulgarian. 92 % of graduates have been employed by IT companies.

Box 1. THE BUSINESS IN SUPPORT OF EMPLOYABILITY: THE SOFTWARE UNIVERSITY EXPERIENCE (CONTINUED)

SoftUni runs over 60 open courses in software, hardware, digital marketing and design, which have attracted more than 20,000 participants. The seminars exceed 225.

In October 2016, the university launched SoftUni Digital, the first full programme for education in digital marketing in Bulgaria. About 500 selected applicants are expected to study in it for 7 months. Since the autumn of 2016, SoftUniKids has started teaching children aged 7 -12 the basics of programming for a period of 8 months.

SoftUni organises hackathons, Softuniada (olympiad in programming and technologies), technological conferences and provides free video lessons (with over 1.2 million views). It maintains partnerships with more than 60 companies and sectoral associations and NGOs.

Source: Software University, 2016.

Innovation Potential of the Bulgarian Economy

Gross Innovation Product

The Gross Innovation Product or the innovativeness of an economy is assessed by the new products and services introduced, the new technologies created and the new scientific outputs produced. It involves and results from the interaction of the innovation, technological and scientific products of a 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 need for changes in the organisation and resources of the innovation process.

Innovation product

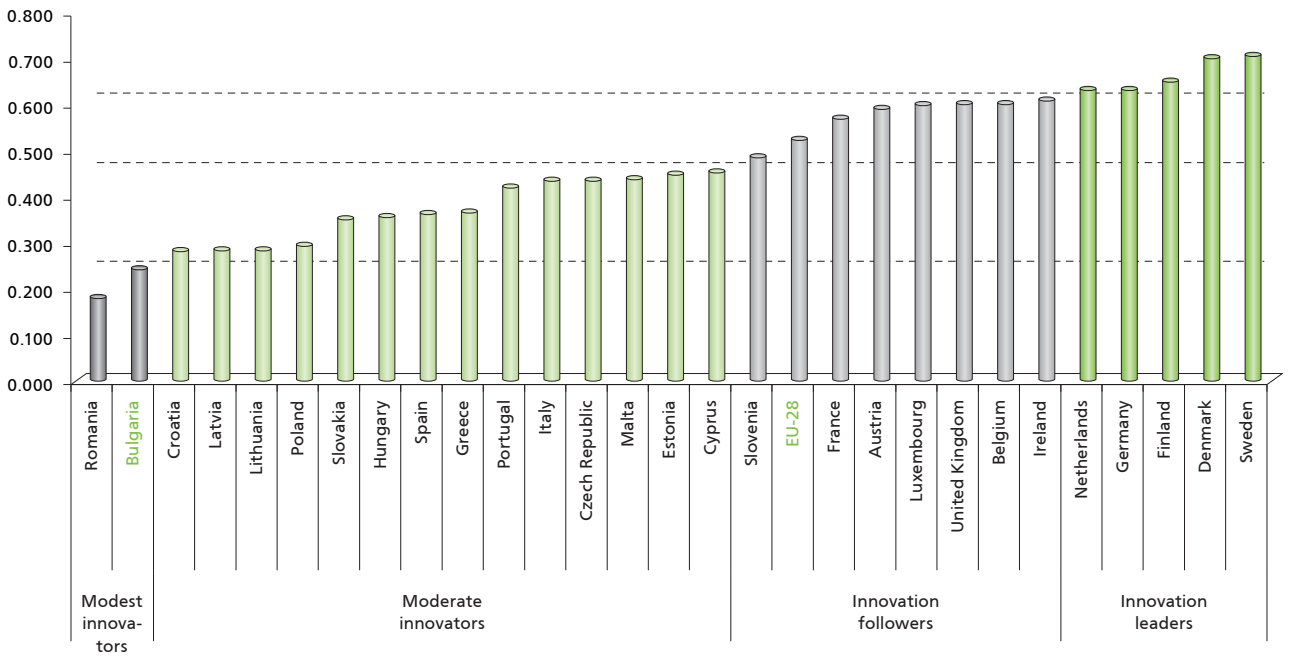
The innovation product results from innovation activity in the form of new and significantly improved processes, products and services based on new and/or adapted knowledge and know-how. It is determined by the innovation activity of enterprises in the country and is the most important indicator for assessing the national innovation system. Innovation activity in business and innovation demand by the public, along with the factors which determine these, comprise the innovation potential of an economy – its capacity to develop based on new knowledge.

Bulgaria – a persistently modest innovator

The better performance of European countries on the innovation potential indicators in the last year **is accompanied by a narrowing gap between the European economy, on the one hand, and the USA and Japan, on the other hand**. All countries report a faltering progress on many specific indicators for innovation enabling environment, innovation activity and company results. However, as the data about leading innovators show, their positions are based mainly on **consistently applied efforts on the whole set of factors having a bearing on innovation performance.** This underlies the fact that the members of the group of leading innovators have remained almost unchanged for the entire period of calculation of the innovation index.

There are two countries in the group of modest innovators in the latest edition of Innovation Union

Figure 10. COMPARATIVE ANALYSIS OF EUROPEAN INNOVATIONS, 2016



Source: Innovation Union Scoreboard, 2016.[29]

[29] The report restores its initial title and again will be called European Innovation Scoreboard, rather than Innovation Union Scoreboard, as published from 2010 to 2015.

2016 – Bulgaria and Romania. It is "comforting" that – despite a slowdown in growth – Bulgaria is not at the last place, mainly due to the serious lagging behind of Romania. Unlike countries such as Poland, Latvia and Lithuania, which have managed to gradually become moderate innovators from modest innovators, next to last within the EU is the highest achievement for Bulgaria.

The lack of substantiated and consistently implemented policy on education, science, technology and innovation, equally engaging both the public and private sectors, results in imbalances and fluctuations of individual indicators used for monitoring progress, which inevitably results in low positions in the comparative analysis of European countries. Despite the remarkable growth on an annual basis or for the entire analysed period reported for Bulgaria on some indicators (Table 1), **the low starting position does not allow the country to bottom out in the European ranking**.

Although **the share of the employed in the high-tech sector in Bulgaria (high-tech activities and knowledge-intensive services) in total employment** had been changing in the period 2008 – 2015, the annual rate **remains positive and moves within the range of 1 and 2** %. This growth, however, is not high enough to make up for the lagging behind other EU member states in the framework of which Bulgarian exceeds only Romania by this indicator.

Table 1. DYNAMICS OF FACTORS IMPACTING THE INNOVATION POTENTIAL OF BULGARIA, 2008 – 2015

Private investments in R&D

- ↑ the share of business spending for R&D in GDP increased by some 272 % for the period;

High-tech sector

- ↑ the share of employed persons in knowledge-intensive sectors of the economy grew by over 13 % in the period (despite this, 26th place for 2015);
- ↑ the share of export of medium high-tech and high-tech products in total export of products rose by over 28 % for the period (despite this, 27th place for 2015);
- ↑ the share of knowledge-intensive services in total export of services rose by over 24 % for the period (despite this, 25th place for 2015);
- ↑ relatively good positions in respect of the share of employed persons in fast growing innovative firms, complemented by growth of over 11 % for the period;

Intellectual property with low technological intensity

- ↑ considerable growth from the base year 2008 for trademarks (2.25 times) and industrial design (nearly 7 times) in combination with positions above the average for EU-28 on both indicators;

Innovation activity with low technological intensity

- ↑ the share of SMEs with organisational and marketing innovations increases by 12 % for the period (despite this, 27th place for 2015).

Public investments in R&D

- ↓ the share of public spending for R&D in GDP accounted for only 0.27 % in 2015;

Innovation activity with high technological intensity

- ↓ the share of innovative SMEs is low (11.6 % for 2015) and decreased further (by over 23 % for the period);
- ↓ the share of SMEs with process and product innovations decreased by 24 % for the period;
- ↓ the share of revenues from created and successfully marketed new for the company products dramatically decreased by some 60 % and the result was 27th place among EU-28 for 2015;

Intellectual property with high technological intensity

- ↓ 27th place by number of patent applications, same as in base year 2008;
- ↓ deterioration of positions (by 1/3) and 26th place by patents in socially relevant areas;

Open innovations and networking

- ↓ only 2.3 % (or 27th place for 2015) of SMEs interact with other firms and organisations in relation to their innovation activities, accompanied by a fall of some 40 % for the period;
- ↓ 26th place by the indicator of joint public-private publications per 1 million persons and a fall by 50 % from the peak 2012.

Source: Innovation Union Scoreboard, 2016.

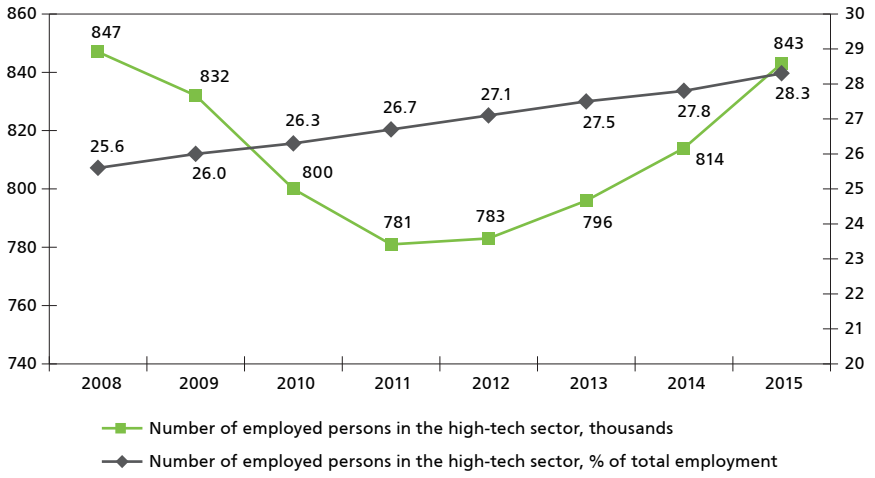
The positive impact of the "employment in the high-tech sector" factor on the innovation activity in the country (Table 1) **could be further undermined, given the fact that in the period 2008 – 2015 the absolute values of the indicator decreased, although minimally,** after the growth in the second half of the period failed to offset the drastic decline of 2011.

Within the European Union, the most serious **regional imbalances as regards high-tech workers as a percentage of total regional employment** are found in Romania with a gap between the regions with highest and least developed high-tech sectors of some 8.5 times, followed by Spain (7.91), United Kingdom (6.5), Greece (5.88), and Poland (5.64). **The result for Bulgaria is 5.50 times higher employment in the high-tech field in the South West Planning Region against the North East Planning Region.**

However, as the data from the Regional Innovation Scoreboard for 2016[32] show, **regional differences in 7 countries, including Bulgaria, allow all regions in the country to fall within the same category.** And if for Austria, Belgium and Ireland this is the category of strong innovators, and for the Czech Republic and Hungary this involves moderate innovators, **the regions of Bulgaria and Romania generally fall in the group of modest innovators**.

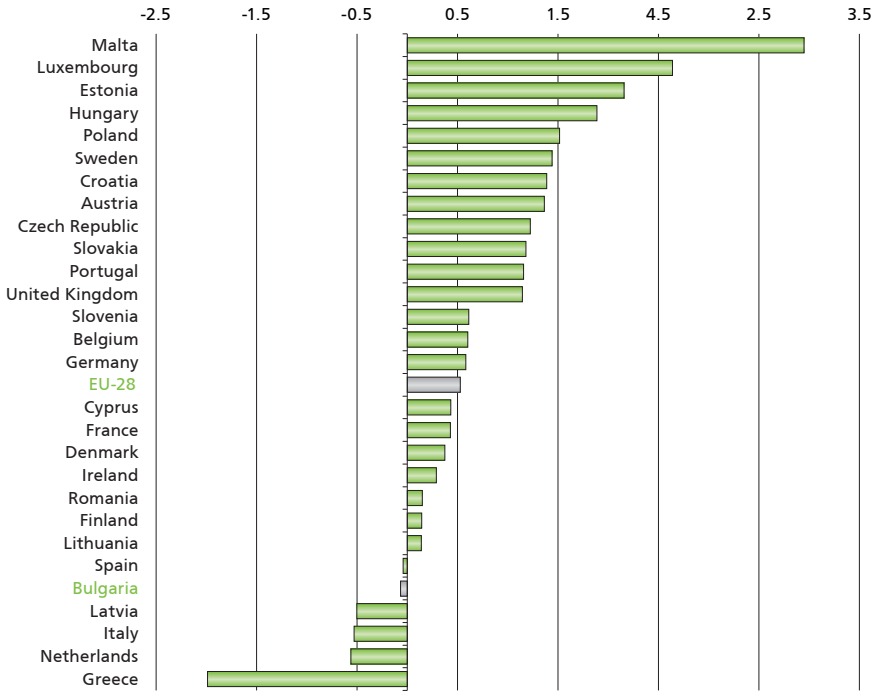
While Belgium, the Netherlands, Ireland, Greece and Romania report a fall in the regional innovation index in all their regions in the last three-year period (2014 – 2016), **Bulgaria is the only country in the EU-28 in which all regions report growth in their innovation index** (at NUTS 1 level this concerns the two regions North and East Bulgaria and South West and South Central Bulgaria).

Figure 11. EMPLOYMENT IN THE HIGH-TECH SECTOR (HIGH-TECH ACTIVITIES AND KNOWLEDGE-INTENSIVE SERVICES) IN BULGARIA, 2008 – 2015



Source: Eurostat.[30]

Figure 12. ANNUAL AVERAGE EMPLOYMENT GROWTH IN THE HIGH-TECH SECTOR (HIGH-TECH ACTIVITIES AND KNOWLEDGE-INTENSIVE SERVICES), 2008 – 2015, %



Source: Eurostat.[31]

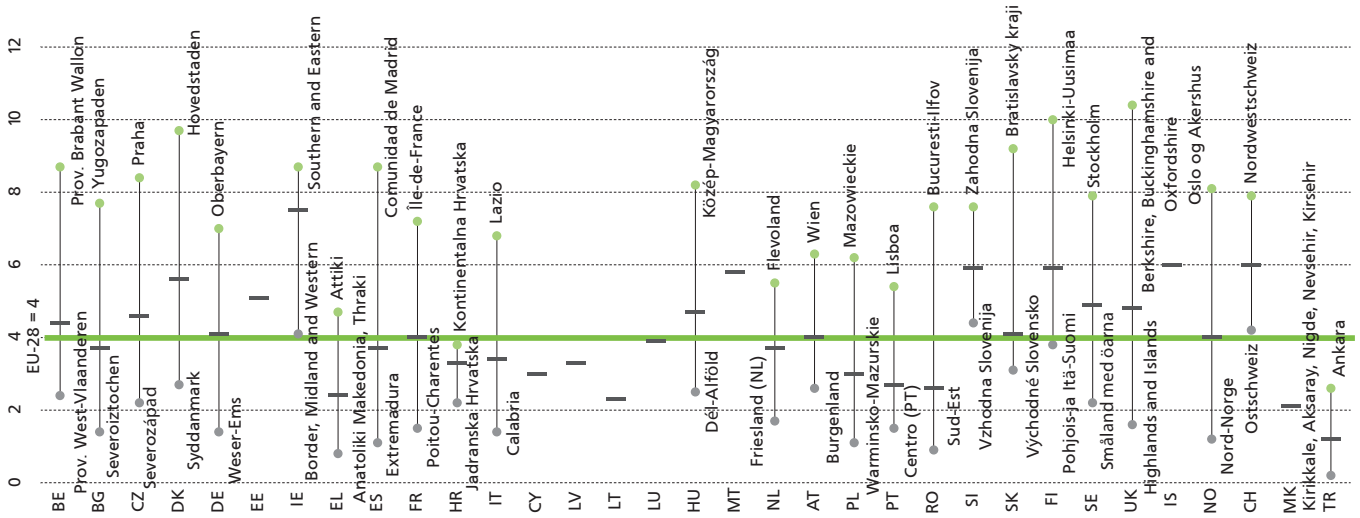
The results of the performance of European regions by innovation potential indicators show **a causal link between the specialisation of regional economies in the field of the six key technological areas and the innova-**

[30] http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=htec_kia_emp2&lang=en

[31] http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=htec_kia_emp2&lang=en

[32] Regional Innovation Scoreboard 2016, http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_en

Figure 13. REGIONAL IMBALANCES IN EMPLOYMENT IN THE HIGH-TECH SECTOR AS % OF TOTAL EMPLOYMENT, NUTS 2, 2015



Source: Eurostat.[33]

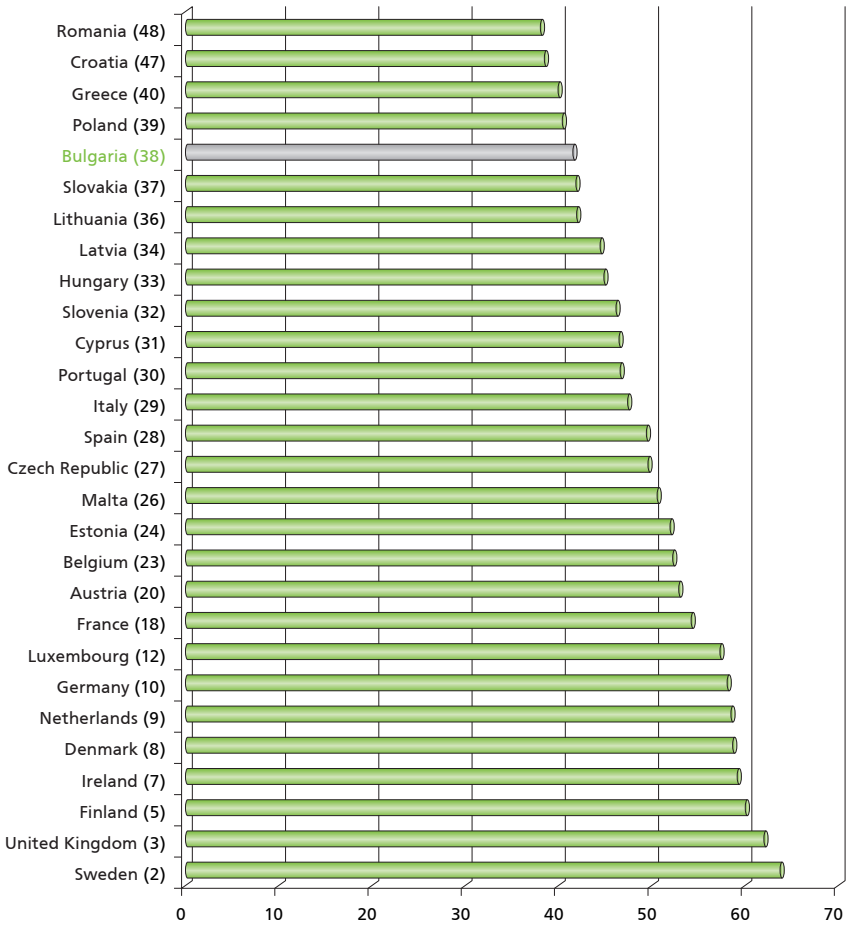
tion performance of the region. The key technological areas include:[34]

- advanced materials;
- advanced manufacturing technologies;
- industrial biotechnologies;
- nanotechnologies;
- micro- and nano-electronics;
- photonics,

and are seen as **horizontal technological platforms with a potential to boost the intensity of innovation activity in all the other areas of economic and social life**, hence becoming a driver of economic growth and higher competitiveness. Innovation leaders have **strongly developed specialisation in key technologies as regards patent activity, output and export orientation.**

In another similar survey – **Global Innovation Index 2016** – Bulgaria moved one place up – to 38^{the} place among 128 countries. However, such an advance was only due to a higher

Figure 14. GLOBAL INNOVATION INDEX 2016, EU-28*



* Country ranking in brackets.

Source: The Global Innovation Index 2016.[35]

[33] http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=htec_emp_reg2&lang=en

[34] Key Enabling Technologies (KETs) Observatory, https://ec.europa.eu/growth/tools-databases/kets-tools/about

[35] https://www.globalinnovationindex.org

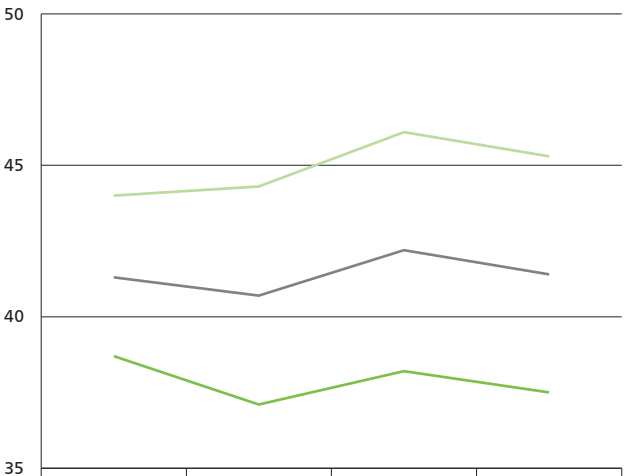
number of countries included in the survey, while **there was no substantive improvement of the indicators of innovation entry and innovation exit, which are underlying for the calculation of the innovation index**. **In the period for which the survey was conducted, there were only minor changes in the two sub-indices for entry and exit of the innovation process, and a drop in the last year.** This inevitably leads to lack of improvement in the efficiency of the innovation activity for 2016 (a ratio of 0.8), and even a deterioration against the base year 2013 when this ratio was 0.9.

According to the Global Innovation Index, the comparative strengths of Bulgaria are mainly in the results of innovations with low technological intensity, which also is a finding of the Innovation Union Scoreboard – protected trademarks and industrial designs; use of information and communication technologies to improve and change the business model; implemented international standards; export of services of cultural and creative industries; registered new companies.

The comparative weaknesses are associated with the environment enabling research and innovation – competitive and business environment; e-government; micro and venture finance; development of clusters and **interaction between universities and businesses.** Of the 7 groups of indicators captured by the Index (5 for innovation entry and 2 for innovation exit), **the poorest results and worst positions for Bulgaria are reported in terms of human resources and research group indicators**, including:

- spending on education;
- number of graduates in scientific and engineering majors;
- ratio of students to teachers in the high education system;
- place of Bulgarian universities in global rankings.

Figure 15. BULGARIA'S SCORE IN THE GLOBAL INNOVATION INDEX, 2013 – 2016*

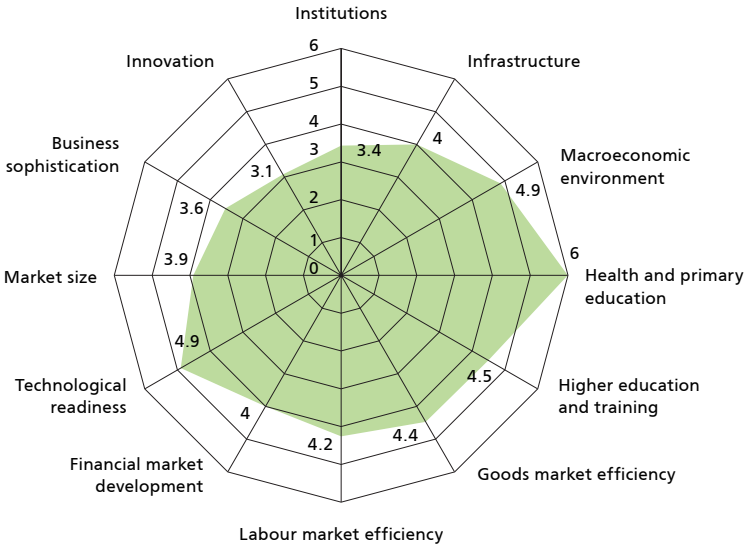


	2013 (142)	2014 (143)	2015 (141)	2016 (128)
Index	41.3	40.7	42.2	41.4
Innovation entry	44.0	44.3	46.1	45.3
Innovation exit	38.7	37.1	38.2	37.5

* In brackets, the number of countries included in the survey for that year.

Source: The Global Innovation Index 2016.

Figure 16. FACTORS OF NATIONAL COMPETITIVENESS, BULGARIA, 2015 – 2016

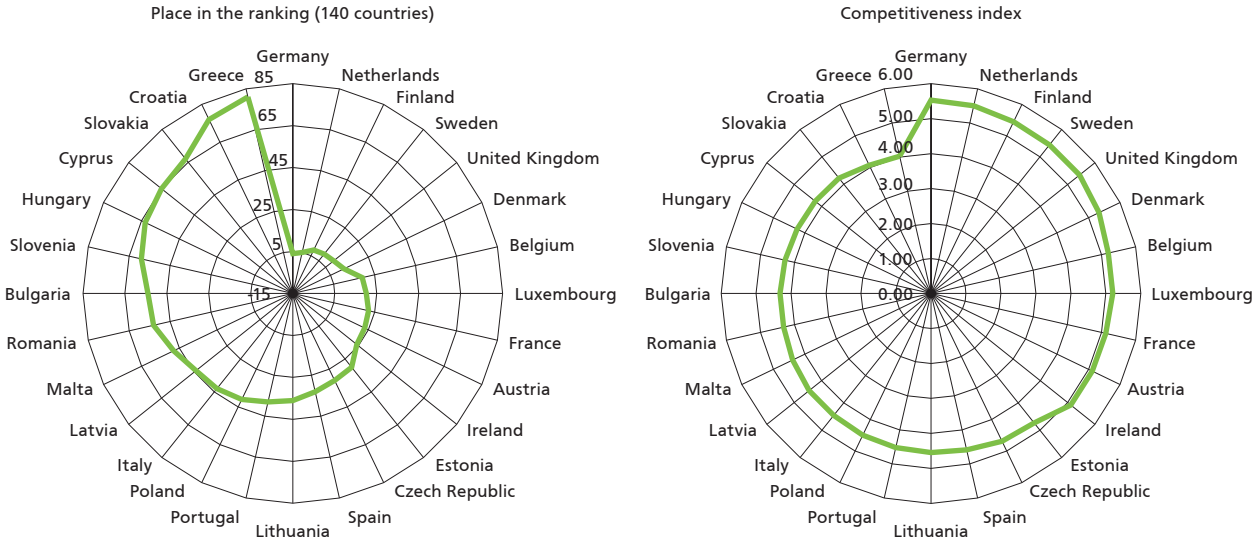


Source: The Global Competitiveness Report 2015 – 2016.

The lack of progress is also confirmed by the **Global Competitiveness Index** 2015 – 2016.[36] In **half of the indicators of the index there is no change on an annual basis** and for three indicators there is deterioration from last year's positions (most seriously in macroeconomic stability) and **only three of the indicators report growth by the mod-**

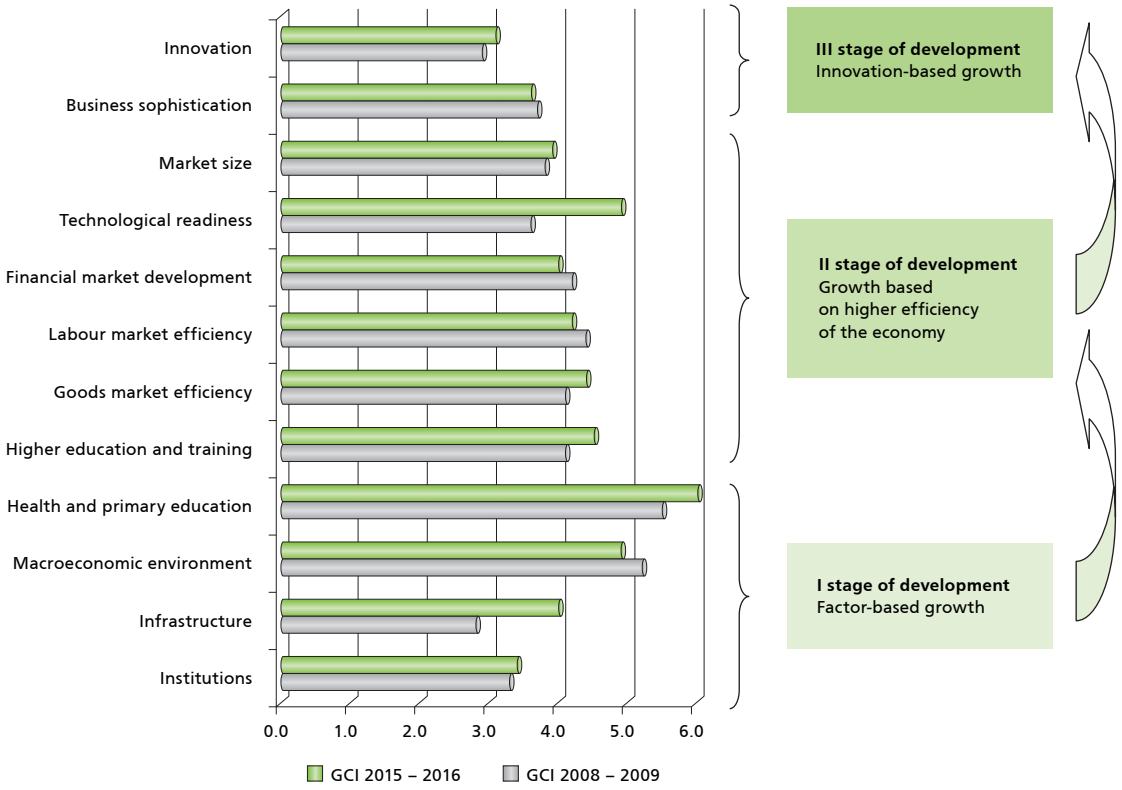
[36] http://reports.weforum.org/global-competitiveness-report-2015-2016/

Figure 17. GLOBAL COMPETITIVENESS INDEX 2015 – 2016, EU-28



Source: The Global Competitiveness Report 2015 – 2016.

Figure 18. ASSESSMENT OF THE FACTORS OF NATIONAL COMPETITIVENESS, BULGARIA



Source: The Global Competitiveness Report 2015 – 2016.

est 2 percentage points for each of them. **The result is 54th position for Bulgaria among 140 countries** (no change from last year, including 148 countries), and 22nd place within EU-28.

Bulgaria is well within the "Emerging and developing countries in Europe" group, including five cur-

rent EU member states (Poland – 41; Romania – 53; Bulgaria – 54; Hungary – 63 and Croatia – 77), along with 6 Balkan economies (Turkey – 51; Macedonia – 60; Montenegro – 70; Albania – 93; Serbia – 94; Bosnia and Herzegovina – 111). The country has a small advantage on the technological readiness and macroeconomic environment indicators and a hardly noticeable advantage as regards financial markets and the labour force, but in terms of institutions the performance is worse. For the other seven indicators there is no variation from the average group values.

Similar position on the global markets corresponds to a similarity in the factors inhibiting business development. **The first four factors assumed to have the strongest adverse impact on business** in emerging and developing countries in Europe, including Bulgaria, **are access to finance, corruption, inefficient work and red tape.** In their assessment, Bulgarian managers add to these the inadequate professional qualifications, lack of continuity in the design and implementation of policies and strategies, as well as the lack of potential for creation and implementation of innovations.

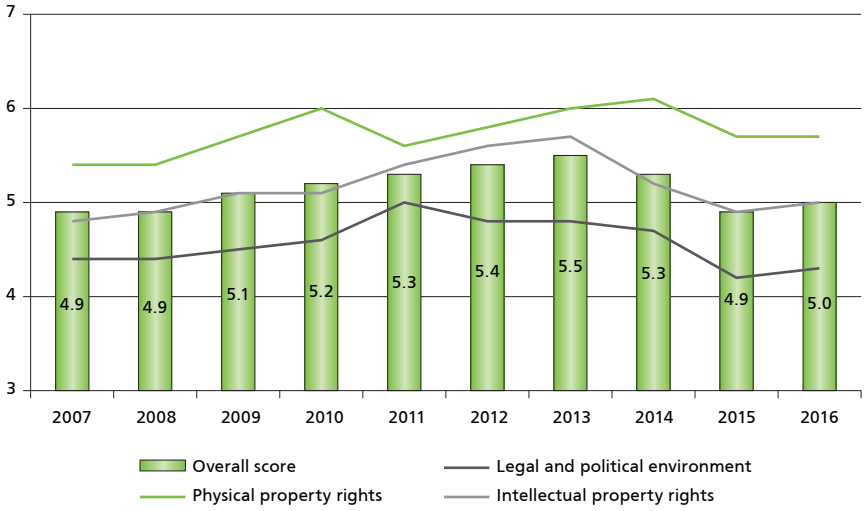
In Bulgaria, stagnation and failure to act hold back development. Unlike previous years, **Bulgaria is the only EU member state which achieved growth based on higher efficiency of the economy** (second stage of development – see Figure 18). Romania is already in the next category (shift from second to third stage of development), along with five other EU member states. The remaining 21 European economies (after accession by Estonia and Slovakia) have innovation-based growth – innovation potential, quality of research infrastructure, R&D spending, innovation interaction, pre-sale public procurement, number of scientists and engineers, patent activity. **The recipes for growth are well known and have been proved in the practice of a number of countries, but the will and capacity to apply them in Bulgarian conditions are still absent.**

Technological product

The technological product (protected and unprotected new technological knowledge) is a result of the creative activities of various participants in the innovation process. Its unique characteristics and economic significance make it attractive as an object of transfer. The analysis of applicant and patent activities, 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 seek ways of improving it.

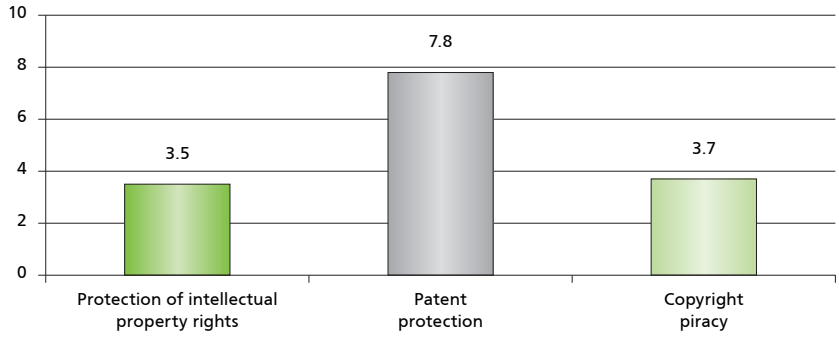
In the International Property Rights Index 2016[37] **Bulgaria has a score of 5.0 out of 10 (or 66th place)**, which is slightly below the average level of 5.45 for all the 128 countries included in the survey. The index cov-

Figure 19. BULGARIA'S OVERALL SCORE IN THE INTERNATIONAL PROPERTY RIGHTS INDEX, 2007 – 2016



Source: International Property Rights Index.

Figure 20. BULGARIA'S SCORE IN THE INTELLECTUAL PROPERTY RIGHTS SUB-INDEX, 2016



Source: International Property Rights Index.

[37] The International Property Rights Index 2016, http://internationalpropertyrightsindex.org/

ers indicators in **three areas: legal and political environment; physical property rights; and intellectual property rights.** The analysis of the Property Rights Alliance, which publishes the index, demonstrates the correlation between the property rights factor, on the one hand, and social and economic progress and well-being of countries, measured through the potential of human resources, social capital, research and innovation, and sustainable development, on the other.

Within EU-28, Bulgaria holds 27th place both in terms of the aggregate index and the intellectual property rights sub-index. The country is close to the average levels and it is a rather typical representative of **the other three groups of countries**:

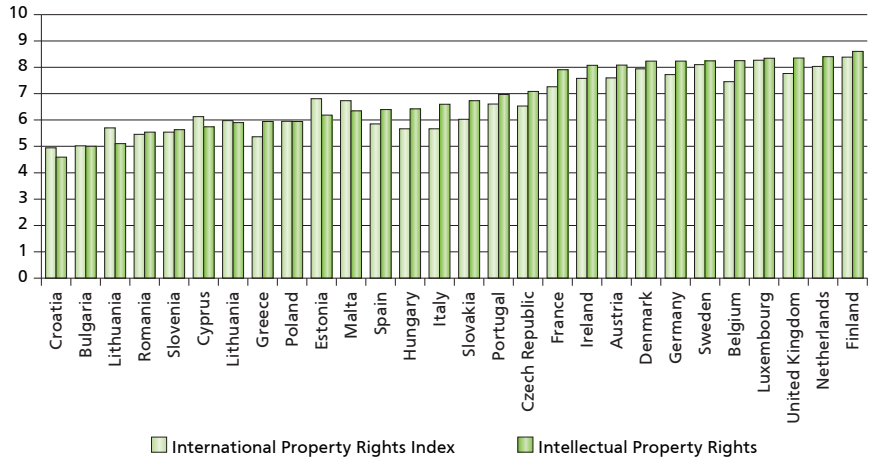
- "upper-middle income" according to the methodology of the World Bank;
- "emerging and developing Europe" according to the methodology of the International Monetary Fund;
- geographically part of Central and Eastern Europe and Central Asia (CEECA).

The progress reported by Bulgaria for the period for which the index was calculated **had been sporadic** (by individual indicators, not aggregated) **and short-term** (not forming a long trend but comprised of a series of fluctuations). As a result of this, **in 2016 Bulgaria had the same level of legal environment and property protection as in the base year 2007**, when the country marked the beginning of its full membership in the European Union.

As data on individual indicators included in the intellectual property rights sub-index show, **Bulgaria has achieved best results in patent protection** (7.8 of 10), which assigns the country the 33rd place in the ranking of 128 countries. This score reflects the strength of patent legislation by five main criteria: scope, membership in international accords, limitation of patent rights, application and duration of protection. The difference for the other two main components is drastic – copyright protection (3.7) and intellectual property protection as a whole (merely 3.5).

The legal framework for patent rights protection, however, proved insufficient to boost patent activity in the country. As data from annual international surveys show (see the section Innovation Product above), **Bulgaria holds leading positions in the protection of intellectual items of low technological intensity, such as trademarks and designs, and remains at the bottom of the rankings in terms of protection of inventions through patents.** This is confirmed by data from the Patent Office of the Republic of Bulgaria (PORB).

Figure 21. INTERNATIONAL PROPERTY RIGHTS INDEX, EU-28, 2016



Source: International Property Rights Index.

Figure 22. BULGARIA'S COMPARATIVE SCORE IN THE INTERNATIONAL PROPERTY RIGHTS INDEX, 2016

Source: International Property Rights Index.

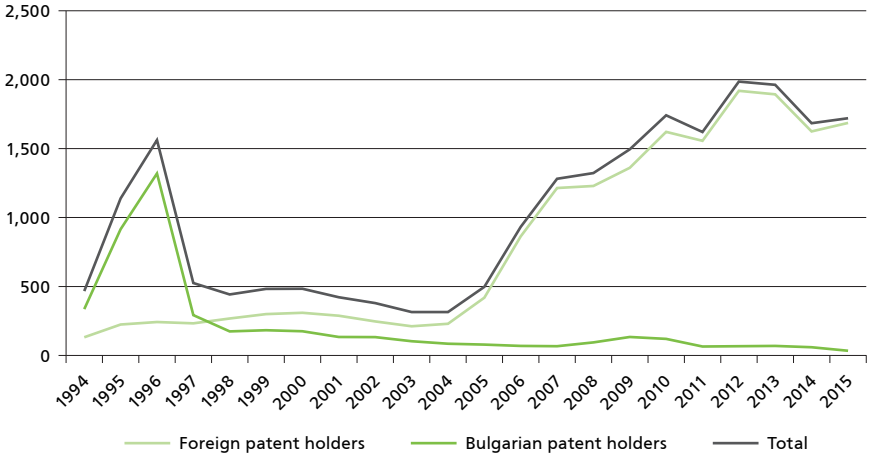
Except for the period 1994 – 1998, when the then existing author certificates were re-registered into patents in accordance with the 1993 Patent Act aligned with European legislation, the patent activity of Bulgarian patent holders has not been high. **The year 2009 was a peak with registered 134 patents, but after that their number has been constantly decreasing. The largest drop (43 %) was registered in 2015, when PORB registered only 34 patents of Bulgarian inventors,** including 15 of individuals, 11 of the business sector, 7 of BAS, and 1 of a higher school.

The total number of patents protected on the territory of Bulgaria in the period 1994 – 2015 is 4,705, and some of these patents are no longer active due to expired legal term for protection or due to cancelation by patent holders. Although the trend over the past 22 years is for the share of individuals to decline, it still accounts for two-thirds (68.8 %) of all registered Bulgarian patents.[38] For that period, the patents of Bulgarian patent holders accounted for 21 % of all PORB registered patents.

After 2001, **the business sector has been represented by 191 companies** with 325 patents in total, including 25 companies with three and more patents, making up 44 % of the total number. Slightly less than half of the companies with patent activity are registered in Sofia.

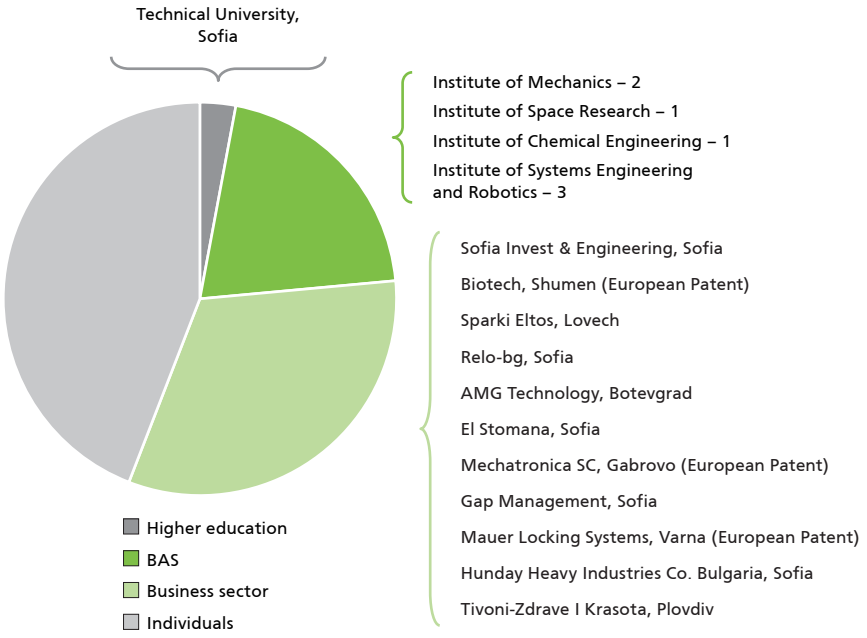
For the past 15 years, **the higher education sector has had 24 patents. There are eight** (out of 51) **higher schools with patent activity,** all of them state funded. Leading is the Medical University – Sofia, with 6 patents; followed by Technical University – Sofia, Technical University – Varna, and University of Chemical Technology and Metallurgy with 4 patents each; Higher School of Civil Engineering with 3 patents; Vasil Levski National University – Veliko Tarnovo, National Academy of Arts-Sofia and Technical College – Yambol (now part of the Thracian University – Stara Zagora) with 1 patent each.

Figure 23. NUMBER OF PATENTS ISSUED FOR INVENTIONS IN BULGARIA



Source: Based on data from the Official Gazette of PORB.

Figure 24. NUMBER OF PATENTS GRANTED FOR INNOVATIONS IN BULGARIA TO BULGARIAN PATENT HOLDERS, 2015



Source: Based on data from the Official Gazette of PORB.

For the period 2001 – 2015, **17 BAS institutes registered 104 patents in total**. Ranking at the top three places are the Institute of Systems

[38] Although there can be no comparison, for 2015 alone 7,440 patents of IBM Corp., 5,059 patents of Samsung Electronics Co., and 4,239 patents of Canon were registered with USPTO. The total number of patents registered with USPTO for 2015 was 298,407, including 140,969 or over 47 % national ones. Within national patents, the institutional structure is as follows: business sector – 90 %, individuals – 9 %, and public sector – less than 1 %. Source: https://www.uspto.gov u http://www.ipo.org

Engineering and Robotics (former Institute of Management and Systems Research) with 24 patents, the Institute of Metal Science with 16 patents and the Institute of Solid State Physics with 12 patents – or exactly 50 % of the protected inventions of BAS.

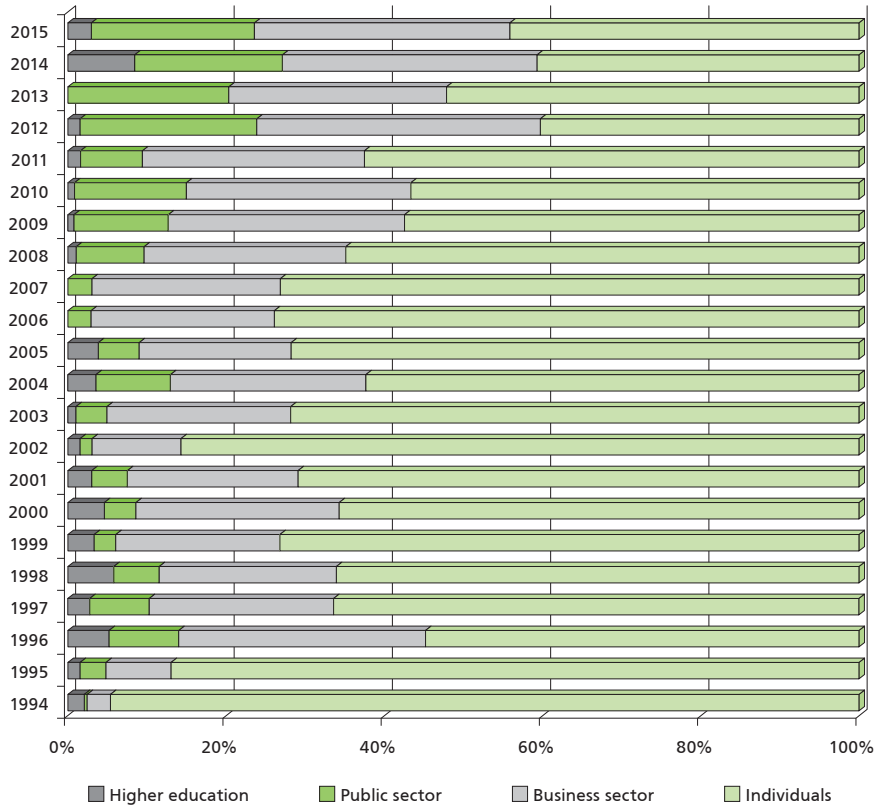
The highest patent interest is reported in the field of technology C-Chemistry and metallurgy, followed by A-Human necessities. The analysis of the correspondence between the fields of technology according to IPC, on the one hand, and economic sectors according to NACE 2008, on the other, allows us to identify the **economic fields whose development is mostly driven by technology and whose innovation is mostly based on the implementation of own new technological knowledge.**

There are 2,343 patents registered in the **five leading economic fields** in terms of interest to Bulgarian inventors; their **share in the total patent activity of Bulgarian patent holders was 50 % in the period 1994 – 2015**.

Foreign patent activity had a strong growth after 2002, when Bulgaria became a member of the European Patent System. A process of expanding the geographical scope of European patents on the territory of the country is expected. Their number for the period 2005 – 2007 was 1,822, and in 2008 alone there were 1,058 foreign patents. Although with certain fluctuations, the interest of foreign patent holders has been constantly rising. **Their share in total patent activity in Bulgaria was highest in 2015 (98 %), given the negligible number of Bulgarian patents.**

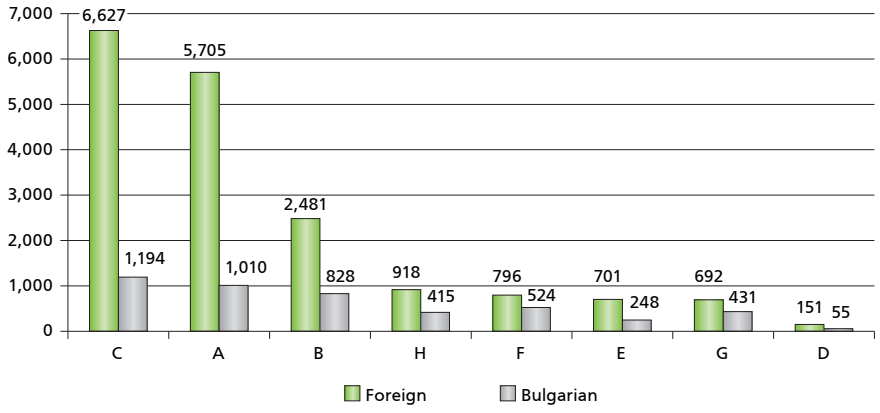
For the period 2001 – 2015, the **top 10 countries with highest patent activity on the territory of Bulgaria include mainly European countries,** along with the USA and Japan as the only non-European countries. In aggregate terms, the top 10 account for 81.5 % of all foreign patents. **Approximately 94 % of the patents of foreign holders are granted by the European Patent Office.**

Figure 25. PATENT ACTIVITY OF BULGARIAN PATENT HOLDERS IN BULGARIA BY INSTITUTIONAL SECTOR, 1994 – 2015, %



Source: Based on data from the Official Gazette of PORB.

Figure 26. NUMBER OF PATENTS FOR INVENTIONS, GRANTED FOR THE TERRITORY OF BULGARIA, ACCORDING TO IPC*, 1994 – 2015



* IPC sections: A – Human necessities; B – Performing operations; transporting; C – Chemistry and metallurgy; D – Textiles and paper; E – Fixed constructions; mining; F – Mechanical engineering; lighting; heating; engines and pumps; weapons; blasting; G – Physics; H – Electricity.

Source: Based on data from the Official Gazette of PORB.

TABLE 2. TOP 5 ECONOMIC ACTIVITIES WITH HIGHEST PATENT ACTIVITY BY BULGARIAN PATENT HOLDERS, 1994 – 2015

No.	Economic sector	Bulgarian patent holders		Foreign patent holders	
		Number	%	Number*	%
1	Manufacture of chemical products	603	12.82	5,308 (1)	29.37
2	Manufacture of metal products, excluding machines and equipment	543	11.54	706 (7)	3.91
3	Manufacture of electrical equipment	444	9.44	571 (9)	3.16
4	Manufacture of basic pharmaceutical products and pharmaceutical preparations	383	8.14	3,349 (2)	18.53
5	Manufacture of computer and communications equipment, electronic and optical products	370	7.86	734 (6)	4.06
	Total:	**2,343**	**49.80**	**10,668**	**59.03**

* In brackets is indicated the sequential number of the economic sector in the ranking of foreign patent holders.

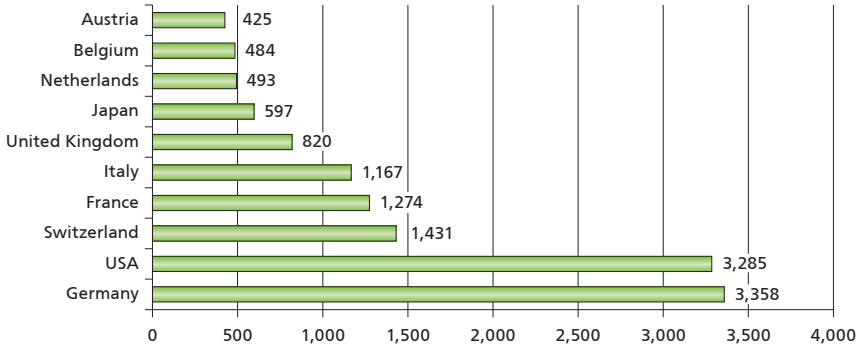
Source: Based on data from the Official Gazette of PORB.

Germany holds the richest technological portfolio in terms of the number of protected patents in Bulgaria and by this indicator it has retained a significant advantage over the past 15 years. Germany along with Italy, United Kingdom, the Netherlands and Austria are leaders as regards foreign direct investment.

The Agricultural Academy is the main research unit in the country carrying out research, as well as support and ancillary activities in the fields of agriculture, stockbreeding and food. The legal protection of the innovative products created by the Academy is achieved through invention patents, certificates for trademarks and for the protection of new plant varieties and animal breeds issued by PORB. Along with the 8 patents granted by PORB in the period 2001 – 2015, the Academy registered 401 new plant varieties and five new animal breeds.

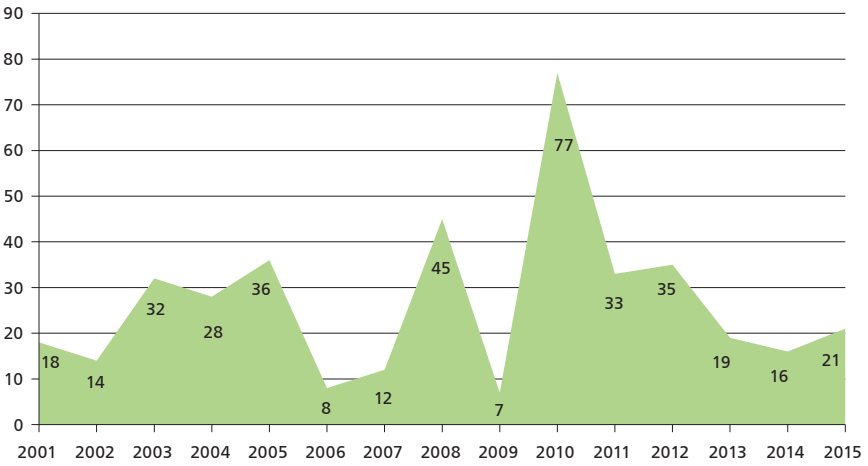
Of all the 25 research institutes at the Academy, 18 have certificates of plant varieties. Most active are the State Agriculture Institute – General Toshevo, the Institute of Plant Genetic Resources-Sadovo, and the Maritsa Vegetable Crops Research Institute. These are the structural

FIGURE 27. NUMBER OF PATENTS GRANTED TO FOREIGN PATENT HOLDERS FOR THE TERRITORY OF BULGARIA FOR THE PERIOD 2001 – 2015, TOP-10 COUNTRIES



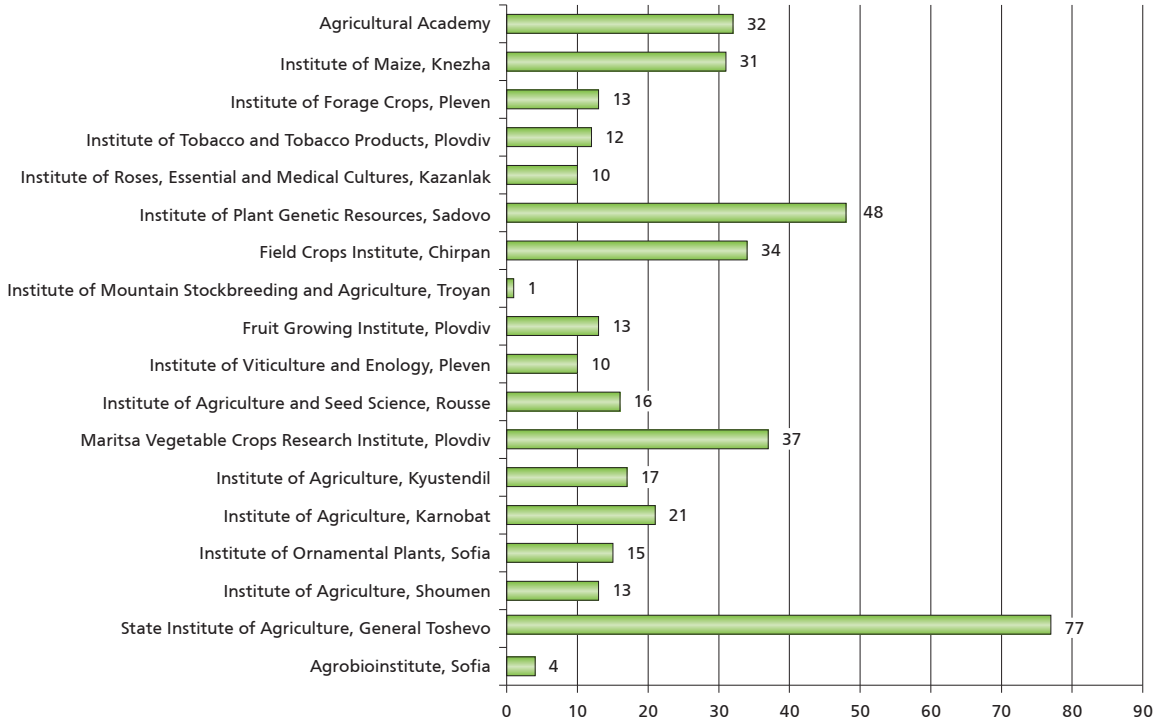
Source: Based on data from the Official Gazette of PORB.

FIGURE 28. NUMBER OF CERTIFICATES FOR PLANT VARIETIES ISSUED TO THE AGRICULTURAL ACADEMY, 2001 – 2015



Source: Agricultural Academy, 2016.

Figure 29. INSTITUTIONAL STRUCTURE OF PLANT VARIETY CERTIFICATES ISSUED AT THE AGRICULTURAL ACADEMY, 2001 – 2015, NUMBER



Source: Agricultural Academy, 2016.

units in which research and development activities had been carried out most consistently and without fluctuations over the review period.

There are two research institutes holding certificates of animal breeds – Agricultural Institute – Shoumen (3 breeds) and Institute of Fishery and Aquaculture – Plovdiv (2 breeds).

The currently deliberated amendments to the Agricultural Academy Act aim to increase the number of scientific and applied research and registered results by the units of the Academy by enhancing their financing and spending autonomy. This autonomy is a condition for putting its cooperation with business on a market footing. In addition, primary units (research institutes, fields stations, experimental bases) are set to be merged into research and innovation centres on a functional principle so as promote cooperation within the Academy, enhance the transfer of knowledge and commercialisation of scientific results in and outside of the country.

Research product

New scientific knowledge is an important condition for enhanced innovation activity in the country. The analysis of the dynamics and structure of the process reveals the potential of Bulgaria to successfully fit in the global scientific networks, its comparative advantages in various fields of knowledge and its ability to successfully compete on the market for intellectual products.

Table 3. BULGARIA'S POSITIONS IN THE GLOBAL RESEARCH COMMUNITY REPRESENTED IN SCOPUS, 1996 – 2015

Bulgaria		Number of documents	Citations per document 8.82	H-index 184
Position in the group	All countries represented in Scopus (239 countries)	51	150	51
	European Union (28 countries)	22	22	23
	Eastern Europe (24 countries)	10	11	7

Source: SCImago. (2007). SJR – SCImago Journal & Country Rank. Retrieved September 10, 2016, from http://www.scimagojr.com

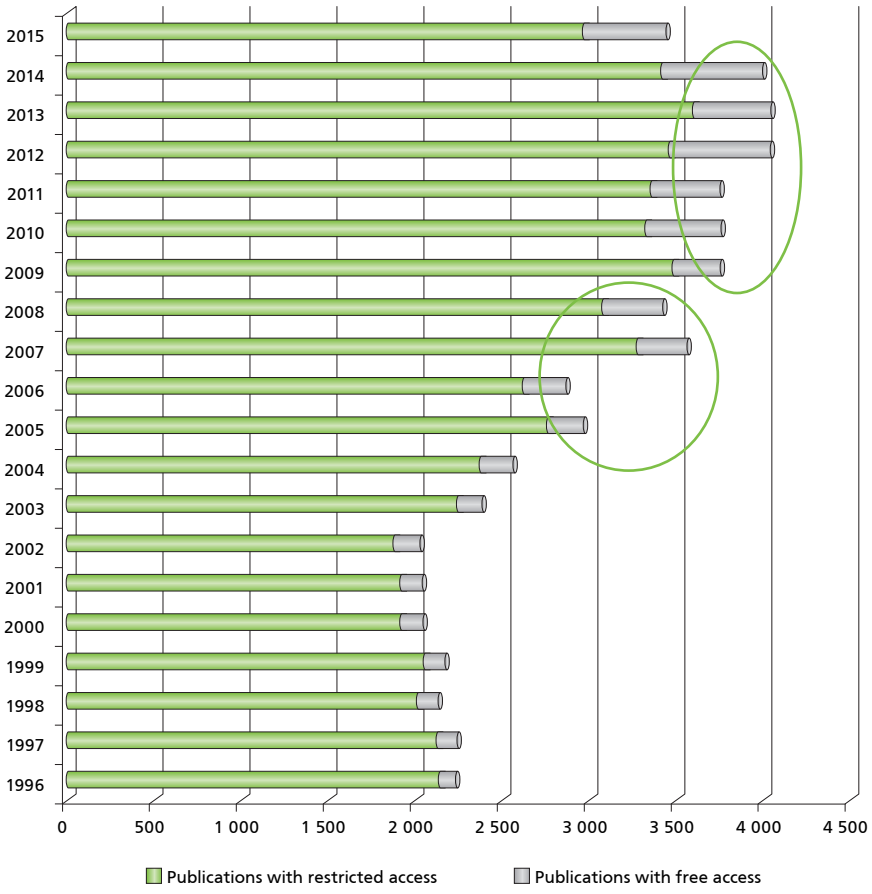
In the period 1996 – 2015, Bulgarian publications in the referenced Scopus database numbered 59,384, with 8.82 citations per document and H-index of 184. With these indicators Bulgaria holds **51st position in the global ranking and 22nd position within the EU.** Among 24 Eastern Europe countries (including 11 EU member states), Bulgaria holds 10th place by number of publications.

In 2015, Bulgaria retained the 22nd position within EU-28 by number of publications (3,441 documents), which takes it to 59th place in the global ranking. The change is due to the **decreased number of publications in the past two years** (15 % in 2015 versus the peak year 2013).

Figure 30 clearly illustrates **the connection between publication activity in the scientific community in Bulgaria, on the one hand, and Bulgaria's participation in the EU framework programmes and membership in the EU, on the other.** There was an upsurge in the number of publications in the pre-accession period and in the beginning of the 2007 – 2013 programming period, immediately before the launch of project finance under operational programmes. This was followed by another increase in the period when projects started to be financed in the 2007 – 2013 programming period (including an almost 2-year delay in the implementation of started projects). The number of publications at the beginning of the 2014 – 2020 programming period fell, but higher project and publication activity is expected in the period until 2020.

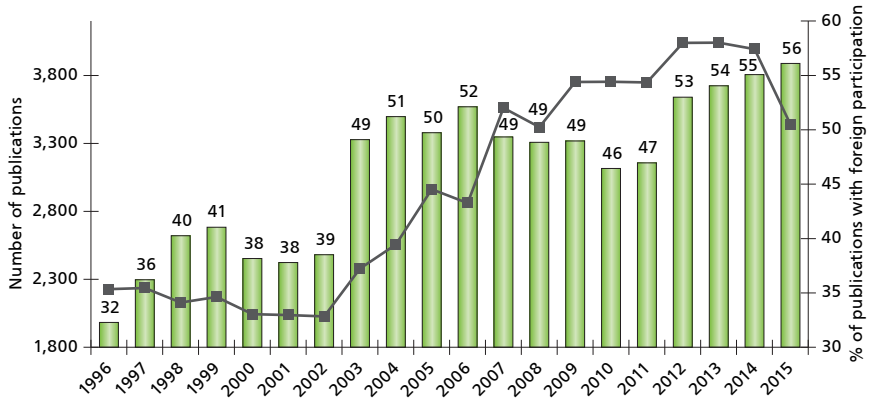
In the context of the global trend – also applying in the EU – towards free access to scientific knowledge and in conjunction with the growing number of publications originating from Bulgaria, there has also been **an increase in the number of documents with free access (from 4 % in 1996 to 14 % in the last years of the review period)**. According to the Science 2.0 initiative and all related strategic documents of the EU, the publications financed through Com-

Figure 30. PUBLICATION ACTIVITY IN SCOPUS DATABASE, 1996 – 2015, BULGARIA, NUMBER OF PUBLICATIONS



Source: SCImago. (2007). SJR — SCImago Journal & Country Rank. Retrieved September 10, 2016, from http://www.scimagojr.com

Figure 31. BULGARIAN PUBLICATION ACTIVITY IN THE SCOPUS DATABASE, 1996 – 2015



Source: SCImago. (2007). SJR — SCImago Journal & Country Rank. Retrieved September 10, 2016, from http://www.scimagojr.com

munity Framework Programmes will be with free access in order to promote transfer and sharing of scientific knowledge and hence its practical application to the public benefit and to improve the scientific and innovation capacity of member states.

The same trend applies to journals. **Out of the total 47 journals published in Bulgaria referenced in the Scopus database in 2015, 11 have free access.**

As a result of increased project finance and free access to scientific knowledge, **the share of Bulgarian publications with international participation is increasing**.

Thematically, **Bulgarian scientists are best represented in the fields of physics and astronomy, medicine, materials science, chemistry, biochemistry, genetics and molecular biology.** The share of scientific articles in these fields in all Bulgarian articles included in Scopus for the period 1996 – 2015 **exceeds 83** % (or 88 % of the total number of scientific publications).

The analysis of the dynamics reveals, however, that **in the last years of the period the performance is weaker both in terms of the number of articles and as a share in the publication activity in each of the thematic fields within EU-28 and the region of Eastern Europe.**

Box 2. ICT FOR THE BENEFIT OF BUSINESSES AND SOCIETY

ICT was distinguished as an economic sector which "combined manufacturing and services industries whose products capture, transmit or display data and information electronically" over 20 years ago by the OECD.[39] This was warranted by the more widespread use of ICT in various areas of economic and social life and their becoming a major driver of innovation.

Guided by similar goals, the Institute of Information and Communication Technologies (IICT) at BAS directed its work not only towards theoretical research in the fields of computer networks and architecture, scientific computations, linguistic modelling, communication systems, etc., but also pursued complex research which could find practical application in a number of areas:

- **Advanced computing**, oriented towards the development of efficient tools for analysis of the reliability of multiscale computer models, highly productive algorithms for parallel processing and super-computer applications, sustainable methods and algorithms for micro-structured analysis of materials and textiles based on 3D images with high resolution; design of personalised biomedical applications; reliable and efficient models of pollution control/ecological rehabilitation, etc.
- **Big data**, related to building of highly productive infrastructures for processing of big data of various size, type and versions, received from various input devices (e.g. 3D computer tomography, thermal camera, high-speed camera, etc.) for potential use in problem areas such as cultural heritage conservation and protection, development of new nanomaterials, etc.
- **Smart interfaces**, intended to address problems with high computation complexity related to real-life or internet objects. Anticipated results involve development of advanced tools for processing of text storages, semantic networks for speech analysis and synthesis; creation of new, efficient methods and algorithms for multi-functional interfaces for tracking eye movements, identification of gesticulations, facial expression, body language, etc., as well as new methods and algorithms for processing of information from hyper-spectral cameras, acoustic gratings, inertial sensors and other devices.
- **Optimisation and intelligent control** as a basis for smart diagnostics and decision-making, allocated managing systems, optimisation methods and algorithms, hierarchical models and algorithms for management of complex systems and cyber security.

The efforts of the research staff over the past few years have been directed namely at **strengthening the innovation potential of the Institute and commercialisation of applied research** with priority focus on the following sectors:

- **healthcare**

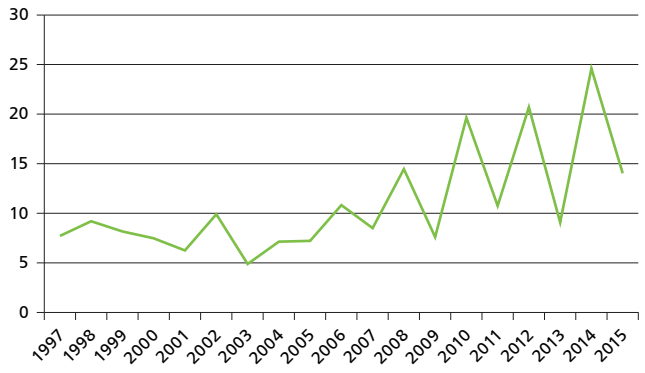
The Linguistic Modelling and Knowledge Processing Department creates **specialised programmes ("extractors") for automatic extraction of significant facts from texts in clinical recordings in Bulgarian**: numerical values of blood pressure, glycated hemoglobin, blood sugar, weight, body mass index, and other important diabetes-related indica-

[39] OECD (2007) Working Party on Indicators for the Information Society: *Information Economy – Sector Definitions Based on the International Standard Industry Classification* (ISIC 4), DSTI /ICCP/IIS(2006)2/FINAL, http://www.oecd.org/sti/sci-tech/38217340.pdf; OECD (2002) *Measuring the Information Economy*, https://www.oecd.org/sti/ieconomy/1835738.pdf

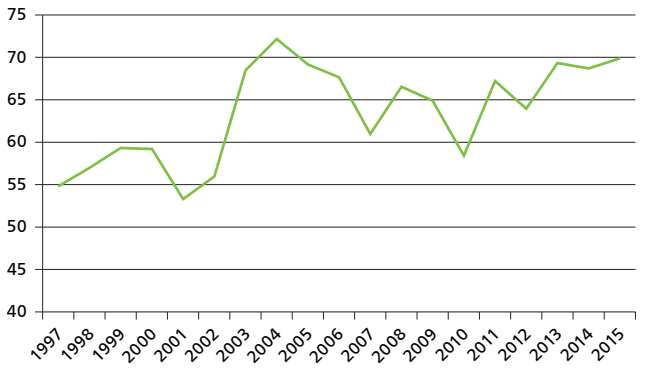
PHYSICS AND ASTRONOMY (1996 – 2015)

Number of documents	Citations	Document citation	H-index
14,725	168,820	11.46	112

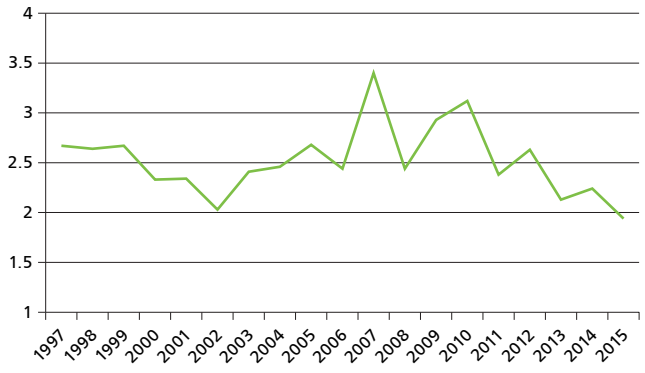
SHARE OF PUBLICATIONS WITH FREE ACCESS



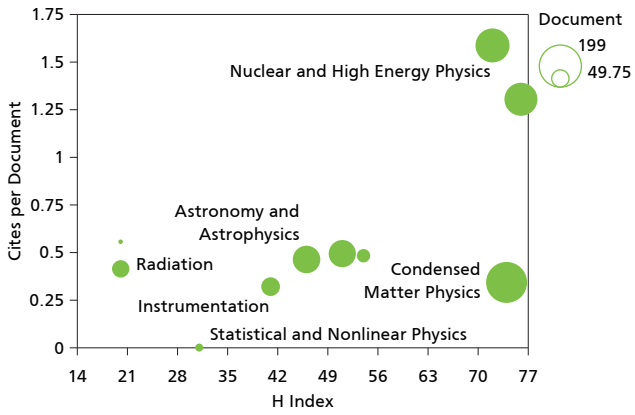
SHARE OF PUBLICATIONS WITH INTERNATIONAL PARTICIPATION



SHARE OF PUBLICATIONS IN THE SCIENTIFIC PRODUCTION OF THE REGION IN THE SAME FIELD



MAJOR CATEGORIES IN THE SCIENTIFIC FIELD



Source: SCImago. (2007). SJR — SCImago Journal & Country Rank. Retrieved September 10, 2016, from http://www.scimagojr.com

Box 2. ICT FOR THE BENEFIT OF BUSINESSES AND SOCIETY (CONTINUED)

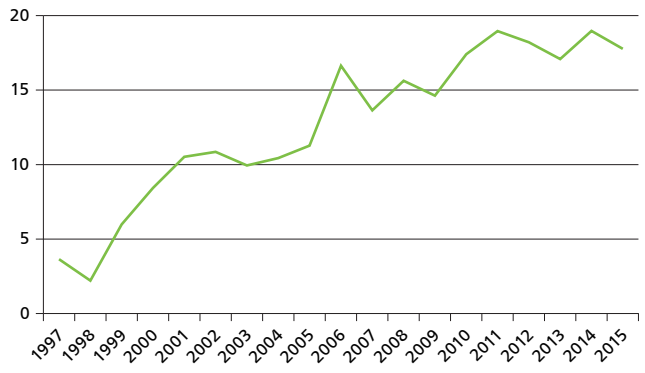
tors, as well as information about administered drug treatment – name of drug, dose, frequency and method of taking. The extractors are integrated in a software environment for generation of a **Register of Diabetics in the Republic of Bulgaria**. The register is automatically generated, without additionally burdening doctors and patients to prepare documentation, based on an entry archive of about 112 million ambulatory sheets submitted to the Health Insurance Fund in the period 2012 – 2014. **The Register is maintained by the University Hospital for Active Treatment of Endocrinology** "Acad. Iv. Penchev", Medical University – Sofia, authorised by the Ministry of Health to keep and update it.

The Scientific Computations Department develops, jointly with the company Amet, an integrated mathematical model, used in the construction of a prototype of **high-frequency interference portable device for contactless electricity-driven removal of bloodsucking ectoparasites (ticks and leeches) in humans and pets.** The method is based on the impact of electricity on nerve terminals in higher organisms, proved in therapeutic practice. A base mathematical model of the impact of electric and temperature fields was created in the course of work, taking into account the diverse structure of the computed area and in particular the possibility for deposition of a thin layer of highly conductive gel on the surface. Algorithms are developed for effective implementation of the model. The modelling results are confirmed by laboratory and clinical experiments.

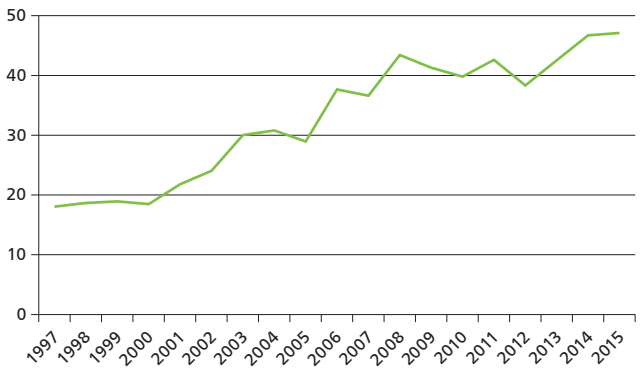
MEDICINE (1996 – 2015)

Number of documents	Citations	Document citation	H-index
11,670	108,398	9.29	110

SHARE OF PUBLICATIONS WITH FREE ACCESS

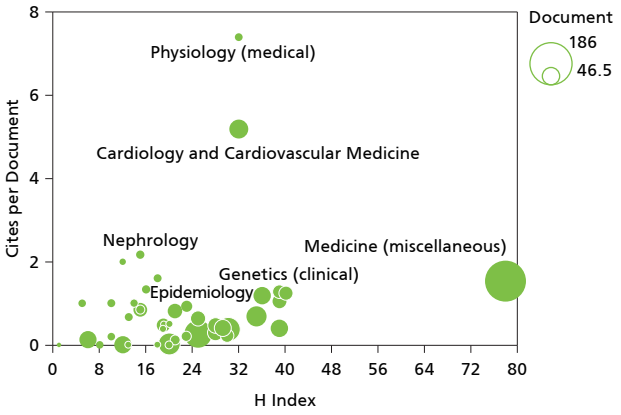


SHARE OF PUBLICATIONS WITH INTERNATIONAL PARTICIPATION



SHARE OF PUBLICATIONS IN THE SCIENTIFIC PRODUCTION OF THE REGION IN THE SAME FIELD

MAJOR CATEGORIES IN THE SCIENTIFIC FIELD



Source: SCImago. (2007). SJR — SCImago Journal & Country Rank. Retrieved September 10, 2016, from http://www.scimagojr.com

Box 2. ICT FOR THE BENEFIT OF BUSINESSES AND SOCIETY (CONTINUED)

- **transport**

The Hierarchical Systems Department carries out a task commissioned by the Ministry of Transport for **optimising the operation of the Bulgarian State Railways**. A mathematical model for evaluation of the potential of the railways is developed, taking into account the capacity of passenger transport services performed by motor vehicles and railway. Based on the model, recommendations are made for intensifying the rail traffic in particular legs and restricting the licenses of bus services granted by the Ministry of Transport. The model evaluates and forecasts appropriate investment solutions for the development of passenger transport via the rail network of the country.

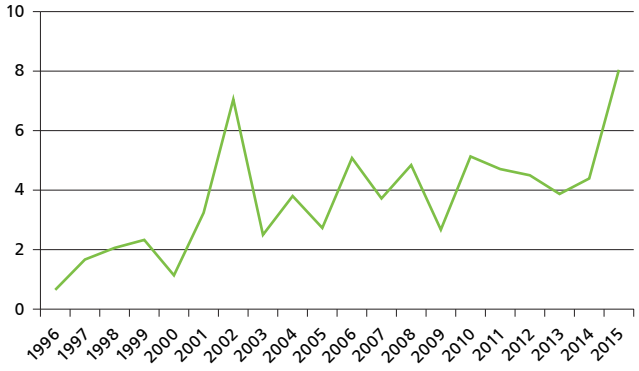
- **ecology**

The Parallel Algorithms Department prepares new parallel applications of the so-called *Danish Eulerian Model* of air polluters, **allowing identification of the sources of specific polluters** and forecasting potential sources in accordance with the prevailing weather conditions. The model is of special importance, particularly in smaller countries in Europe, including Bulgaria.

MATERIALS SCIENCE (1996 – 2015)

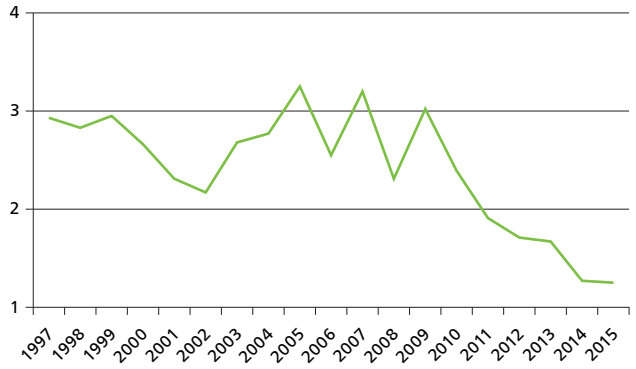
Number of documents	Citations	Document citation	H-index
9,096	93,020	10.23	91

SHARE OF PUBLICATIONS WITH FREE ACCESS

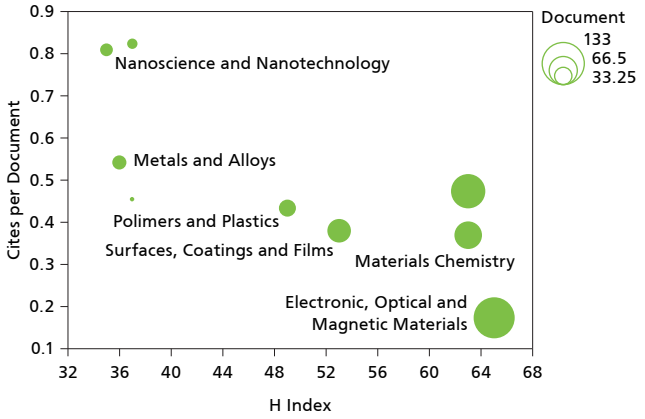


SHARE OF PUBLICATIONS WITH INTERNATIONAL PARTICIPATION

SHARE OF PUBLICATIONS IN THE SCIENTIFIC PRODUCTION OF THE REGION IN THE SAME FIELD



MAJOR CATEGORIES IN THE SCIENTIFIC FIELD



Source: SCImago. (2007). SJR — SCImago Journal & Country Rank. Retrieved September 10, 2016, from http://www.scimagojr.com

Box 2. ICT FOR THE BENEFIT OF BUSINESSES AND SOCIETY (CONTINUED)

- **security**

The Information Technologies and Security Department and the company Stemo are developing and approbating a model of a system for support of decision-making in the area of cyber-intelligence, using highly productive computational units. The innovation is connected with the development of e-government and the preparation of a Strategy for Cyber Security of the Republic of Bulgaria.

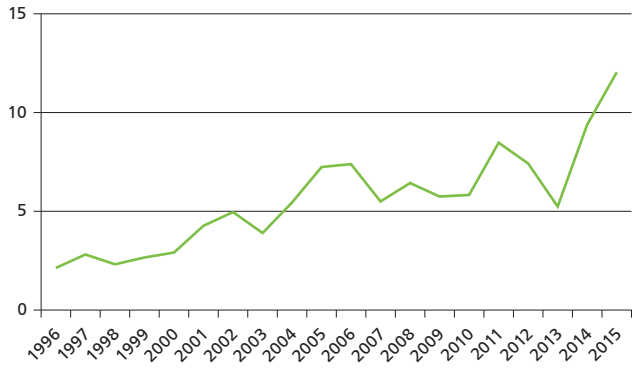
IICT-BAS has become **one of the leading ICT research centres in Eastern Europe**, providing infrastructure and conditions for research comparable with the standards of the West European centres of ICT excellence. The Institute coordinates the following **international and national research infrastructure platforms**:

- Bulgarian Research and Education Network
- National Grid Infrastructure
- National Highly Productive Computation Infrastructure for Research Communities in South East Europe
- National Interdisciplinary E-infrastructure for resources and technologies for Bulgarian language and cultural heritage
- National Centre for High Performance and Allocative Computing.

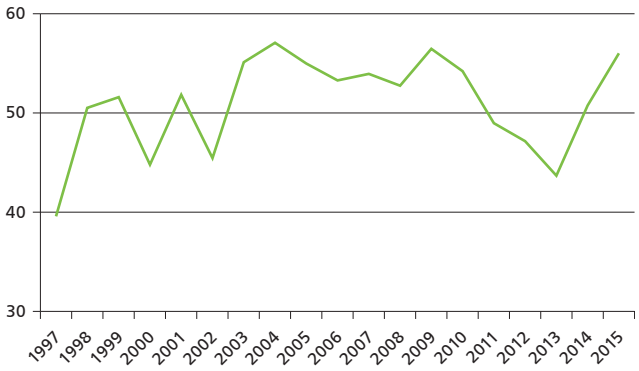
CHEMISTRY (1996 – 2015)

Number of documents	Citations	Document citation	H-index
8,732	114,072	13.06	104

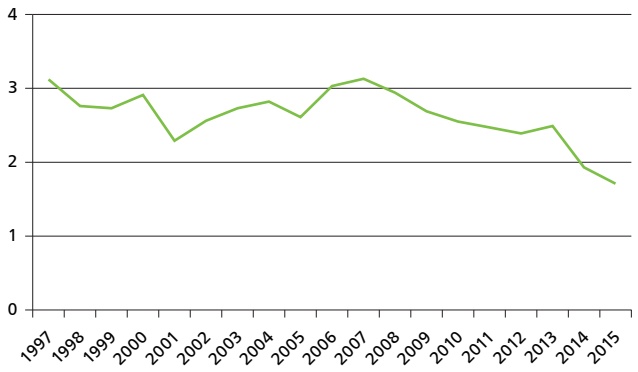
SHARE OF PUBLICATIONS WITH FREE ACCESS



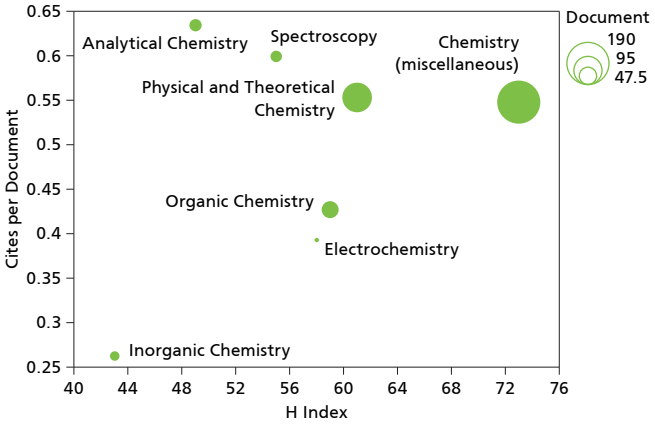
SHARE OF PUBLICATIONS WITH INTERNATIONAL PARTICIPATION



SHARE OF PUBLICATIONS IN THE SCIENTIFIC PRODUCTION OF THE REGION IN THE SAME FIELD



MAJOR CATEGORIES IN THE SCIENTIFIC FIELD



Source: SCImago. (2007). SJR — SCImago Journal & Country Rank. Retrieved September 10, 2016, from http://www.scimagojr.com

Box 2. ICT FOR THE BENEFIT OF BUSINESSES AND SOCIETY (CONTINUED)

The Institute applies an in-house regulation for shared use of research infrastructure, mainly on a contractual basis with external clients. An internal innovation strategy is currently being developed, including rules for the management of objects of intellectual property rights.

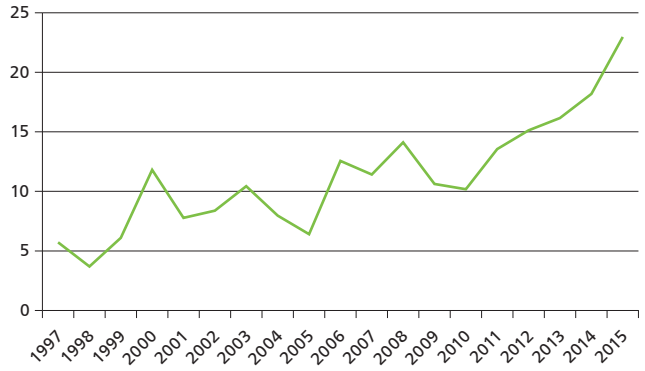
In 2015, **a new super-computer was installed** at the IICT, **complying with the European Technology Platform for High Performance Computing** (ETP4HPC). For a second six-month period the machine is in the Top-500 ranking of the most powerful super computers in the world, which is a unique achievement of the country. This way Bulgaria asserts its leading place as regards electronic infrastructure in Central and Eastern Europe. As a result of the contacts with big European infrastructures an option exists for Bulgarian scientists to use additional software packages, not installed on Bulgarian computation resources.

IICT-BAS is proactive in the area of **technology transfer**. The major channel for this are so-called **user groups – dynamically increasing expert groups which distribute the innovative results developed at the Institute among Bulgarian companies open to innovation**.

BIOCHEMISTRY, GENETICS AND MOLECULAR BIOLOGY (1996 – 2015)

Number of documents	Citations	Document citation	H-index
7,853	93,606	11.92	102

SHARE OF PUBLICATIONS WITH FREE ACCESS



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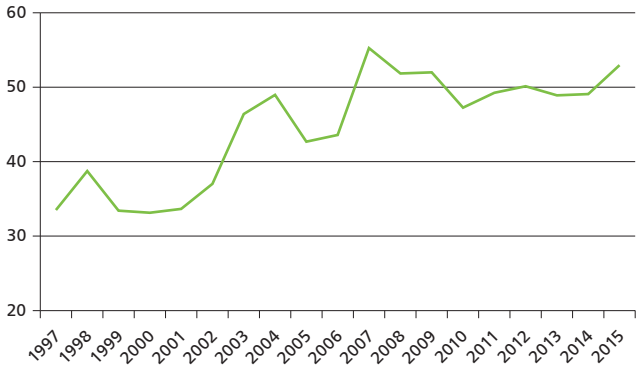
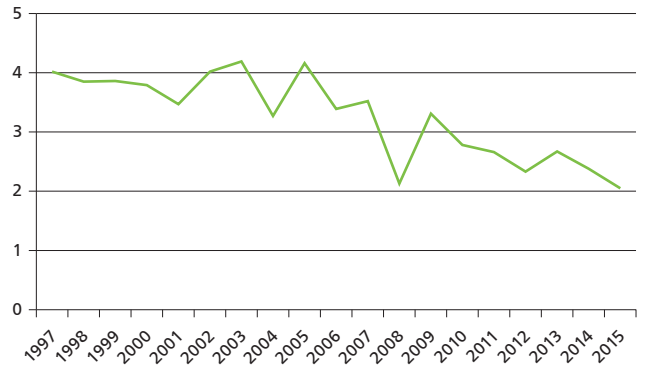
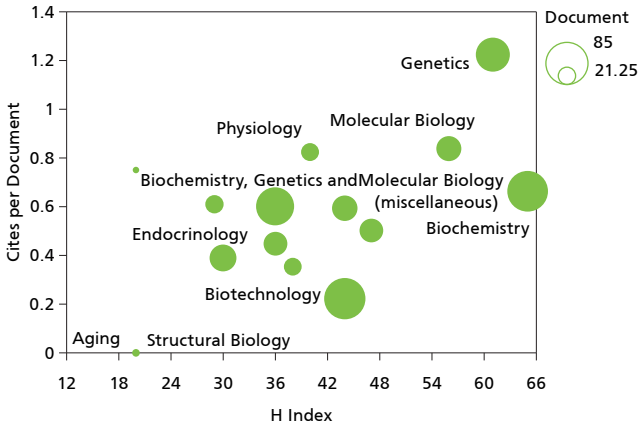


SHARE OF PUBLICATIONS IN THE SCIENTIFIC PRODUCTION OF THE REGION IN THE SAME FIELD



MAJOR CATEGORIES IN THE SCIENTIFIC FIELD



Source: SCImago. (2007). SJR — SCImago Journal & Country Rank. Retrieved September 10, 2016, from http://www.scimagojr.com

Box 2. ICT FOR THE BENEFIT OF BUSINESSES AND SOCIETY (CONTINUED)

At present such groups exist in the following areas:

- Smart management of digital content;
- Progress in 3D technologies;
- Industrial mathematics;
- Progress in materials analysis;
- Mechatronics and industrial applications.

For the implementation of fundamental and applied research and transfer of research results the IICT relies on the **successful cooperation** with a number of research and university bodies in the country and abroad, implemented mainly on a **project basis** with funding under international and national programmes. The Institute has the **trust of its business partners.** In 2015, three contracts with foreign companies and organisations and 15 contracts for applied research funded by Bulgarian companies were signed.

Most of the difficulties faced by **scientists in the course of transfer of scientific results** (which apply not only to Bulgaria) arise from the advanced nature of research. In a number of cases they not only work on commission for practical

applications (particularly in the area of new materials and large databases) but they have to prove the advantages of the results achieved – fully in line Schumpeter's "the creative destruction" related to a change of existing stereotypes, substitution of platforms, elimination of old bureaucratic procedures. This is all the more true for public areas whose management is based on the interaction of many institutions and a complex legal framework and which are publicly sensitive.

Furthermore, the technologies for analysis and visualisation of big data allow complex social systems or their elements (e.g. in health care) to be evaluated, thus proving their inefficiency. In this sense, there is little enthusiasm for the results to be presented.

Another problem arises from the fact that ICT offer solutions originating from external areas of application. Thus, in addition to overcoming the internal resistance of the system against the externally initiated changes, to address the multidisciplinary issue and the clash of cultural models, as well as the competences of the human factor who undertakes to apply them. The IICT scientists see a solution to that problem in the so-called "digital natives" – young people who are born in the digital age and who can adapt more easily to changes in the technological environment.

A factor that impacts the Bulgarian transfer market for high-tech products is the size of the company and the scale of its operations. Quite often Bulgarian research institutes remain outside the focus of interest of high-tech giants operating in the country, which have their own research and innovation potential and traditional providers of research expertise. On the other end of the scale are Bulgarian companies which, even when they are interested in joint implementation of innovation projects, do not have the financial resources for that. There are opportunities for the application of scientific results on foreign markets due to the well-known advantages of Bulgaria – a quality product at a low price, on the basis of which no long-term strategies for competitiveness could be built, however.

No less critical for the success of IICT are the well-known problems with human resources and financing. The Institute manages to raise external funding which matches its institutional budget and in this respect it is one of the leaders in the Academy. Nevertheless, not being able to rely on a steadily high public funding affects adversely the ability of the research unit to retain young people and risks its long-term survival. IICT sees itself as a talent incubator, attracting undergraduate and postgraduate students from the Technical University-Sofia and Sofia University, the Faculty of Mathematics and Informatics, as well as doctoral candidates from abroad on a project basis. But after they complete their bachelor's and/or master's studies and/or doctoral studies the young people elect to seek a job abroad or a career in business,[40] i.e. the "middle echelon" is missing to ensure continuity between generations. The software industry, due to its highest pay levels, is one of the main IICT competitors in attracting young people.

In this respect, project finance, no matter how prestigious it is, cannot provide a steady basis for high pay to researchers. Moreover, work on projects entails constant changes in research tasks, in line with the requirements and diversity of priorities of the funding instruments, which does not allow development of competences in several key specialised areas of the Institute.

Fluctuations in public finance for research units in Bulgaria are consistent with the lack of clear legislative and strategic national framework for management of research and innovation in the country. The numerous strategic documents are not supported by clear financial plans for their practical application. In addition, the great number of government institutions acting in the ICT area inhibits assumption of political responsibility for achieving the strategic goals in this area.

Source: IICT-BAS, 2016.

[40] See further the findings in the Human Resources section below.

Entrepreneurship and Innovation Networks

Entrepreneurship is one of the binding elements of the national innovation system. It is embodied in newly-established companies and in the means of interaction and exchange of information, know-how and technologies among stakeholders in the innovation economy. Entrepreneurship is crucial for the robustness, as well as the adaptability and flexibility of the national innovation system. A high spirit of enterprise and a culture of innovation should underlie the objectives of national innovation policy.

Bulgaria – modest and low-innovation entrepreneur

In 2015, for the first time Bulgaria joined the **Global Entrepreneurship Monitor** (GEM),[41] which is the largest research effort in the area of entrepreneurial ecosystem dynamics. GEM 2015 comprises 62 countries, 24 of which are European. The study evaluates **social perceptions and individual attitudes towards entrepreneurship, entrepreneurial activity at different stages of its implementation, as well as the framework conditions of the entrepreneurial ecosystem** regarded as a dynamic and institutionally determined interaction between entrepreneurial attitudes, abilities and goals of individuals who direct the allocation of resources through the process of creating and developing new endeavours.[42]

In Bulgaria, the successful entrepreneur has a high social status (according to 71.5 % of the respondents or 20th in the ranking), **entrepreneurship is perceived as a good choice for career development** (57.5 %) and **a relatively low number of respondents define themselves as being resistant to taking risks** (33.3 %, which, within Europe, is at the level of the Netherlands and only behind Finland and Slovenia).

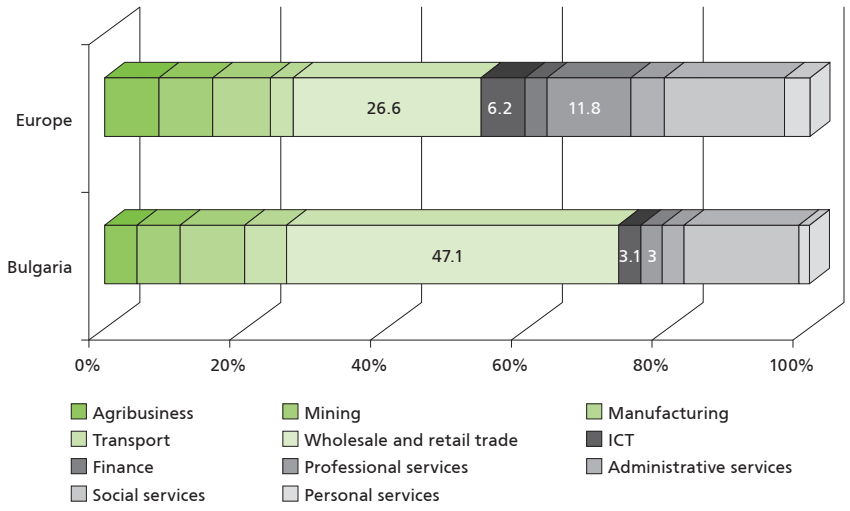
In practice, however, when it comes to concrete actions, things look differently:

- **5.3 % of the respondents** (or 59th in the global ranking and 23rd in the ranking of European countries) **express an intention to start a new business** against an average level in Europe of 12.8 %;
- **15.8 %** (58th place) **see opportunities for entrepreneurial activity compared to** 36.7 % on average in Europe;
- **35.2 % of the respondents** (53rd place in the global ranking and 21st in Europe) **demonstrate a positive evaluation of their own abilities and self-confidence as possible future entrepreneurs**.

A relatively strong reason for entrepreneurial activity in Bulgaria is the self-evaluated lack of other alternatives (33.4 % of the respondents). In the old continent only entrepreneurs in Croatia (40.1 %) and Macedonia (52.1 %) feel more driven by necessity to start their own business, at an average level for European countries of 22.4 %. On this basis, **the motivational index of entrepreneurial activity in Bulgaria** (the ratio of improvement-driven to necessity-driven entrepreneurs) **is one of the lowest in Europe** (0.9), along with the index in Macedonia (0.5) and Croatia (1.0). Leaders in the European ranking are Switzerland (6.5), Norway (6.3), Sweden (5.7) and Luxembourg (5.6), with the average level at 2.8.

As a consequence, **a large number of business ventures are concen-**

Figure 32. Sectoral structure of entrepreneurship, 2015, %



Source: The 2015 Global Entrepreneurship Monitor.

[41] http://www.gemconsortium.org

[42] REDI: The Regional Entrepreneurship and Development Index – Measuring regional entrepreneurship, http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/regional_entrepreneurship_development_index.pdf

trated in activities which do not require specific skills, competences and serious investments – above all wholesale and retail, where we have a clear lead over all the other European countries and a last place in Europe with 47.1 % at an average level of 26.6 %.

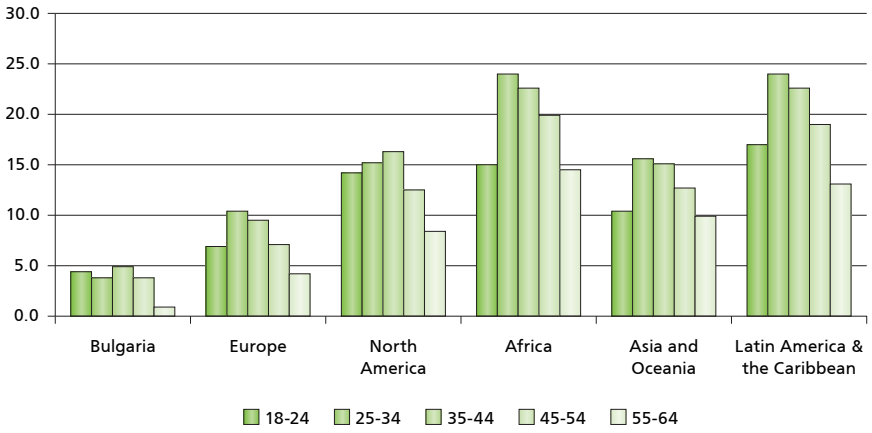
Against this background, **it is understandable that most entrepreneurially oriented are the representatives of the 35-44 age group** who had tried to participate in the labour market but for some reason had remained jobless. For them, starting up a small business is the only alternative for securing employment and income. **At all age groups the share of entrepreneurs in the country is far below the average level of Europe and the world.**

The data for those who have started up a new business (total early-stage entrepreneurship) show that **in Europe, Bulgaria has the lowest entrepreneurial activity**, which places it at the bottom of the world ranking. The index is an aggregate value, which includes entrepreneurial activity at two of the earliest stages of new business development and is based on data of the percentage of the working population in the process of starting up entrepreneurial activity (up to 3 months), as well as owners who manage their own business, which have been active in the last 3.5 years (up to 42 months). Latvia, Estonia and Romania are among the most entrepreneurial countries in Europe.

Bulgaria holds the last place in Europe (55th in the world ranking) **in terms of entrepreneurship at the workplace.** Only 0.4 % of the respondents state they have invested time and effort in new business projects as hired persons and for the employer's benefit.

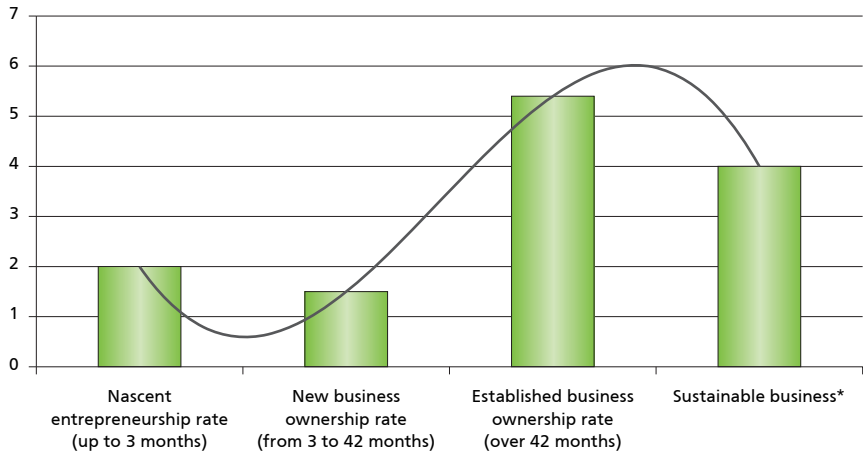
The low entrepreneurial culture and insufficient preparation for starting

Figure 33. AGE STRUCTURE OF PERSONS WHO STARTED UP A NEW BUSINESS, 2015, %



Source: The 2015 Global Entrepreneurship Monitor.

Figure 34. ENTREPRENEURSHIP LIFE CYCLE IN BULGARIA, 2015, %



* The share of owners of established business is adjusted for the percentage of discontinued businesses.

Source: The 2015 Global Entrepreneurship Monitor.

up a new successful business when entering the entrepreneurial system in Bulgaria logically lead to low levels of positive impact on the country's economic and social systems:

- **low expectations and lack of intentions for future growth** – among all countries featured in the research **Bulgaria has the highest number of entrepreneurs who state they do not expect to create new jobs in the next five years** (72.4 % of responders, compared to 46 % average level in Europe). A little over 20 % (33.3 % in Europe) indicate that it is possible to create between 1 and 5 new jobs for the same period, and only 7.3 % (compared to 20.7 % on average in Europe) have the ambition to hire 6 or more employees. In comparison, Macedonia almost entirely follows the average European levels, while Romanian entrepreneurs dem-

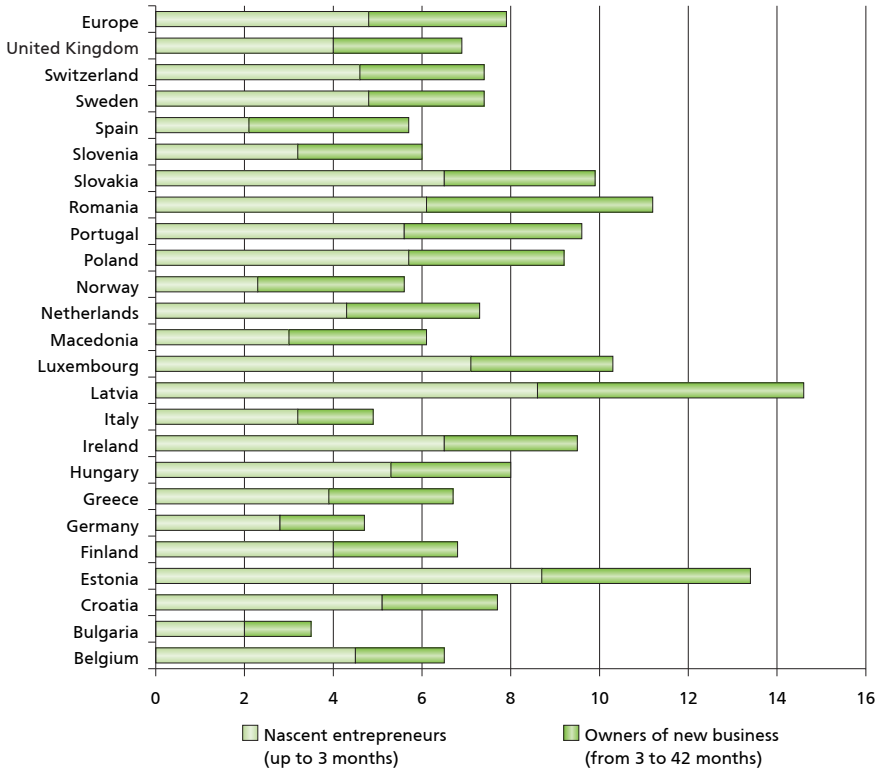
onstrate significantly higher preparedness to create jobs.

- entirely in line with their preference for low-tech economic sectors **only 8.6 % of entrepreneurs in Bulgaria indicate that their products or services are new for the end users and in this sense have developed comparative advantages** differentiating them from the rest of the entrepreneurs – a percentage which several times lower than the other European countries (59th place in the global ranking).
- **the orientation towards international markets** is inextricably linked to the degree of innovation in new business ventures. For Bulgaria, the percentage of entrepreneurs who indicate that at least 25 % of their clients are representatives of other countries is 7.9 – a result which ranks the country at the 21st place in Europe.

The poor performance of the Bulgarian entrepreneurs in the world ranking of entrepreneurial activity is determined by a number of factors. **The low trust in public institutions in Bulgaria is reflected in the evaluation by the experts of the unsatisfactory policies and programmes implemented by the government,** in particular at the start of a new business and their relevance to the needs of entrepreneurs.

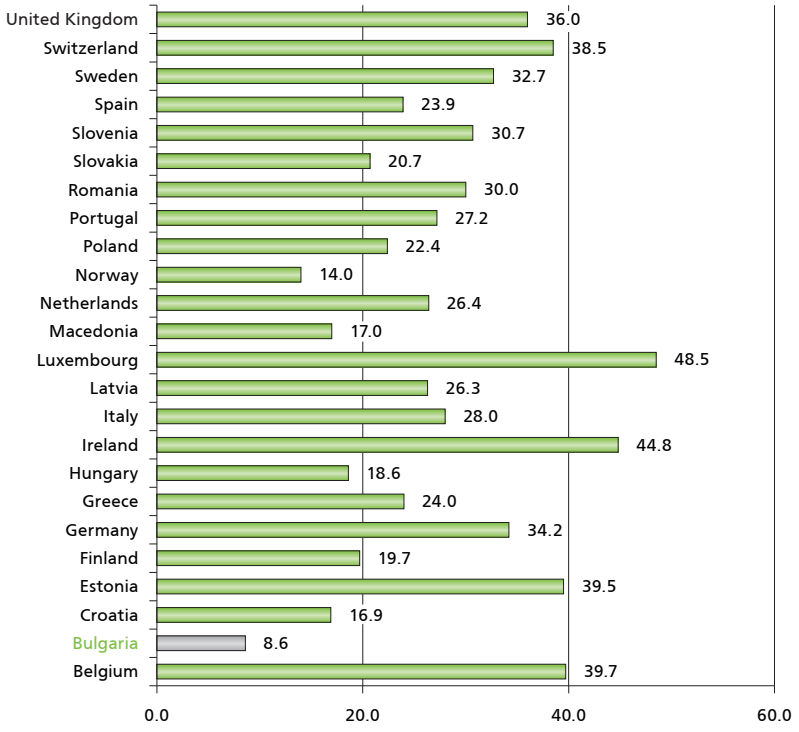
The tax policy and the opportunities for raising financial resources are appreciated much better. **An interesting measure of the trust in entrepreneurs is the willingness to invest personal funds in the undertaking of someone else – main element in the 3 Fs of the first risky investment: family, friends and fools**. In Bulgaria, 2.5 % of the respondents answer positively the question of whether in the last three years they have provided personal funds to support the entrepreneurial plans of someone else.

Figure 35. EARLY STAGE ENTREPRENEURSHIP ACTIVITY, 2015, %



Source: The 2015 Global Entrepreneurship Monitor (GEM).

Figure 36. LEVEL OF INNOVATION AND ENTREPRENEURIAL ACTIVITY, 2015, %



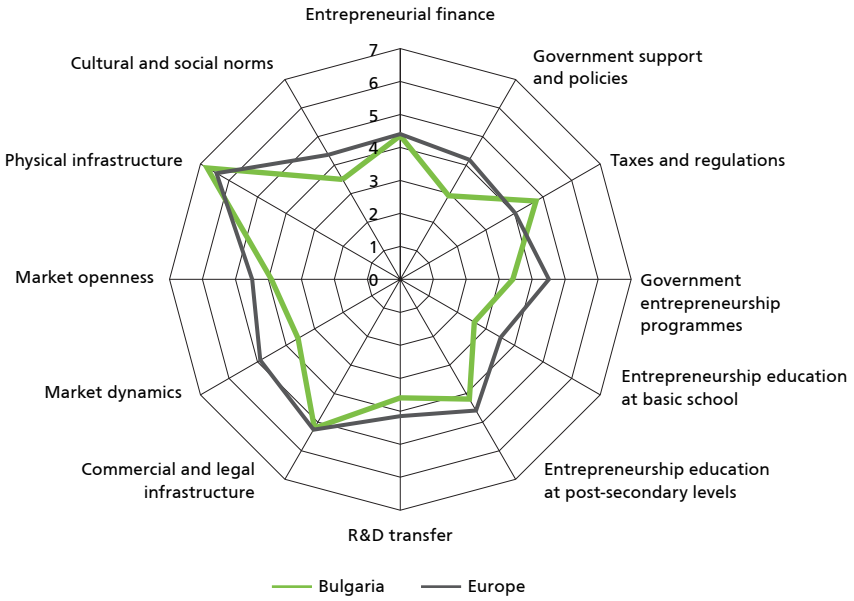
Source: The 2015 Global Entrepreneurship Monitor (GEM).

Within the 19 European countries covered by this question, in 2015 only the United Kingdom ranks after Bulgaria with a share of 2.21 %.

Against the background of the results of the other European countries, **very few of the Bulgarian entrepreneurs use public financing from national programmes for promoting entrepreneurship and small businesses** – 6.5 %. Less than 1 % are the people who have indicated venture funds as a possible source of financing, as much as the users of crowdfunding platforms – a method for fundraising through the collective effort of large groups of people, which is significantly more popular among the entrepreneurial community in Europe and across the world.

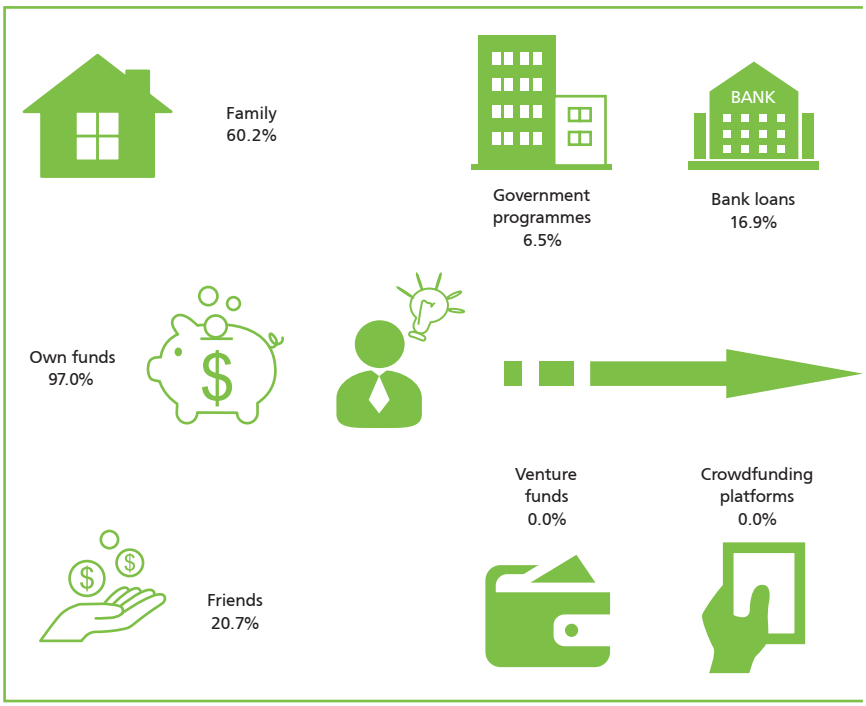
Despite the measures[43] taken in the last years for including entrepreneurship-related subjects in the curriculum at different stages of the education system, a long time will be needed before the results become visible. Education is a conservative and inert system and the negative results from the lack or the imitation of reforms will continue to influence adversely the attitudes, abilities and intentions of young people in their development as independent entrepreneurs.

Figure 37. FRAMEWORK CONDITIONS OF THE ENTREPRENEURIAL ECOSYSTEM, 2015



Source: The 2015 Global Entrepreneurship Monitor (GEM).

Figure 38. FINANCIAL SOURCES USED BY ENTREPRENEURS IN BULGARIA, 2015



Source: The 2015 Global Entrepreneurship Monitor.

[43] In November 2015 the government approved the Entrepreneurship 2020 Bulgaria Action Plan with a list of 31 measures in accordance with the Entrepreneurship 2020 Action Plan – Reigniting the Entrepreneurial Spirit in Europe (COM/2012/0795 final) of the European Commission. See Implementation Report on the Entrepreneurship 2020 Bulgaria Action Plan for 2015, https://www.mi.government.bg/bg/themes/plan-za-deistvie-pred-priemachestvo-2020-balgariya-1612-442.html

Investment and Financing for Innovation

Spending on research and innovation is a measure of the investment in the creation, use and dissemination of new knowledge in the public and business sectors. It is considered an indirect indicator of the innovation capacity of the national economies. A high ratio of R&D financing to GDP is a factor fostering dynamic economic growth and competitiveness.

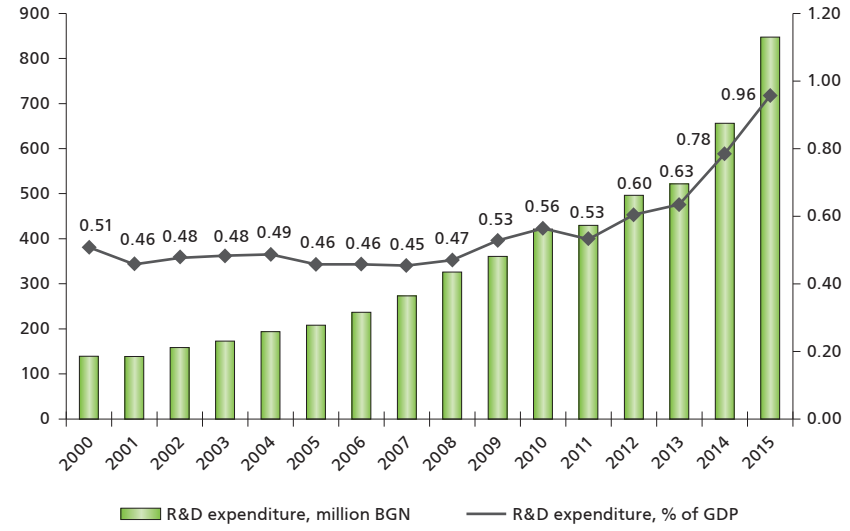
R&D spending

In 2015, **the upward trend in R&D expenditure** continued in absolute terms and as a percentage of GDP (by some 30 % from the previous year). There are two enabling factors:

- **a steady high level (ranging from 40 % to 50 % for the period after 2010, 44 % for 2015) of foreign investment in innovation projects**, including European structured finance allocated directly through the European framework programmes for applied research and development, and indirectly, through the national operational programmes, as well as foreign direct investment in research projects and subsidiaries of foreign companies based in the country's territory;
- **more than doubling from the previous year of the funds allocated by enterprises for research and development** (own and externally commissioned) and **their share in the structure of total R&D financing in the country reaching peak levels of 35 % in 2015**.

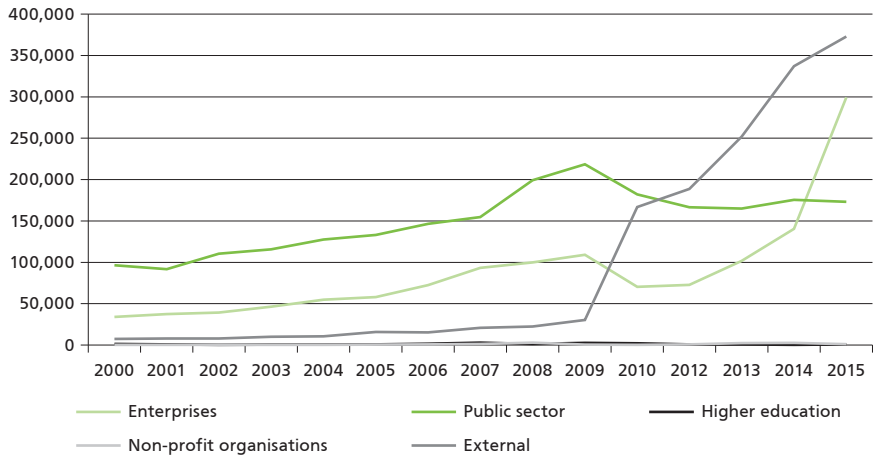
Business in Bulgaria invested approximately BGN 621 million in research and innovation projects in 2015 – an increase by 45 % from the previous year, and 10 times more than the pre-accession 2006. **Foreign finance** (53 % share in the last year of the review period) **plays the biggest role in the raising of internal private investment** (46 % co-financing from companies).

Figure 39. R&D EXPENDITURE IN BULGARIA, 2000 – 2015



Source: NSI, 2016.

Figure 40. R&D EXPENDITURE BY FUNDING SOURCE, THOUSAND BGN



Source: NSI, 2016.

The higher education sector also doubled its own funds for scientific research compared with the previous year. Nevertheless, its share in total R&D finance in the country stood negligibly low – 0.08 % in

2015, ranking the country at the last place in structural terms. **The total budget for the higher schools in Bulgaria for fundamental and applied research amounted to some BGN 46 million in 2015.** The sector offset the lack of own funds for R&D with funds received from the government, which accounted for 42 % of its budget, external project finance of 34 %, and funds for projects commissioned by the business sector approximating 23 %.

For a sixth year in a row **the share of public expenses for R&D decreased.** This is a period when external finance played a leading role in the country. **The decline on 2009 is almost triple, reaching the present level of 20.43** %. The public research units (BAS, the Agricultural Academy, and other research centres at ministries) spent almost fully the public funds for their fundamental and applied research (82.34 % in regards to sources of finance), including purely institutional finance, direct public procurement, and through the National Science Fund. Only 15 % of their budgets originated from external sources (research institutes in the country are not eligible beneficiaries under operational programmes and the National Innovation Fund; they may implement only projects commissioned by business and financing from European and other research projects is still not decisive for them).

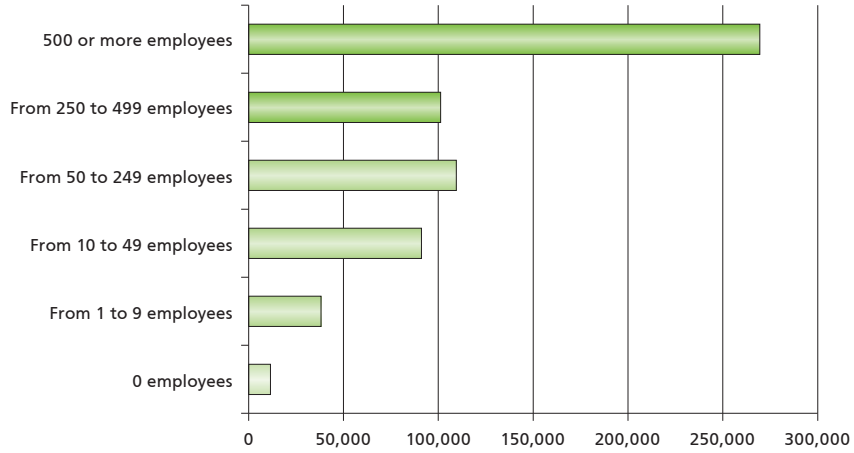
Approximately 15 % of R&D costs of the business sector in 2015 include investments in fixed assets. As regards the public sector, this "allocation for the future" amounts to slightly above 7 %, being a direct effect of the dominant institutional finance, which is allocated mainly for wages and to cover current expenses.

The intensity of the research and innovation of companies depends on their size. Although the number of large companies in Bulgaria employing over 500 persons is only 555, their budget for R&D almost equals the budget of the other groups of companies. Also, they have the highest growth in investment – for 2015 the increase is nearly 8 times compared with the previous year.

The major part of business sector expenditure for R&D is focused in two main fields of science: technical sciences (54 %) and medical sciences (41 %). There is a logical mismatch between these and the priorities of public spending, as the latter is focused on fundamental science and covers all scientific areas. The highest share (one-third) of the budget of the higher education sector is also focused on the development of technical sciences.

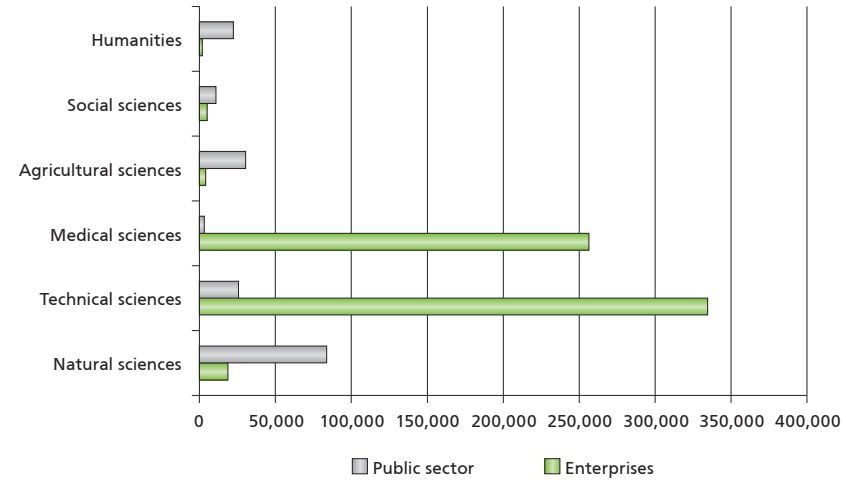
Much more balanced is the allocation of R&D expenditure among planning regions in the country in 2015, compared with the previous year. The share of the South West Planning Region fell from 83 % to 76 %, followed by the South Central Planning Region with some 8 %

Figure 41. R&D EXPENDITURE IN THE BUSINESS SECTOR BY COMPANY SIZE, 2015, THOUSAND BGN



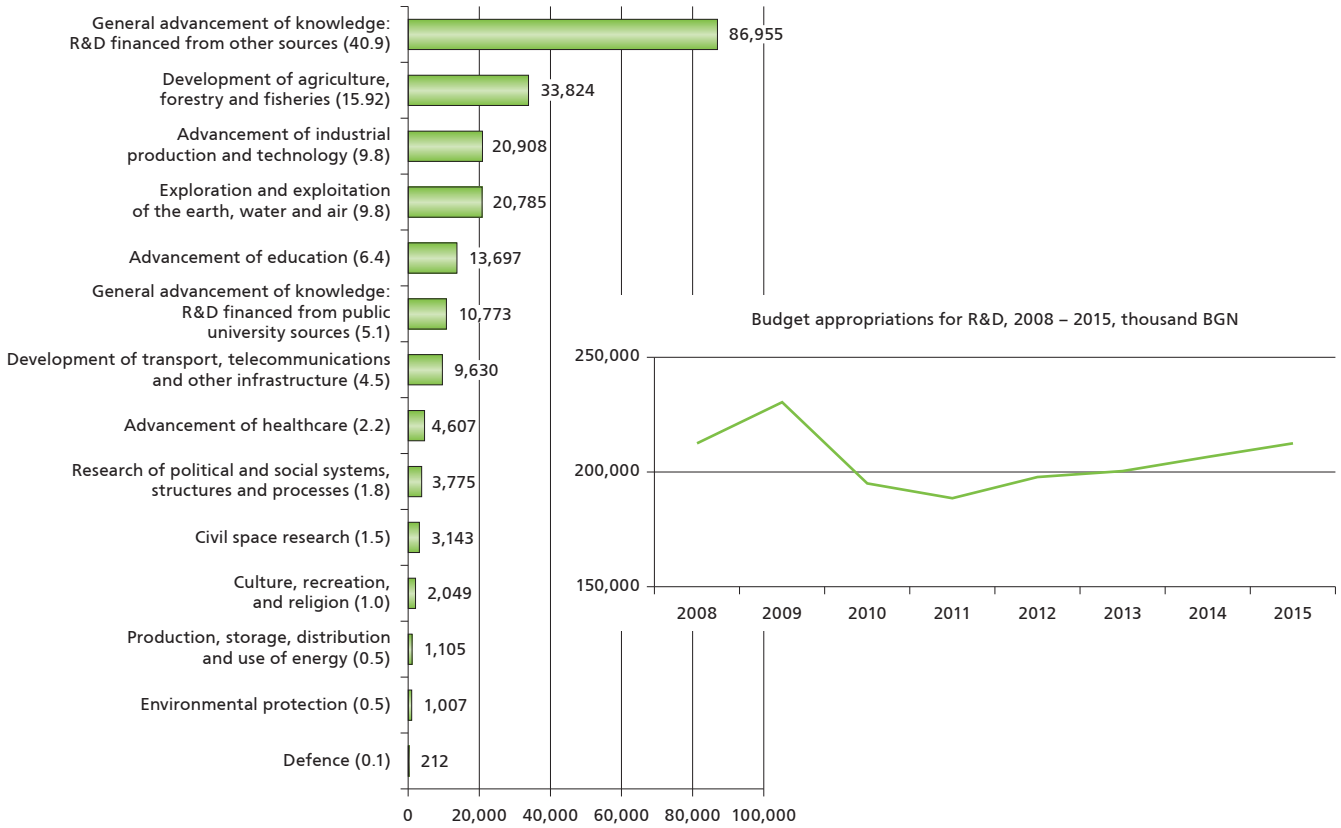
Source: NSI, 2016.

Figure 42. R&D EXPENDITURE BY AREA OF SCIENCE, 2015, THOUSAND BGN



Source: NSI, 2016.

Figure 43. BUDGET ALLOCATIONS FOR R&D BY SOCIO-ECONOMIC OBJECTIVES, 2015, THOUSAND BGN*

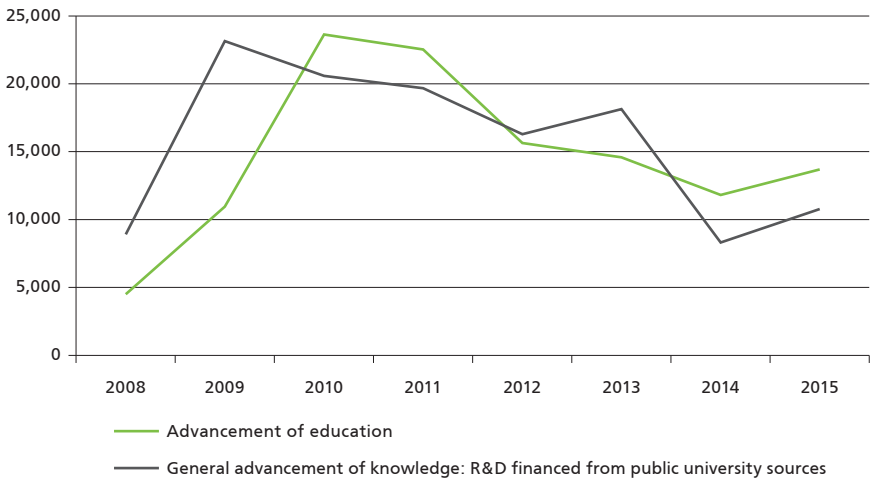


* The share of the objective in the overall allocation is in brackets.

Source: NSI, 2016.

and equal performance of the other regions within about 4 %. In all planning regions R&D investments increased and the highest growth was in the Severen Tsentralen Region (3.6 times) and the Severozapaden Planning Region (2.8 times). The regional structure of R&D costs almost exactly matches the general structure of R&D costs in the country. The main part of investments in the **public sector is concentrated in the Yugozapaden Planning Region (84 %), while financing in the other regions of the country is reduced to the bare minimum – 6 % in the Severoiztochen Planning Region and a mere 0.22 % in the Severen Tsentralen Region.**

Figure 44. BUDGET APPROPRIATIONS FOR R&D IN THE EDUCATION SYSTEM, 2008 – 2014, THOUSAND BGN



Source: NSI, 2016.

In terms of **socio-economic objectives, the highest share in the public expenditure for R&D** is the financing of BAS for fundamental research through the item "General advancement of knowledge: R&D financed by other sources", although it includes expenses for membership in CERN, the Institute for Nuclear Research in Dubna and others. Furthermore, BAS receives funding under

other thematic areas as well. In second place, with nearly 16 %, is the funding of "Development of agriculture, forestry and fishing", which is mainly allocated to the Agricultural Academy.

After a five-year period of continual reduction of spending for the advancement of education and research of publicly funded universities, the combined increase of the two budget items was slightly above 45 %. As a result, **the share of funding of the education system as a whole amounted to 11.5 % in 2015.**

Bulgaria in the EU Framework Programmes

As of August 2016, under **Horizon 2020,** 36,551 projects had been approved with a total funding of EUR 15.5 billion and with the participation of 122 countries from all over the world.[44] Out of these, **199 projects involving Bulgarian organisations raised almost EUR 22.5 million,** which ranks the country at the 21st place among the other EU member states. The two leading countries that are significantly ahead of the rest in terms of number of projects and agreed funding are the UK and Germany.

In Bulgaria, most active in the work under European projects are non-governmental organisations. The sector has the greatest number of representatives to have won European funding under the Horizon 2020 (46 organisations) and have participate in the implementation of the highest number of projects (67). **As regards approved funding, the business sector is leading.**

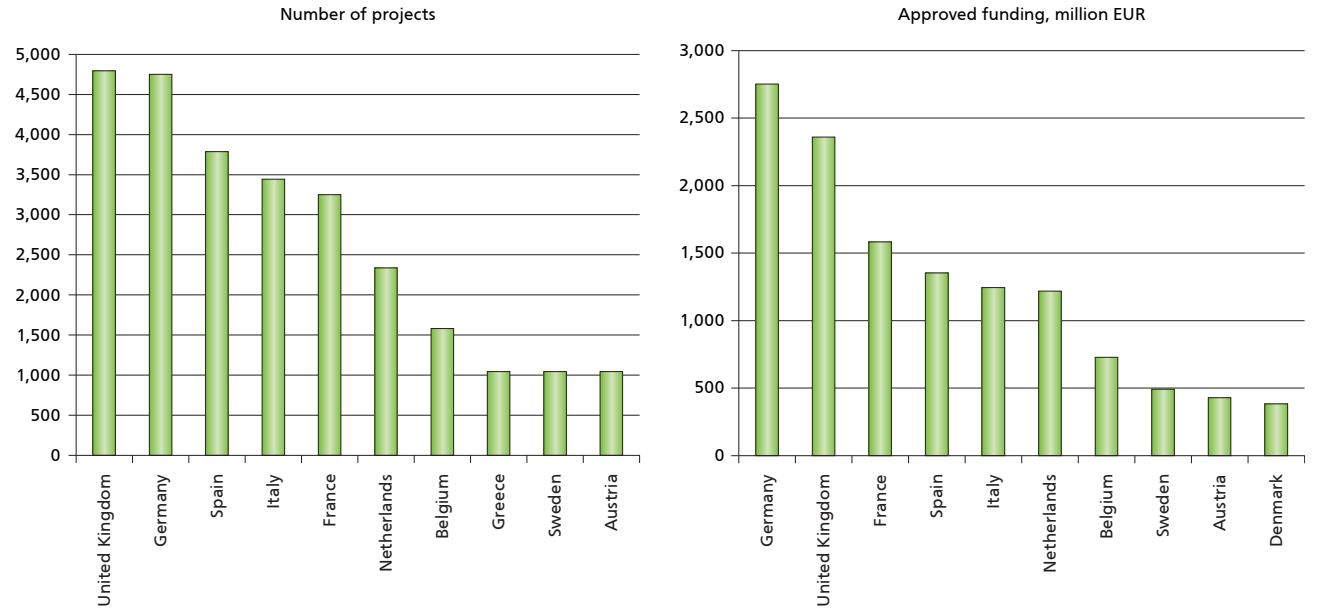
BAS participates in the framework programme with 20 of its structural units and has won 38 projects. Given the fact that the AA is a second-level spending unit at the minister of agriculture and food, **the higher education sector remains at the last place according to the number of higher schools** (14) and **the number of projects** (26), **and exceeds the public sector only in terms of approved funding** (EUR 3,824,131.24).

Sofia University has leading positions in the number of awarded projects (7) and agreed funding (EUR 1,841,237) in the higher education sector, followed by the Technical University-Sofia, Technical University-Varna with two projects each, and project budgets of over half a million euro. Plovdiv University has three projects under the framework programme.

When the employed faculty staff are taken into account, **the Technical University-Varna has the highest external funding under Horizon 2020,** followed by the Higher School of Management. Sofia University remains third.

In continuation of the tradition of the past programming period and the Seventh Framework Programme, the **Applied Research and Communications Fund (ARC Fund), along with**

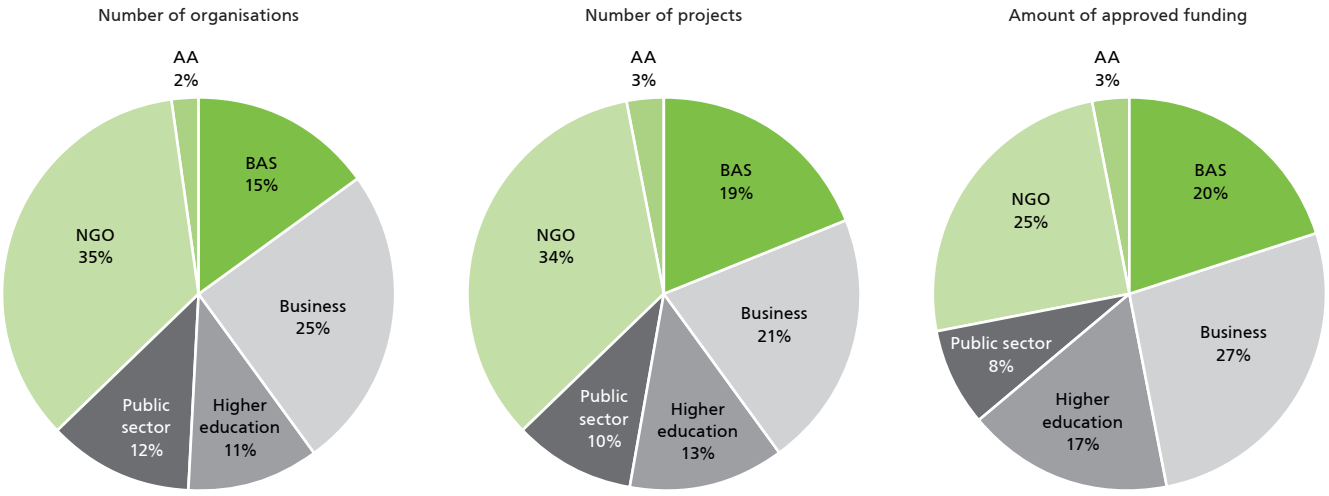
Figure 45. TOP 10 EU MEMBER STATES WITH HIGHEST PROJECT ACTIVITY UNDER HORIZON 2020



Source: European Union Open Data Portal, August 2016.

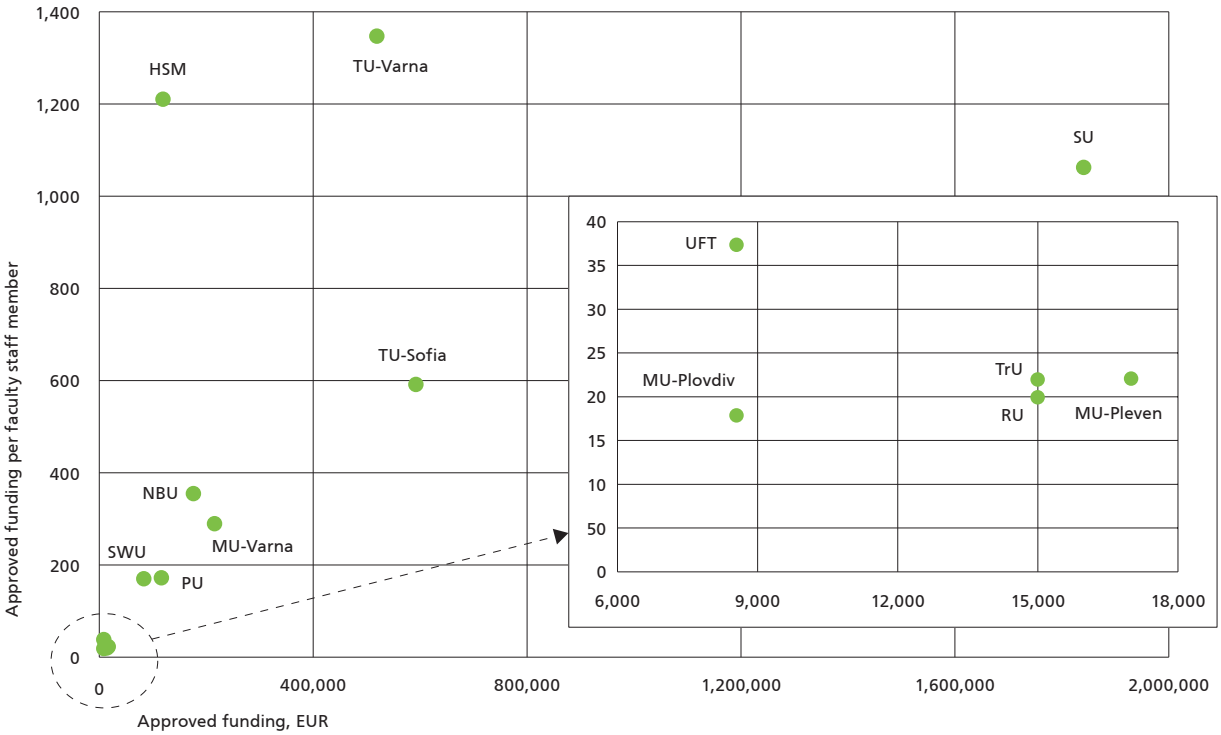
[44] European Union Open Data Portal, https://data.europa.eu/euodp/en/data/dataset?q=cordis&op=&ext_boolean=all

Figure 46. INSTITUTIONAL STRUCTURE OF BULGARIAN BENEFICIARIES UNDER HORIZON 2020



Source: European Union Open Data Portal, August 2016.

Figure 47. EFFICIENCY OF HIGHER SCHOOLS – BENEFICIARIES UNDER HORIZON 2020*



TU-Varna	– Technical University – Varna	SWU	– Southwestern University
HSM	– Higher School of Management	UFT	– University of Food Technologies
SU	– Sofia University	MU-Plovdiv	– Medical University – Plovdiv
TU-Sofia	– Technical University – Sofia	TrU	– Trakia University
NBU	– New Bulgarian University	RU	– Rousse University
MU-Varna	– Medical University – Varna	MU-Pleven	– Medical University – Pleven
PU	– Plovdiv University	MMA	– Military Medical Academy

* Military Medical Academy has not submitted data about faculty staff employed.

Source: European Union Open Data Portal, August 2016; MES, 2015/2016 school year.

its commercial unit ARC Consulting again have the highest number of awarded projects for Bulgaria under Horizon 2020.

Particularly attractive for the small businesses is **the SME Instrument**. It funds innovative projects for which the companies can apply independently or in partnership.

The projects approved under **Phase 1 Concept and Feasibility Assessment** were 1,476 in total. The funding covered activities related to technological and economic feasibility of the concept, risk evaluation, market research, intellectual property management, innovation strategy development, search for partners. The maximum amount of funding was EUR 50,000 for a six-month period of implementation. The innovation designs should have been new for the sector and possess a level of technological readiness of 6 or higher, i.e. a working prototype, demonstrated pilot system, system with a commercial design or a ready system for large-scale production.

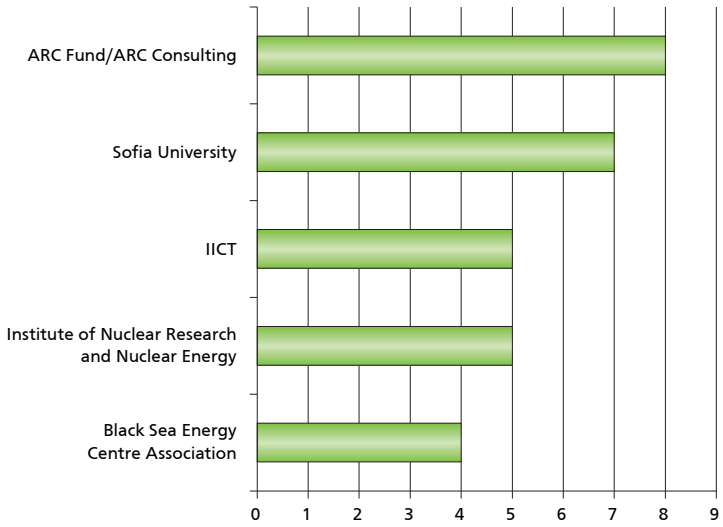
There were only four companies in Bulgaria which received funding under the SME Instrument, all in Phase 1. Most active were the companies from Spain, Italy and the United Kingdom, which held the first three places under Phase 1 and Phase 2 of the Instrument.

The symbolic number of Bulgarian companies who have won funding under the SME Instrument is not due to the lack of interest by business. **With 413 submitted projects and 408 projects that have passed the evaluation procedure under Phase 1, Bulgaria holds the 12th place within the EU.** The main advantages of the SME Instrument include the following:

- Stage support of innovation project development, which begins with evaluation of the economic viability (phase 1), development and demonstration of the innovation (phase 2) and non-financial support for the commercialisation of the innovation results (phase 3). This way the company may apply directly for the phase reached by it in its innovation cycle.
- The fast "time to grant" procedures and lack of bureaucratic impediments from the deadline for submitting proposals until the signing of a contract for the successfully awarded projects. The "time to grant" for phase 1 was 3 months, for phase 2 – up to 6 months, which corresponded to the business dynamics of innovative firms.

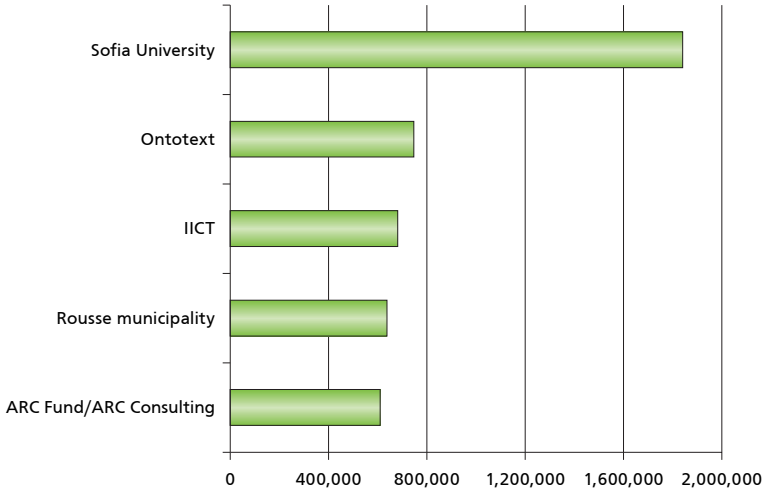
Most of the submitted Bulgarian projects, however, failed to pass the

Figure 48. TOP 5 BULGARIAN BENEFICIARIES UNDER HORIZON 2020, NUMBER OF PROJECTS



Source: European Union Open Data Portal, August 2016.

Figure 49. TOP 5 BULGARIAN BENEFICIARIES UNDER HORIZON 2020, APPROVED FUNDING, EUR

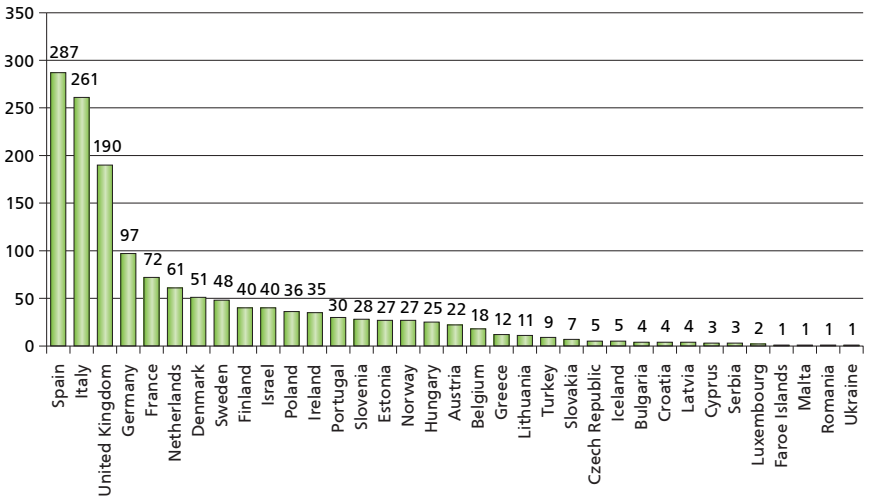


Source: European Union Open Data Portal, August 2016.

threshold of 13 points or 4 out of 5 points maximum on each of the three criteria: excellence, impact and implementation. The main reason for the extremely low success rate of Bulgarian companies when applying to the SME Instrument should be sought in the following features of the national innovation ecosystem, which pose serious challenges to companies:

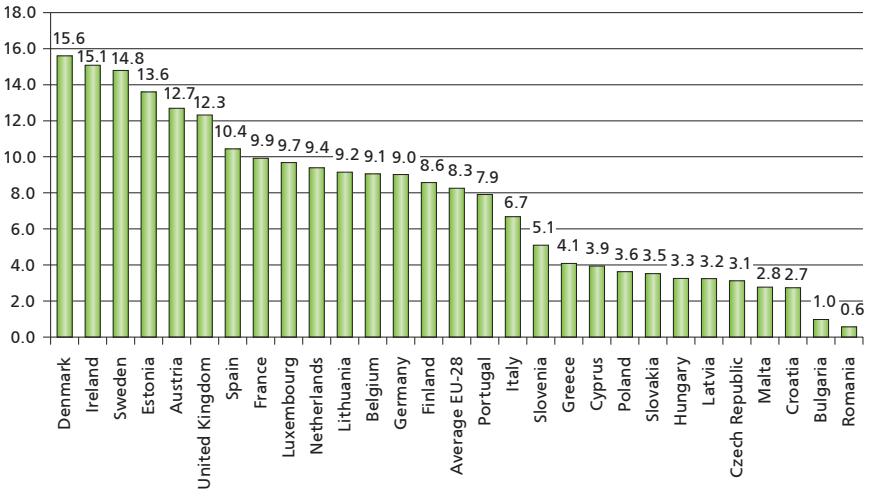
- The applicant company needs to make an unbiased and comprehensive evaluation of the degree of innovativeness and the market potential of the innovation with which it intends to apply to this funding instrument because the latter is intended for support of the so-called innovation champions. A priority of the instrument are innovations at European and global levels, demonstrating high market demand or creating new markets, as well as innovations that are in high priority technological areas for the European Union.
- The evaluation of the technological readiness level (TRL) of the innovation is a complicated process and needs to be done as precisely as possible when applying for funding. The TRL degrees are assessed specifically, depending on the innovation sector and the specifications of the innovation processes in it. For instance, TRLs in healthcare include clinical trials, while in ICT there are differences in TRLs with hardware and software developments which have to be taken into consideration. In complex innovations consisting of several components, the evaluation of the TRL is complicated further because the readiness of each component in the system needs to be taken into consideration.
- The application to the funding instrument and evalua-

Figure 50. NUMBER OF PROJECTS FINANCED UNDER THE SME INSTRUMENT, BY COUNTRY, PHASE 1



Source: Executive Agency for SMEs.

Figure 51. SUCCESS RATE IN THE SME INSTRUMENT, PHASE 1, EU-28, %



Source: Executive Agency for SMEs.

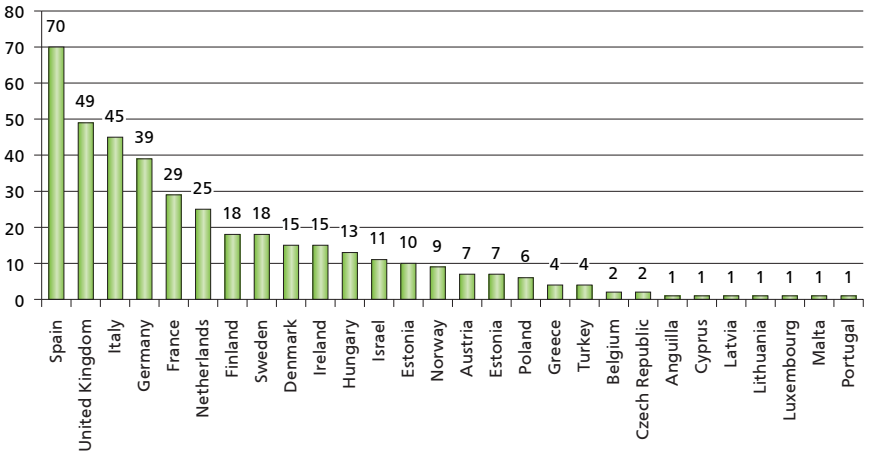
Table 4. APPROVED PROJECTS OF BULGARIAN COMPANIES UNDER THE SME INSTRUMENT

SME	City	Phase under the SME Instrument	Deadline for submission of projects
Cores	Varna	Phase 1 (2014)	December 2014
Comac Medical	Sofia	Phase 1 (2015)	June 2015
Scad	Bourgas	Phase 1 (2015)	September 2015
Bulteh 2000	Stara Zagora	Phase 1 (2015)	November 2015

Source: Executive Agency for SMEs.

tion of the project proposals is in a highly competitive environment among the most innovative companies in the EU, with which ambitious Bulgarian companies having the potential for growth and internationalisation have to compete.

Figure 52. NUMBER OF PROJECTS FUNDED UNDER THE SME INSTRUMENT, PHASE 2



Source: Executive Agency for SMEs.

Human Capital for Innovation

The staff engaged in R&D together with those engaged in scientific and technological activities measure the 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 sectors reveals the country's specialisation in high innovation activity sectors.

Human resources in research and innovation

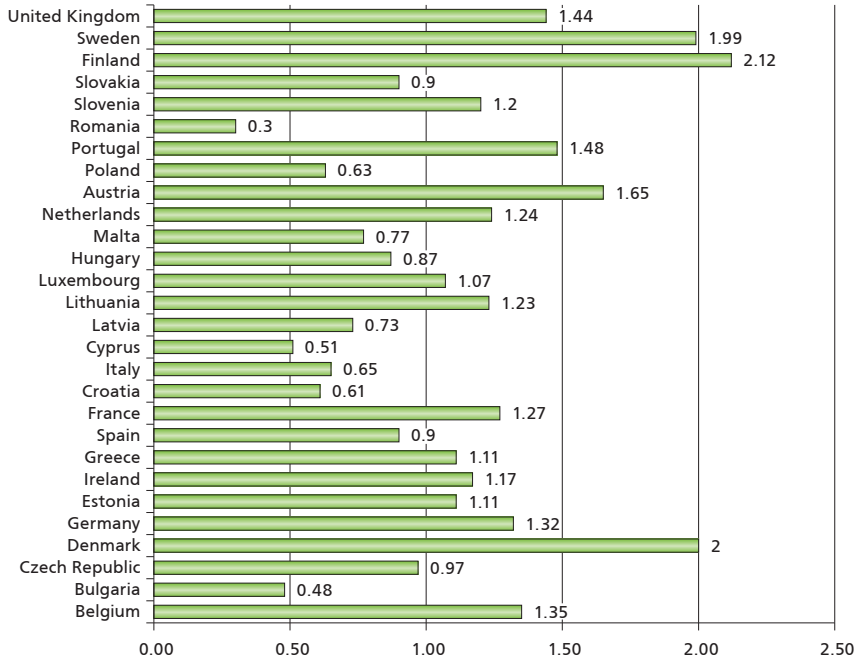
In 2015, the staff engaged in R&D in Bulgaria numbered 29,519 persons. Of these, 19,326 – a little over 65 % – were researchers. After 2000, the number of researchers has been constantly increasing, but **the country still holds one of the last places in EU-28 by the share of researchers in the working age population** – only 0.48 % in 2013, which is sufficient to exceed the rate of Romania, but is far from the average level of 1.12 % for EU-28.

Innovation leaders in Europe have much more human resources (around and over 2 % of the working age population) engaged in basic and applied research, hence their results constitute a sound basis for further application in practice in the form of product or process innovations.

Approximately 40 % of the R&D staff is in companies. In 2015, **the business sector almost doubled the number of the staff engaged in research and development compared with the previous year,** in contrast to the public and the higher education sectors where the trend reversed.

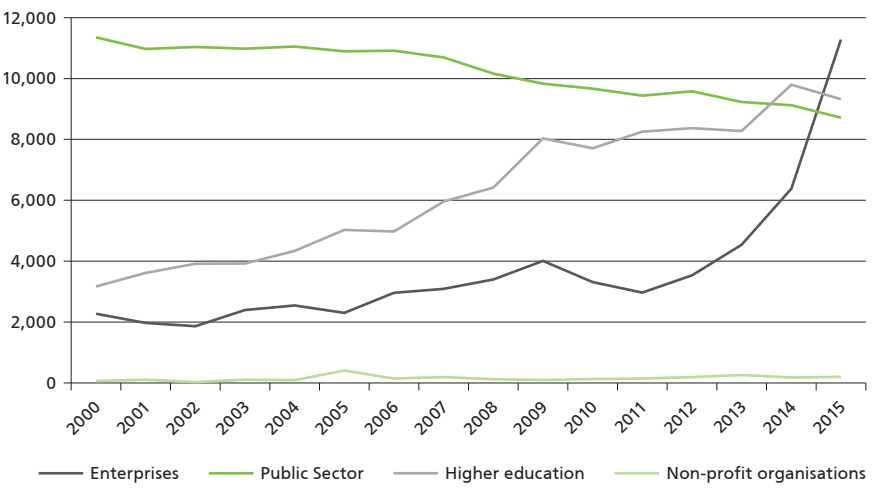
After 2000, the public sector has been the only sector that has been constantly reducing its R&D staff, which represents a drop of 23 % over the entire period. The diverging trends between academic institutions focused on fundamental research and academic staff of tertiary education schools engaged mainly in teaching result in a comparative balance of the positions of the two sec-

Figure 53. R&D STAFF, EU-28, 2013, % OF THE WORKING AGE POPULATION



Source: Eurostat, 2016.

Figure 54. NUMBER OF R&D STAFF, BY INSTITUTIONAL STRUCTURE, 2000 – 2015



Source: NSI, 2016.

tors in the institutional structure by this indicator. In practice this means that in quantitative terms there is a drop in the number of personnel engaged in fundamental science in favour of applied research.

Over the last ten years, the reduction of R&D staff in the public sector applied to all age groups, except for those under 25 (for whom the growth in 2015 was almost triple compared with 2005) – an age that is suitable for obtaining doctoral degree and commencing research. The difference in the age group from 25 to 34 is drastic: the drop there is by 45 % and it is most serious in terms of age structure. Outflows are most often related to searching for career opportunities abroad or in the private sector, and more rarely in the higher education sector.

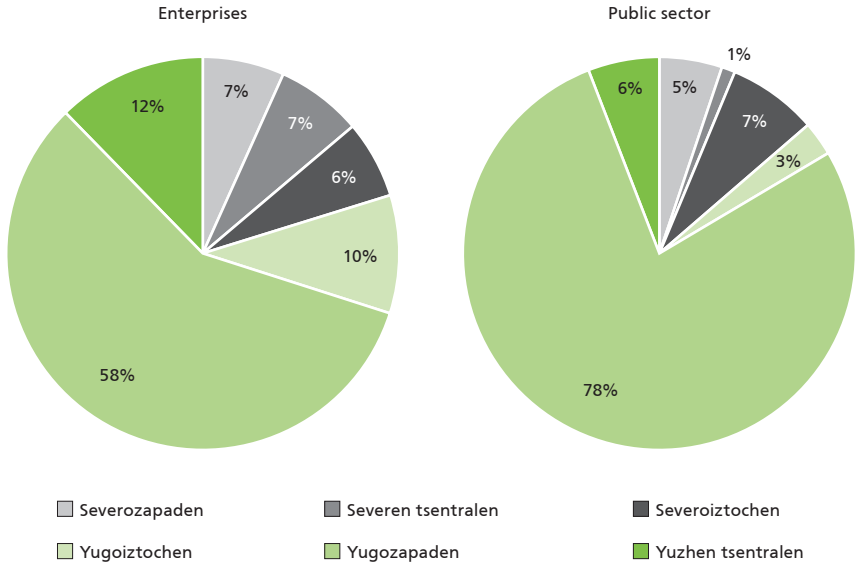
In the higher education sector the upward trend in the number of academic staff applies to all age groups and is most pronounced again with regard to researchers aged under 25 (over five-fold increase in 2015 versus 2005) and gradually decreases with age.

The greatest share (40 %) of R&D staff is in the technical sciences – a lead which is clearly visible after the 40 % increase over the last two years. The main supporting factor in this case is the higher investment of businesses, which is mainly directed to that field. Natural sciences attract half as many researchers (19 %), followed by medicine (15 %). In the last year, **the only drop was in the field of agricultural sciences** by about 20 %.

The greater share (59 %) of the R&D staff in 2015 was concentrated in the Yugozapaden planning region, remaining nearly unchanged at the previous year's level. Despite the faster growth in research staff against the base year 2000 in all the other regions (from 1.92 times for Severozapaden region to 3.87 times for Yuzhen tsentralen region), **the Yugozapaden region** (mainly the capital Sofia) **retained its positions of a research hub of Bulgaria.**

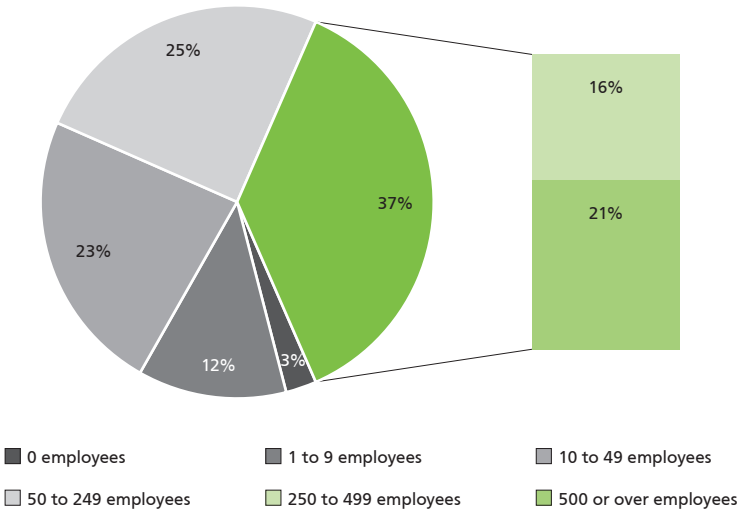
The regional structure of the research staff in the enterprises sector almost fully matches the average for the country. Outside the non-profit organisations sector, whose potential is mainly concentrated in Yugozapaden region, the regional distortions are most drastic in the public sector, with over 80 % of all R&D staff being concentrated in the capital. **Most balanced is the territorial distribution of academic staff in higher schools**.

Figure 55. R&D STAFF BY PLANNING REGION, 2015



Source: NSI, 2016.

Figure 56. R&D STAFF IN THE ENTERPRISES SECTOR BY SIZE OF ENTERPRISE, 2015, %



Source: NSI, 2016.

Within the enterprises sector, **size is decisive both in terms of investments made**[45] **and in terms of the number of research staff**:

- **The highest innovation activity driven by own applied research and development is in large businesses** (over 250 employees), followed by the group of medium-sized enterprises (10 to 49 employees).
- The dynamics of research staff recruitment are similar. In 2015, **the enterprises with over 500 employees tripled their R&D staff on an annual basis**. The growth in the number of research staff is also high in small and medium enterprises (1.79 and 1.75 times respectively).
- **Large enterprises have the highest level of applied research measured by the higher share (over 75 %) of researchers** within total R&D staff, unlike the other groups of enterprises whose efforts are focused mainly on development and demonstration projects in which technical and support specialists have a more significant share (about and over 50 % of the R&D staff).

Potential for development

An important indicator of the potential of the economy to develop and apply innovations based on the creation of new technological knowledge are higher education graduates from the scientific and technological fields. If they find a reason to stay in the country and manage to find employment matching their expertise, they would ensure sustainability and improved innovation of businesses, research and academic bodies.

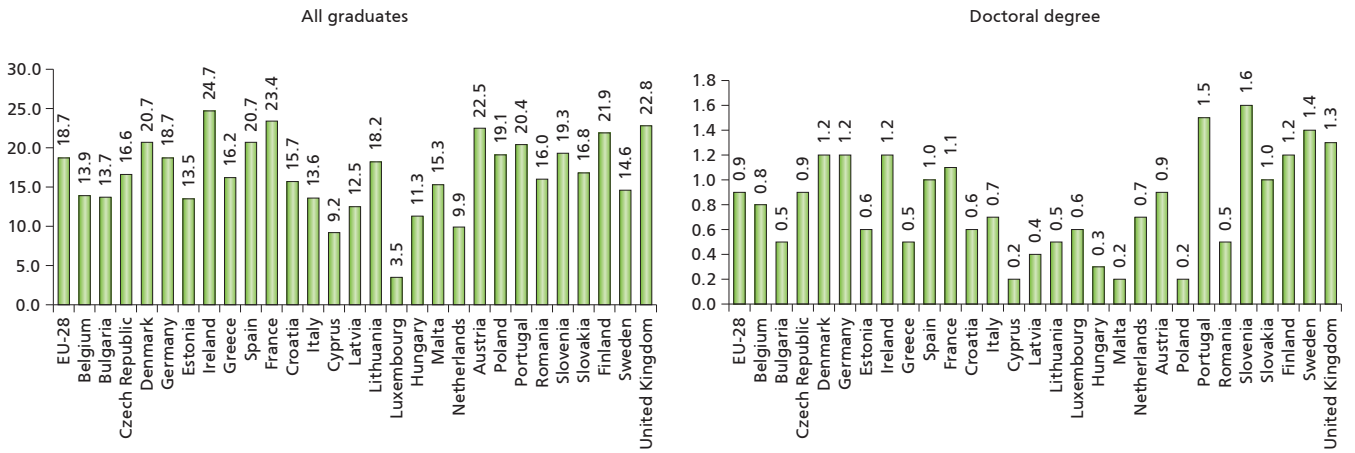
According to Eurostat data for 2014, **the share of graduates from scientific and technological fields of education in Bulgaria amounted to 13.9‰ of the population aged 20-29 versus the EU-28 average of 18.7‰ and is far below the levels of the innovation leaders**. In addition, the country's position with respect to doctoral degree graduates needs improvement.

Given NSI longer-term data (since 2010) it can be safely assumed that there are signs of such improvement. The average increase in the share of doctoral graduates in scientific and technological fields is 1.44 (ranging from 1.23 for the physical and chemical sciences to 2.35 in architecture and building). Given, however, that the average increase for all fields of education is 1.65, this suggests that the interest of students is still directed outside science.

Bulgaria seems to be an educational hub of neighbouring countries and countries in the region. This refers mainly to our southern neighbours whose students study mainly in the fields of medicine and technical sciences, the countries from the former Yugoslavia and countries with a strong Bulgarian diaspora.

In addition, there is another group of students with completed previous level education in another country, including: United Kingdom (861 students), Germany (659 students), Italy (278 students) and others. These include mainly Bulgarian citizens who

Figure 57. TERTIARY GRADUATES IN SCIENTIFIC AND TECHNOLOGICAL FIELDS OF EDUCATION,* PER 1,000 PERSONS OF THE POPULATION AGED 20-29, 2014



* Science, mathematics, computing, engineering, manufacturing, construction.

Source: Eurostat, 2016.

[45] See further the previous section.

have completed secondary education or obtained a bachelor's degree and have decided to return to Bulgaria for the next educational degree.

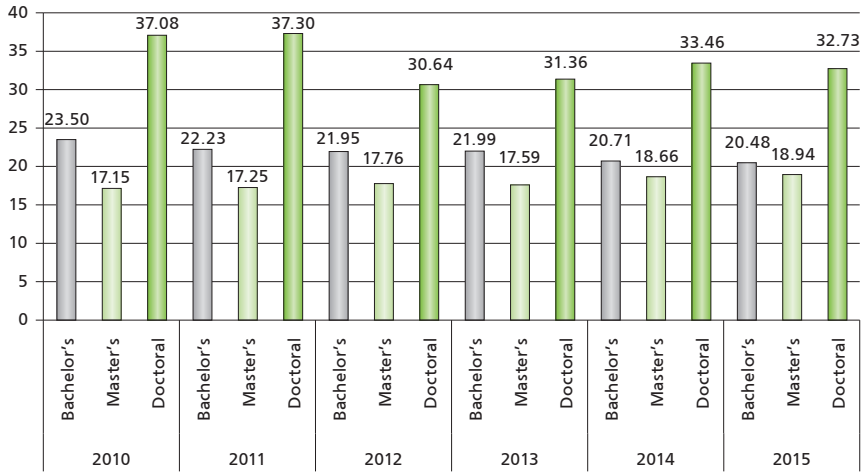
Over the last 5 years, the admission of mobile students in Bulgaria rose by 15 % (or 1,558 students). At the same time, after 2010 the number of all students studying for tertiary degrees in the country has decreased – by 9 % for the last academic year, and by 12 % for the whole five-year period (or 32,832 fewer students). The adverse effects of the demographic crisis and the continuous brain drain of students studying abroad persisted in higher education, and hence in the labour market.

For students, participating in **Erasmus+**, which is effective from the beginning of this programming period, is of key importance for building professional competences and successful career development. The objectives of the programme go beyond education by linking it with the needs of businesses so as to ensure higher competitiveness through the channels of vocational education, lifelong learning and involvement of businesses in sustainable partnerships with educational institutions. Such interaction and mobility have an impact on the personal, social and nation-wide levels.[46]

In the period 2007 – 2014, **11,645 students from 37 higher schools in Bulgaria took part in student exchange programmes and had part of their studies abroad**. For the seven-year period their number rose by 55 %, from 1,140 students in the 2007/2008 academic year to 1,757 students in the 2013/2014 academic year. The most attractive countries for Bulgarian students are Germany, Spain, France, Turkey, Italy and Portugal.

In the same period, **5,224 foreign students studied in 47 host educational institutions in Bulgaria**. Their number doubled to 894 students in the 2013/2014 academic year. Bulgaria attracts students mainly from Poland, Spain, France, Portugal and Germany.

Figure 58. TERTIARY GRADUATES BY DEGREE LEVEL, SCIENTIFIC AND TECHNOLOGICAL FIELDS OF EDUCATION, 2010 – 2015, % OF ALL GRADUATES



Source: NSI, 2016.

Table 5. MOBILE STUDENTS, TOP 10 COUNTRIES OF COMPLETED PREVIOUS LEVEL OF EDUCATION, 2015/2016 ACADEMIC YEAR

Country of completed previous level of education	Number
Greece	3,141
Turkey	2,489
Ukraine	561
Macedonia	553
Serbia	402
Cyprus	351
Moldova	318
Russia	286
Albania	198
Kosovo	58
71 % of all 11,777 mobile students studying in Bulgaria in the 2015/2016 academic year	8,357

Source: NSI, 2016.

The **low rates of participation of adults in lifelong learning** are a worrying trend. Eurostat data for 2015 show that **with a 2 percentage involvement of adults in training programmes Bulgaria, comparable**

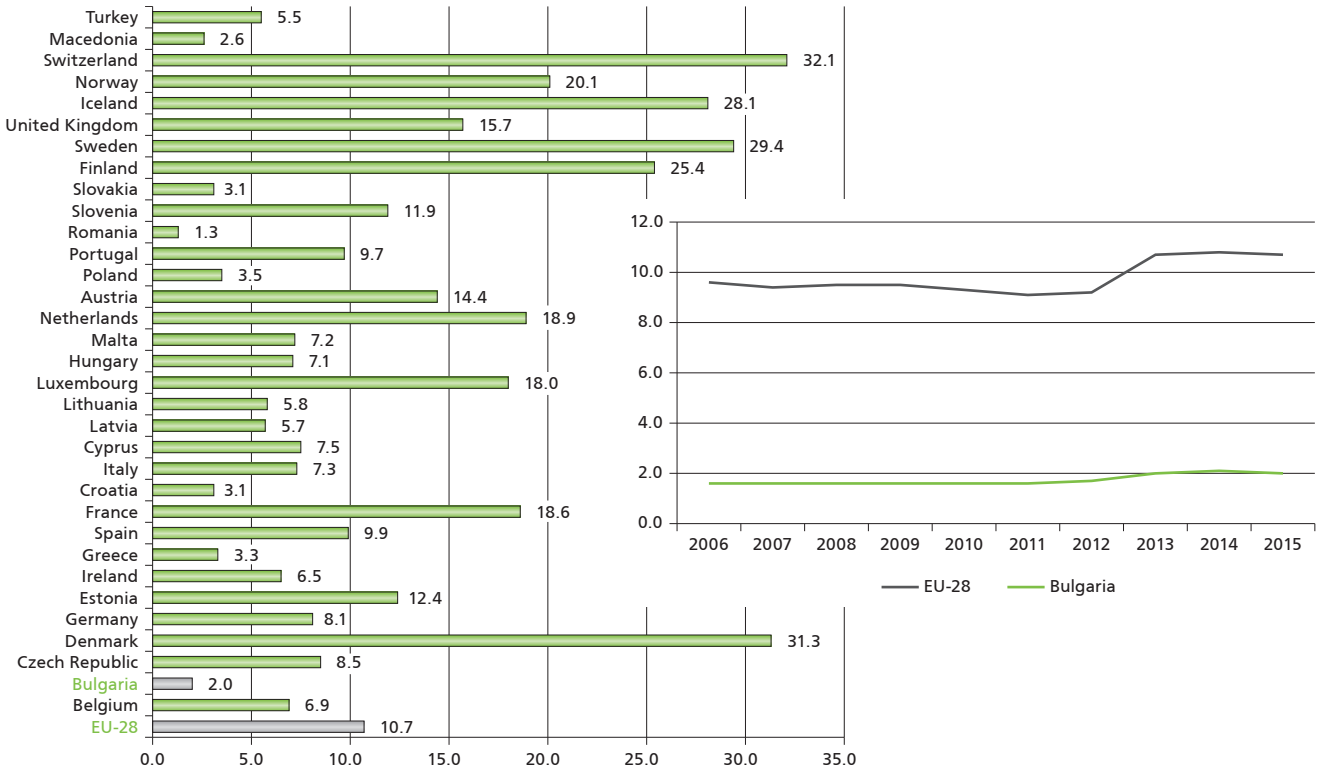
[46] CHE Consult (2016) *The Erasmus Impact Study, Regional Analysis*, Luxembourg: Publications Office of the European Union, http://www.naerasmusplus.cz/file/2035/erasmus-impact-study_en.pdf

Table 6. TOP 10 HIGHER SCHOOLS IN BULGARIA WITH THE LARGEST NUMBER OF MOBILE STUDENTS, 2013/2014 ACADEMIC YEAR, NUMBER

Host institution	Number	Home institution	Number
Sofia University	104	Sofia University	274
Veliko Tarnovo University	66	University of National and World Economy	161
University of National and World Economy	52	Veliko Tarnovo University	160
University of Economics – Varna	40	Technical University – Sofia	126
American University in Bulgaria	38	University of Economics – Varna	122
National Sports Academy	32	Naval Academy	84
Medical University-Plovdiv	30	Rousse University	75
Technical University – Sofia	30	University of Architecture, Civil Engineering and Geodesy	69
University of Architecture, Civil Engineering and Geodesy	29	New Bulgarian University	46
National Military University	28	Technical University – Varna	42

Source: EC Erasmus Statistics 2013-14, http://ec.europa.eu/education/resources/statistics_en

Figure 59. PARTICIPATION OF THE POPULATION AGED 25-64 IN EDUCATIONAL AND TRAINING PROGRAMMES IN THE LAST 4 WEEKS, 2015, %



Source: Eurostat, 2016.

only to Romania, is dwarfed by the innovation leaders in Europe (with over 30 % participation) **and almost all the European countries.** There seem to be no long-term prospects for efforts to bridge the gap.

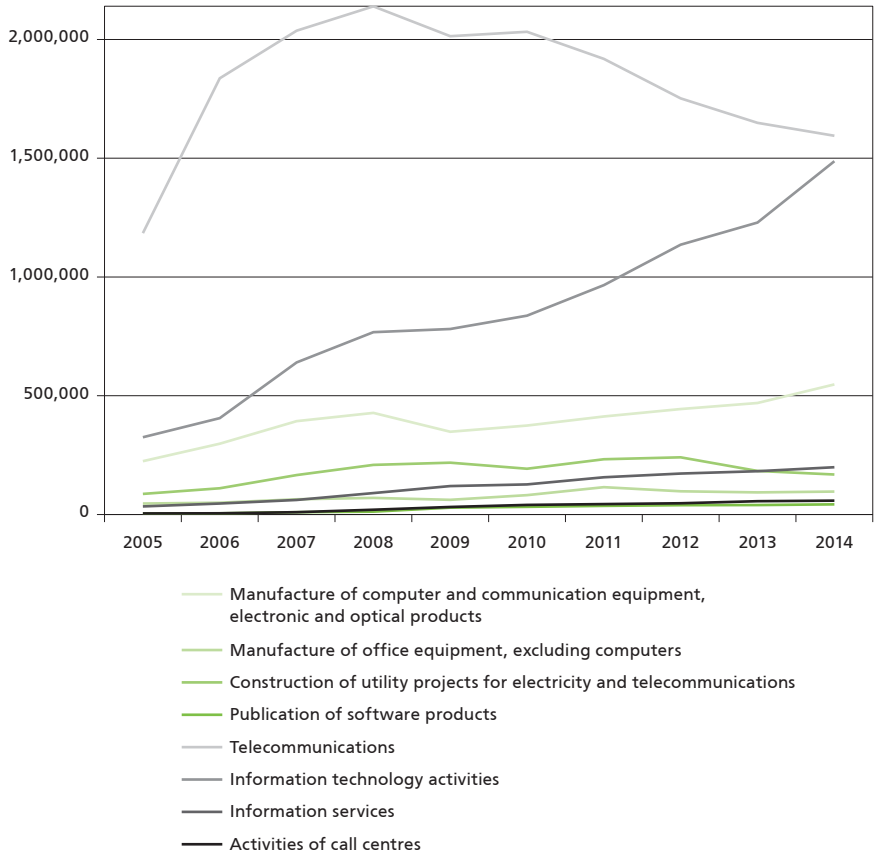
Moreover, the issue concerns participation in short-term, informal educational and training programmes, which do not require serious investments, but rather build on existing knowledge and add skills which are crucial to the development of human resources.

Against the background of the dynamic development of technologies and labour market demands, which increasingly result in the creation of new professions and narrow specialisation of existing professional competences, relying on the knowledge obtained at the stage of formal education means utter lack of understanding of the processes of change in social and economic life. Such reliance forgoes the opportunities for personal accomplishment and hence for adding value to the community in which one lives.

Information and Communication Technologies

The information and communication technologies (ICT) sector and related sectors have generated steady growth over the years. The share of revenues of ICT companies in total revenues of all companies increased from 4 % in 2005 to 6 % in 2014, and the share of related sectors, from 5 % to 7.3 % respectively.[47] In particular, the IT sectors (NACE 62 and 63) have increased by 370 % in total, against a total revenue growth of 50 % for the economy as a whole. The companies from the sub-sector of data processing, hosting and related activities (NACE 6311) increased their turnover 10 times for a period of ten years and those in computer programming (NACE 6201) 7 times. Even higher growth rates are reported for the software publishing sub-sector (NACE 582), where the turnover in 2014 was about 12 times higher than in 2005, for the manufacturing of loaded electronic boards sub-sector (NACE 2612) – 12.5 times higher – and some 14 times higher revenue growth for call centres (NACE 8220).

Figure 60. DYNAMICS OF REVENUE IN SELECTED ICT SUB-SECTORS, 2005 – 2014, THOUSAND EUR



Source: Amadeus, Bureau van Dijk.

The revenues of the telecommunications sector nearly equal those of the IT sector. The peak revenue in telecommunications was generated in the pre-crisis 2008 for Bulgaria. A drop in revenue followed, with a slight attempt at recovery in 2010. The revenue of the biggest companies in the sector – Vivacom, Mobiltel and Telenor – decreased. In 2015, aggregate revenues rose by BGN 600,000. The biggest loser was Mobiltel with BGN 22 million less revenue, and the biggest winner was Telenor with BGN 15 million increase in 2015 compared with 2014. Given the fact that both Vivacom and Mobiltel offer fixed internet along with mobile telephony and television, and Telenor does not, then Telenor has exceeded Mobiltel and is little behind Vivacom by revenue from mobile communications. After the acquisition of Blizoo, total revenues of Mobiltel would probably approximate that of Vivacom. Mergers and acquisitions among internet providers in the last 10 years transformed some of the revenues reported in the wired telecommunications sector into revenues reported in the wireless telecommunications sector. Although competition in the sector is not as strong as in the EU (at least measured in terms of market concentration of the biggest operator – 39 %, and above average EU levels), investment in networks is above the average level (24 % of revenues), there is good 3G coverage, and years' long convergence of services (mobile telephony, mobile and fixed next generation access internet and television). By all broadband internet indicators – geographic coverage and affordability, home and business subscribers, quality and speed Bulgaria is above the average European level. However, too many users of mobile telephone sets cannot afford smart phones, or data plans and the country lags behind Europe by this indicator.

[47] All data are computed through Amadeus database, Bureau van Dijk.

One measure of the level of electronisation of key business processes is the summary e-business index of the European Digital Scoreboard.[48] It measures what part (without weighing) of 12 e-business technologies is used by non-financial enterprises with 10 or more employees. In some cases this concerns technologies (having a website, whether websites use B2C functionalities, presence in the social media, use of ERP or CRM, sharing information on the supply chain, broadband access to internet with capacity of over 30 mbps), and in other cases it measures certain intensity of use or sophistication of available technologies (most employees use internet in their work, over 20 % of the employees use mobile devices for work purposes, the website has sophisticated functionalities, access to specialised ICT skills, at least 1 % of the revenue is generated from e-commerce).

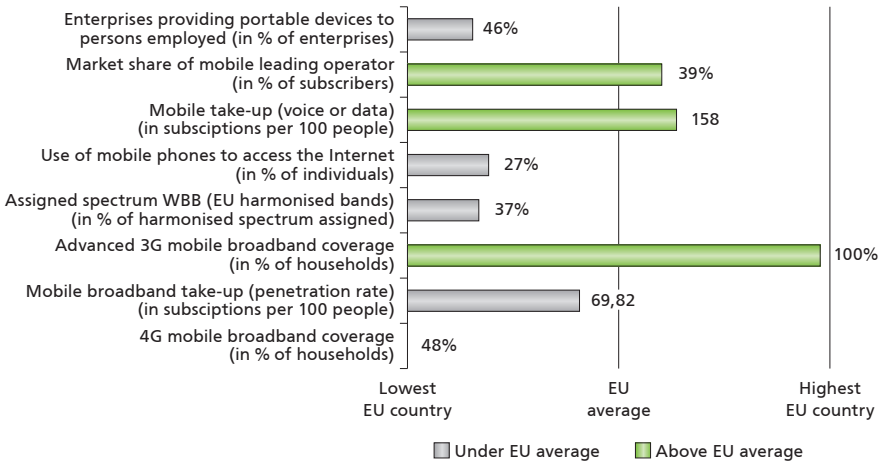
Certainly, this indicator is not sensitive to the most recent innovations in e-business, does not capture early adopters and micro-trends observed in companies like Gartner, Forrester, Pyramid Research, etc., and it is not used by business in decision-making, but it gives a sound basis for taking policy decisions, on the other hand.

Bulgaria performs worse on this indicator and the share of companies using three or fewer of the listed technologies is about 60 % – by only several percentage points better than Romania. This is probably a seriously underestimated indicator, as only 48 % of surveyed companies stated that they had website in 2015, although back in 2008 56 % of them had websites (*Innovation.bg 2009*), and it was probably higher even in 2006. It does not make sense that companies established since then should have a lower share of presence in internet, even if we assume that some new companies are present only in the social media.

Further grounds for doubting the share of companies with a website is the high percentage of companies (67 %) which claim that at least 1 % of their turnover is generated via e-commerce. In Romania such discrepancy is even more drastic – 45 % have websites and 96 % generate over 1 % of their turnover from e-commerce. Although this is technically possible (companies to sell their products via aggregator websites such as olx.bg, ebay.com, etsy.com; they can sell via stores of other merchants – quite often these are craftsmen making jewellery, cards, hats, hand-made small gifts, can sell mobile applications without having a corporate website, etc.) such a big difference seems implausible. In most cases this involves companies with less than 10 employees or even informal firms which would not fall in the sample of the Digital Scoreboard survey.

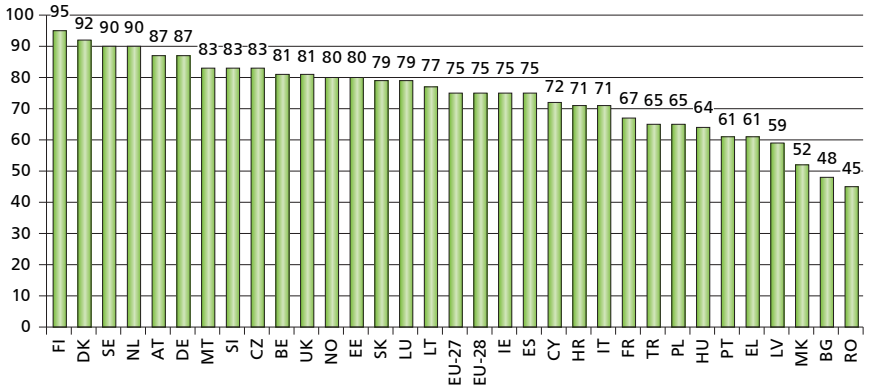
Data about internet access also give grounds to doubt their accuracy – 71.3 % of enterprises use broadband internet according to the Digital Scoreboard. In 2009, Eurostat assessed that over 80 % of companies

Figure 61. MOBILE MARKET INDICATORS FOR BULGARIA, 2015



Source: Digital Scoreboard, 2016.

Figure 62. SHARE OF ENTERPRISES WITH A WEBSITE, 2015, %



Source: Digital Scoreboard, 2016.

[48] https://goo.gl/fV7KDg

have internet and almost all newly registered companies have at least e-mail, use the electronic services of the National Revenue Agency and for years only broadband internet has been provided on the market. Back in 2006, national representative surveys (including smaller companies which are more likely to have not been connected to internet) assess connectivity to internet at 70 % to 82 %.[49]

This problem has been well-known to Bulgarian and East European researchers and is due to certain differences in the technological development of internet providers in Western and Eastern Europe. For a long time, Eurostat did not recognise LAN internet as broadband internet and identified only DSL access, satellite and cable internet as broadband. In Bulgaria and other East European countries people did not associate LAN with cable internet (there was a separate technology and a brand associated with that type). Furthermore, due to wrong instructions to interviewers they classified many ADSL subscribers as dial-up subscribers only because of the presence of modems and ignorance of the users that the service is DSL. Thus, there was a period when nobody provided dial-up internet (at least not to end users),[50] while NSI reported that 15-20 % of internet users had such access at their homes.

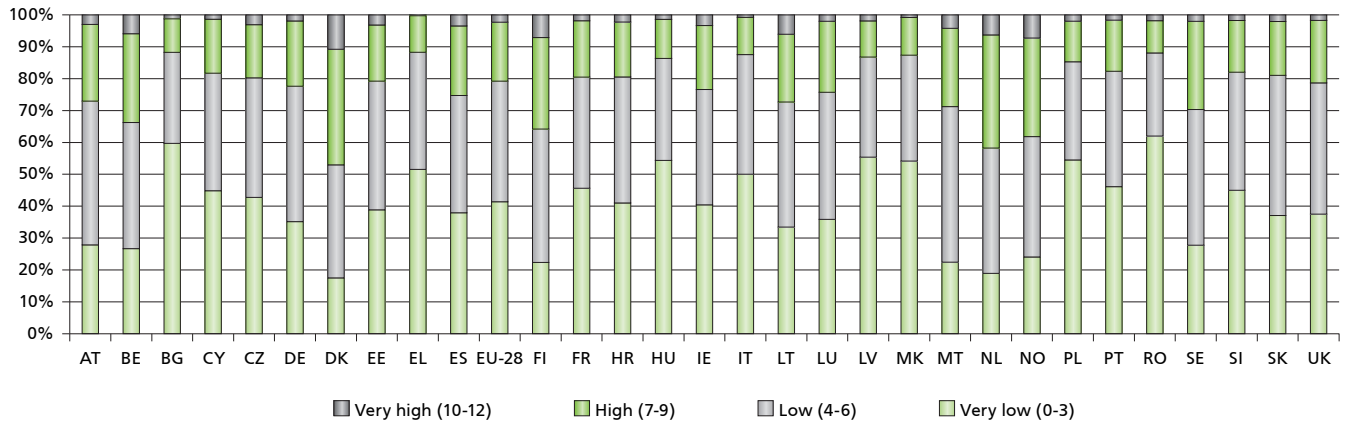
However, in terms of more digitally advanced companies (using over 7 of the 12 technologies) Bulgaria does not seem bad, and is at a comparable level with Greece, Italy, Latvia, Macedonia, Hungary and Poland. Bulgarian companies use more often software for planning and management of resources in enterprises (ERP) than in Estonia, Romania, Turkey and Hungary and paradoxically – even the United Kingdom. Implementation of high-class ERP systems began comparatively late in Bulgaria – in the period 1996 – 1998, and the process took about a year and more (e.g. in Ideal Standart – Vidima, Sevlievo).

The first adopters were the subsidiaries of large multinational companies for whom implementation was part of a global strategy for optimising relationships with the parent company. According to representative surveys of enterprises (Survey of enterprise innovation activity – INA 3) ERP penetration before 2008 was less than 4 %; however, taking into consideration only non-financial enterprises with over 10 employees their share would go slightly up. The Digital Scoreboard shows a fast growth from 6-8 % in 2007 – 2008 to 25-27 % in 2014 – 2015.

Many will probably be surprised by the good performance on the indicator of sharing of information along the supply chain (the value added chain), where Bulgaria ranks higher than the EU average and exceeds countries like Poland, Austria and France. These values could be due to methodological errors like the error with internet and websites, but more probably it is an economically justified fact.

The reason for enterprises in Bulgaria to use more e-business applications in planning and management of a company's resources and sharing information along the value added chain while being at the bottom of the ranking by use of CRM software (ahead only of Hungary), is due to

Figure 63. SHARE OF ENTERPRISES BY GROUPS WITH DIFFERENT DIGITAL INTENSITY, 2015



Source: Digital Scoreboard, 2016.

[49] Ялъмов, Т. (ред) А. Тотин, Д. Марков, К. Огнянова, М. Димов, С. Георгиев, Т. Ялъмов, Х. Христов, Ц. Цветков, 2006, *е-България 2006*, Фондация „Приложни изследвания и комуникации", София.

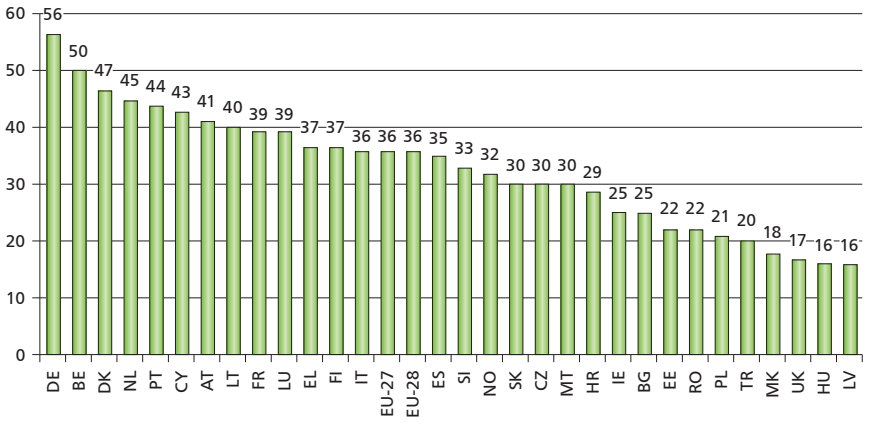
[50] Technologically some POS terminals use dial-up connection. They can be identified by the unusually long time it takes to establish a connection and the frequent loss of connection.

the fact that Bulgarian enterprises are already steadily incorporated in the global supply system but few of them manage relationships with Bulgarian customers. Data from other surveys[51] show that about a quarter of companies in Bulgaria have taken advantage of the global economic crisis in 2008 – 2009 and have increased their turnover. By becoming part of these global chains, it is quite logical that they should implement software enabling efficient production and supplies even in low-tech sectors such as the manufacture of clothes. Besides ERP, this industry implements systems of labelling, bar-code readers, logistics planning systems, RFID, etc. In regard to the latter indicator Bulgaria ranks at one of the first places in Europe, at 17 %. Certainly, a more careful analysis of the RFID technologies and their place of use is necessary because the value added of RFID for automatic management of storages is much higher than, for instance, access to the entrances or lifts in residential blocks or schools and control of working hours. On both indicators the growth is significant: 9.25 % of enterprises use RFID for product identification while 12.5 % use it for staff identification. In many cases installing such systems (particularly in schools) is rather a symptom of poor management and inadequate functioning because parents do not receive information whether their child is inside or outside the school, and often the system is not set up not to allow more than one entrance if there is no exit, etc.

Probably, if out of the total number of companies (about 13 %) using customer relationship management systems remote centres for such management (call and support centres via telephone and online) are excluded, manufacturing companies in Bulgaria using CRM for their customers would be much less closer to the levels identified in 2008 – about 8-10 %. In Bulgaria most popular systems for management relationships with customers are Salesforce, SugarCRM, Antipodes CRM and Microsoft Dynamics CRM and of course, the SAP integrated solution servicing all business processes. Even when the integrated system is installed, companies do not use all available functionalities. This observation is in line with the observation of Bulgarian consumers using smart phones before the emergence of iPhone, who rarely used all their functionalities. Moreover, fashion often is the leading motive for the purchase of technologies rather than a reasonable need or attitude of curiosity or experiment.

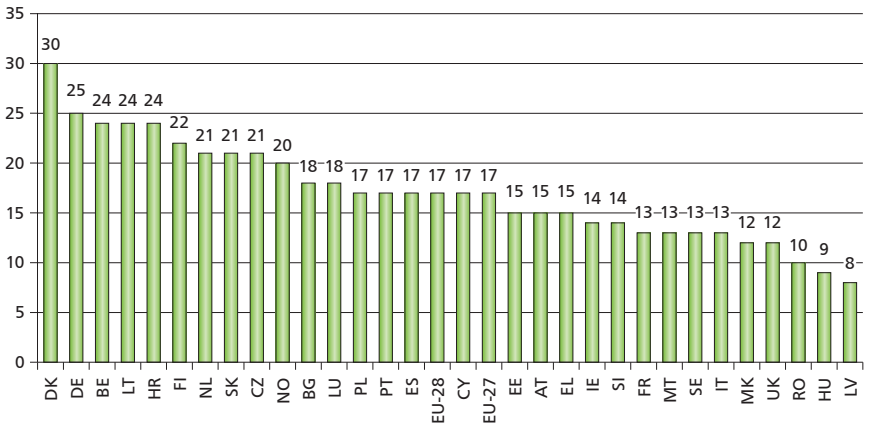
Similar to the differentiation of e-business as a strategy for company reorganisation (in terms of IBM) from technological solutions (specific software and hardware solutions), the CRM focuses mainly on the strategy and relationship to customers rather than on the specific software. In Bul-

Figure 64. SHARE OF ENTERPRISES USING SOFTWARE FOR PLANNING AND MANAGING THEIR RESOURCES, 2015, %



Source: Digital Scoreboard, 2016.

Figure 65. ENTERPRISES SHARING INFORMATION IN A DIGITAL FORMAT ALONG THE SUPPLY CHAIN, 2015, %



Source: Digital Scoreboard, 2016.

[51] Ялъмов, Т. и Т. Атанасов, 2016. 'Кои фирми спечелиха от кризата?' в *Съвременни управленски практики IX, Управленска наука, икономика и бизнес практики – съвременни ракурси и предизвикателства*, Бургаски Свободен Университет, pp. 327-334.

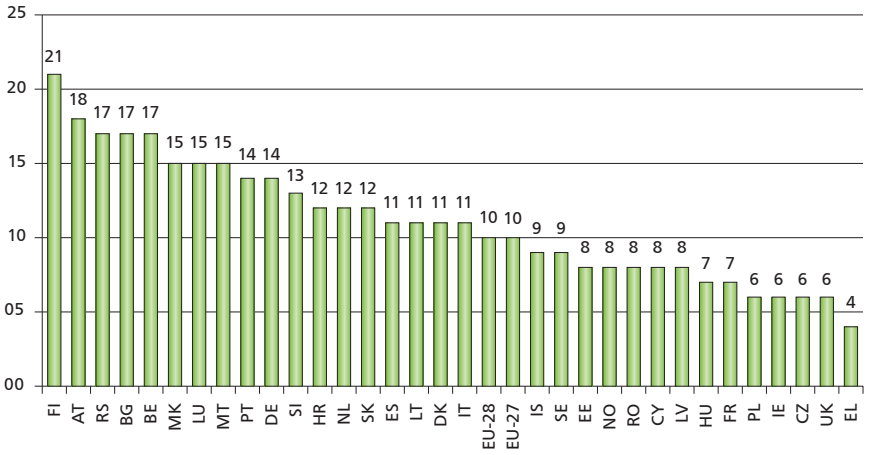
garia such differentiation is of crucial importance because even where CRM software is installed, training of employees and the culture of customer relations is such that the software is not used (effectively). Many examples could be given with telecommunication operators, banks and financial institutions whose employees often make sales calls to customers without considering the prior wishes expressed by the customers made earlier through call centres, complaint centres, etc.

Such a problem of inadequate storage of information about the overall experience of the customer – not only part of it (e.g. use of phone services as recorded in the system) – with the company, which leads to inadequate behaviour of the company towards the customer exists in other countries and companies, too. As a response to this problem companies like SAP and analysts like Gartner introduced a new concept and accordingly specialised software solutions for this – customer experience management systems. They use modern business intelligence systems to analyse consumption and customer feedback to the company.

According to Digital Scoreboard data on 2014 and 2015 a quarter of enterprises advertise in internet. This makes up about half of the companies with websites. Slightly more are the enterprises using social media in their work (30 %). This involves mainly Facebook, though many human resources management departments use Linkedin for initial staff recruitment. Between 7.5 % to 11 % of enterprises use more than one social media.

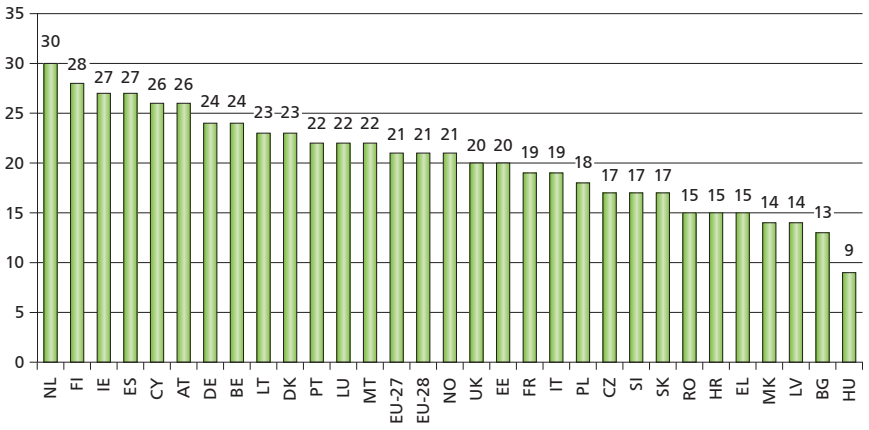
The history of internet advertising in Bulgaria began in 1999 with the publication of a banner of IBM in the portal dir.bg. This was not by accident, because the first commercial banner in the world was that of IBM and it was published in 1994 in

Figure 66. SHARE OF ENTERPRISES USING RADIO FREQUENCY IDENTIFICATION (RFID), 2014, %



Source: Digital Scoreboard, 2016.

Figure 67. ENTERPRISES USING SOFTWARE FOR CRM, 2015, %



Source: Digital Scoreboard, 2016.

yahoo.com. Dir.bg hosts many forums, blogs and sites, which after their separation become a major channel for online advertising. One of the interesting examples in this regard is bg-mamma.com. The site was bought by a non-governmental organisation which was created by the group in dir.bg with the same name for the purposes of advertising. Advertisements in this site are both standard – using banners – and through hidden bloggers paid by companies.

Internet advertisement has many forms – web banner, text link, e-mail footer, advertising box, paid article or publication, animated commercial, etc. In general, two methods of pricing and sale are used – for displaying (cost per impression) and for action (performance). In the first years of internet advertisements (in Bulgaria) they were not always paid but were bartered. After that, many users learned to maintain suitable pages in Facebook and Snapchat even without direct payment for advertisement. Advertisements took the form of video clips shared in social media and mobile advertising emerged.

Measuring the revenue from advertisement in Bulgaria is very complex. Most modest data on the internet advertising market are those of the Bulgarian Association of Communication Agencies (BACA) which estimates revenue from internet advertisement at BGN 19 million for 2014. This means an increase of over 5 times for 10 years. Still the share of internet advertisement in the total share of internet, press and television (outdoors, billboards excluded, and events and sports), according to these estimates, is very low – about 6-7 %.

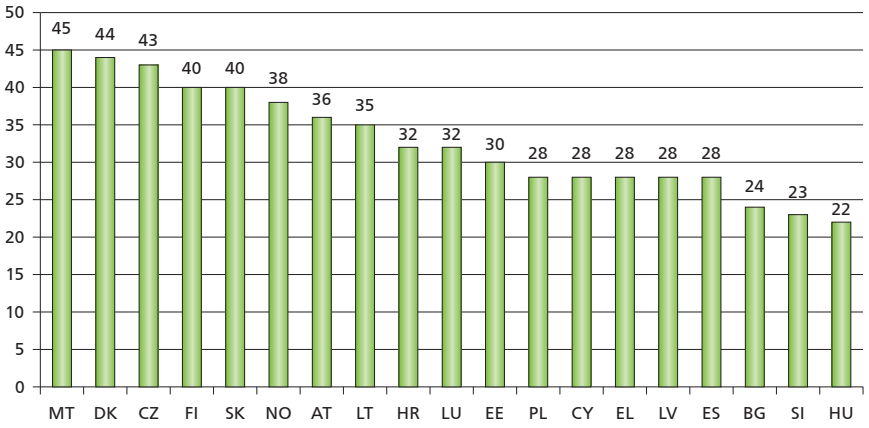
However, the above data on internet advertising do not include costs of SMEs which prefer to pay directly to Google, Facebook or games like Pokemon Go, and advertisement via mobile phones. It is possible to have an implicit reason for underestimation of the internet market, as influential companies behind this Association earn more from TV advertising. The growth of TV advertising from 2002 to 2008 matches the general growth of the economy, the credit growth and the increased purchasing power.

The estimates of the Bulgarian Association of Communication Agencies of the advertising market of BGN 307 million comprise about 60 % of all revenues of advertising agencies. The other part covers billboards and print advertising and probably includes inaccurate estimates. The total revenue in this sector was about BGN 500 million in 2014 (based on data from the database on financial and business information Amadeus).

An alternative source of data on the internet market is the Interactive Advertising Bureau (IAB) – Bulgaria, including companies which are part of the Swedish MTG – Netinfo (with vbox7), dir.bg and Darik News, together with smaller, but influential niche players like Economedia and neg.bg (bg-mamma). Their estimates of the market are much higher than the estimate of BACA and account for about BGN 62 million for 2015 and about 22 % market growth compared with 2014. The estimate of local advertising by IAB is by some BGN 3 million more than BACA, and the remaining difference is related to advertising in Google (positioning in search results, advertising in websites and Youtube) and Facebook (where it grew by 66 % in 2015 on 2014). The problem with this estimate is the strong underestimation of advertising via Google, which according to independent experts (outside the online industry) is about BGN 80 million and a total market of about BGN 150 million paid for advertising (including for digital advertising of Bulgarian products to an audience outside Bulgaria).

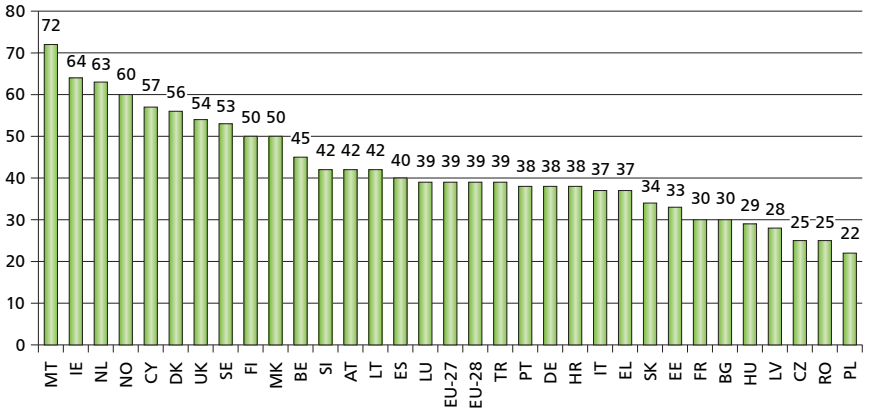
Bulgarian companies lag behind in the use of cloud services. At present, only 5 % of enterprises have subscribed for such services. In Finland, which is the leader in Europe, more than half of enterprises use cloud services. However, such delay in Bulgaria is not a serious barrier to e-business development as the shift to cloud services is often driven by

Figure 68. SHARE OF ENTERPRISES PAYING FOR ADVERTISEMENT IN INTERNET, %



Source: Digital Scoreboard, 2016.

Figure 69. SHARE OF ENTERPRISES USING SOCIAL MEDIA IN THEIR WORK, 2015, %



Source: Digital Scoreboard, 2016.

Table 7. ADVERTISING REVENUES IN MILLION BGN

	2002	2003	204	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
TV stations	76.3	88.6	105.6	140.1	183.3	240.3	257.6	209.3	185.2	176.4	180.3	184.8	184.5
Press	51.2	53.2	53.9	68.5	93.5	101.8	109.5	67.6	46.1	44.5	42.1	40.0	41.4
Internet				3.6	6.8	12.9	20.9	21.0	22.0	24.7	24.7	20.6	19.0
Net total	156.1	175.9	201.6	270.2	371.1	473.9	473.9	382	329	309	305	303	307

Source: Bulgarian Association of Communication Agencies.

optimisation of costs, lack of sufficient experts to maintain the IT system in the enterprise and fast internationalisation of business. In other words, these are fully market factors that are not in play yet in Bulgaria. In addition, as with broadband internet indicators it is possible that interviewees are not aware of the term "cloud services". While, for example, both RFID and the integration of management systems with similar systems of providers or customers along the value added chain are more concrete and recognisable, determining whether the IT systems in use are cloud-based or managed with a virtual private network requires specialised knowledge.

Examples of cloud services are Microsoft Power BI, Office 365 (office in the cloud, accessible from anywhere), Dropbox (management of documents in the cloud), e-commerce platforms (SaaS), online software for surveys (SurveyMonkey or LimeSurvey), Asana (management of meetings and projects), etc. Entering the cloud represents a complex financial-management-technological process that transforms long-term investments in intangible assets into operating costs and in practice constitutes outsourcing of complex and risky business processes which go beyond the strategic orientation and competitive advantages of the company.

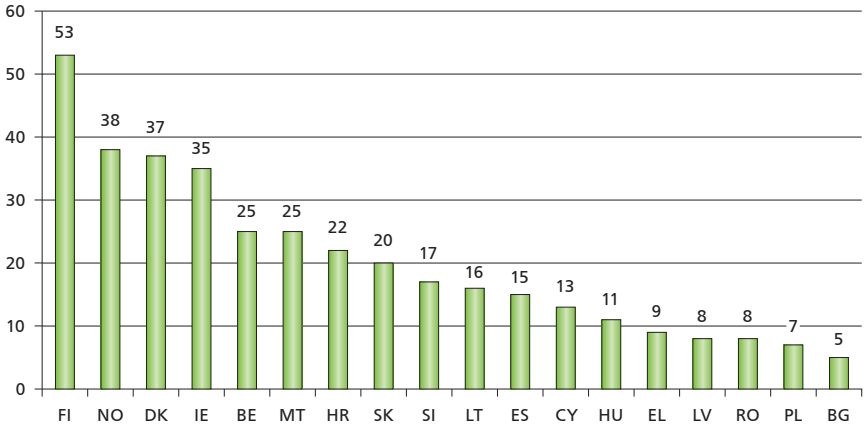
The cloud services model is "software as service" (SaaS). Initially the software as service was used for hosting web and e-mail servers and after that became more complex and includes virtualisation of such servers. Remote maintenance of the local network and software installed in it is transformed in building whole systems (ERP, CRM, accounting, content management, human resources management, etc.) on virtual servers located outside the company. Gradually other concepts emerged – "infrastructure as service" (key providers here are Oracle and VMWare), "platforms as service," etc.

Table 8. NET INTERNET ADVERTISING REVENUE BY TYPE (IN MILLION BGN)

Advertising type	2015	2014
Total revenue	61.84	50.83
Display advertising	16.88	16.26
Google search	15.65	13.04
Facebook	15.65	9.43
YouTube	8.60	7.58
Click advertising	2.58	2.37
Announcements and references	0.59	0.35
Other	1.89	1.80

Source: AdEx 2015, IAB Bulgaria, IPSOS Bulgaria, IHS.

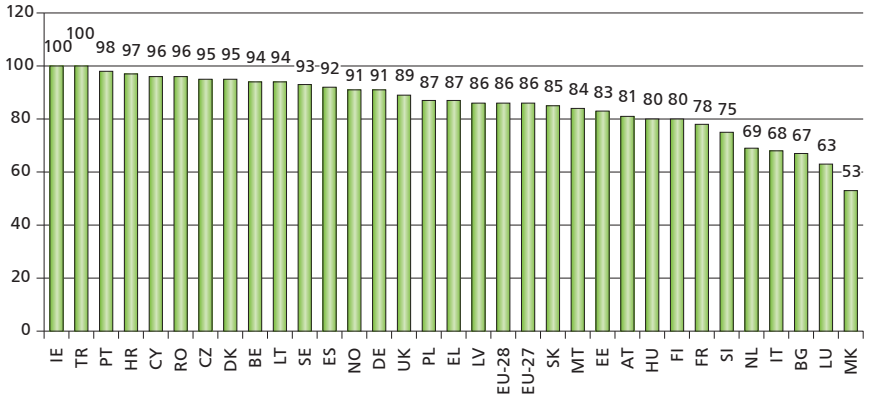
Figure 70. SHARE OF ENTERPRISES USING CLOUD SERVICES, 2015, %



Source: Digital Scoreboard, 2016.

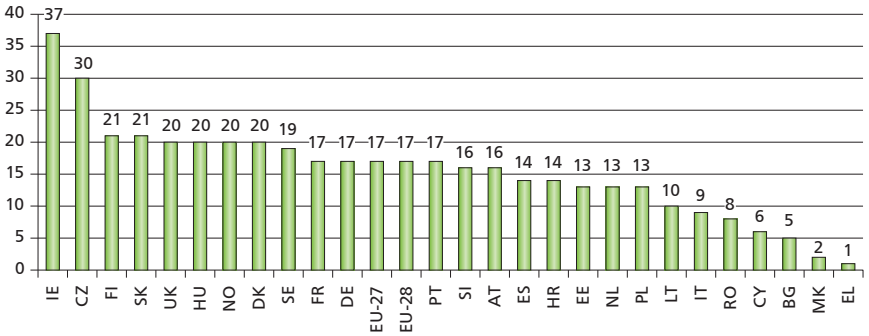
The data from the Digital Scoreboard on the share of enterprises generating at least 1 % of their revenues from e-commerce cause concern. In our view, the problem is with the sample. There is a sufficient number of non-financial enterprises with over 10 employees which do not have and could not have even one e-commerce transaction, for example, restaurants, bakeries, coffee shops, etc., which do not have home delivery and do not have any booking system, pharmacies which are not authorised to make home deliveries, teams of construction workers, etc. In Turkey, Portugal and Croatia it is obvious that it is impossible to have 97 % to 100 % of enterprises with minimum 1 % turnover from e-commerce. Data on Bulgaria with a share of 67 % are also very optimistic, even if e-mail is assumed as e-channel or payment by bank card via POS terminal. Data on Bulgaria for 2010 are even higher – 95 %. Far more realistic are data on the share of websites that have B2C functionalities – from 2.6 % to 3.1 % (2013 – 2015), although there is discrepancy in the share of companies selling online to customers in the European Union outside Bulgaria – 2.85 % for 2015.

Figure 71. SHARE OF ENTERPRISES GENERATING AT LEAST 1 % OF REVENUE FROM E-COMMERCE, 2015, %



Source: Digital Scoreboard, 2016.

Figure 72. SHARE OF E-COMMERCE REVENUE IN THE TOTAL TURNOVER OF ENTERPRISES, 2015, %



Source: Digital Scoreboard, 2016.

This means that companies selling only in Bulgaria are less than 0.3 %. The companies in the totality of the Digital Scoreboard are about 20,000 (which have over 120 employees and operating in the non-financial sector). Therefore, there could be only about 60 companies selling online in Bulgaria, which is seriously understated. However, the indicator of average share of revenue from e-commerce in the total turnover of enterprises is far more realistic – 5 % for Bulgaria, followed only by Macedonia (with 2 %) and Greece (with 1 %).

The development of e-business in Bulgaria is closely related to the general development of the Bulgarian ICT sector. The links between the two areas are many. On the one hand, SMEs could not implement new ICT without local providers of services, without adapting their software to the Bulgarian environment, including language problems. In other words, e-business, which is a user of technologies, depends strongly on the existence of enterprises which have interest and capacity to service these technologies, not focusing only on foreign markets. On the other hand, due to the higher wages in the ICT sector associated with more interesting work and options for career development, it is more likely that capable ICT experts would not work for a small non-ICT firm but would go to work for specialised companies selling on foreign markets. In this sense, the ICT sector development caused disturbances in small firms, including those in machine-building and the light industry. Recently, however, development of technologies and particularly cloud technologies enable many SMEs to address the challenges of managing ICT infrastructure, platforms and services without super specialised ICT staff.

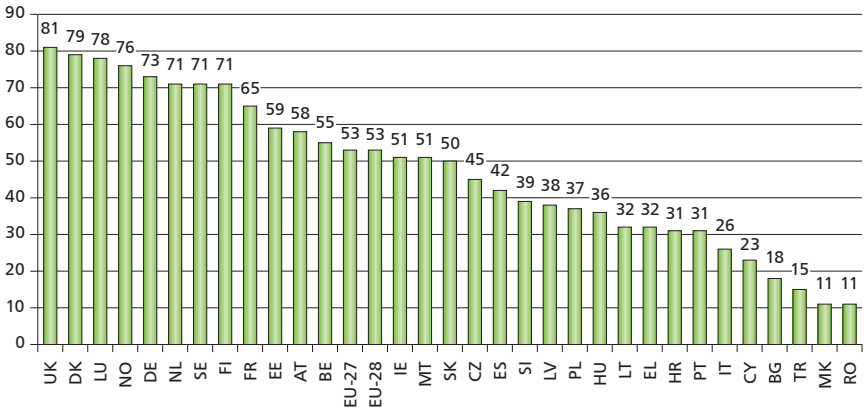
Quite naturally, as long as Bulgarian companies do not provide sufficient goods and services at attractive prices, consumers will buy from abroad. Almost a fifth (18-19 %) of the population buys online and 40 % – 50 %

of them order from abroad. By this indicator Bulgaria is above the average European Union level – about 30 % of internet consumers in EU purchase online from other countries. Group shopping is very popular because it gets better prices compared to in-store prices in Bulgaria.

Though slowly, and often in the hidden economy, micro entrepreneurship in hand-made jewellery, clothes and accessories, gifts and works of art is developing. These products are sold abroad entirely online – either via special websites such as etsy.com, via Ebay or via Facebook (orders) and payments via Paypal or Western Union. Still, probably the highest share of the 7 % who stated that they made e-commerce abroad, have had in mind that they purchased and the actual share of the sellers is rather 0.7 %.

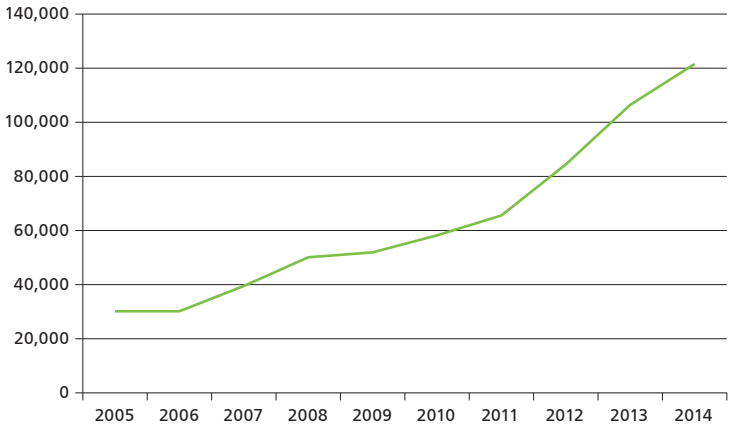
Other related indicators of e-business development are data on growth in courier services, which is 160 % over the last 10 years. Regardless of whether national trade, imports or exports are concerned, there is always a carrier. Cloud technologies for development of e-stores include systems for installation by one click, which integrate system for management of supplies of couriers and the front-office and back-office of e-merchants.

Figure 73. SHARE OF PEOPLE PURCHASING GOODS AND SERVICES ONLINE, %



Source: Digital Scoreboard, 2016.

Figure 74. REVENUE FROM RETAIL SALES* VIA MAIL ORDER HOUSES OR VIA INTERNET, THOUSAND EUR



* NACE sector 4791.

Source: Amadeus, Bureau van Dijk.

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BG-07-16-080-EN-N

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- 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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